

POLICYREPORT

Improving maternal, newborn and child health in Papua New Guinea through Family and Community Health Care

SUMMARY PAPER





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This paper summarises a longer review of the evidence-base, with additional content on interventions and their implementation. Downloadable from: www.burnet.edu.au or www.wchknowledgehub.com.au.

The views and opinions expressed in this document are those of the authors and do not necessarily reflect the views of their respective institutions, AusAID or the Australian Government.





Preface

One of World Vision's main goals is to improve the health of children and mothers around the world. Whilst significant progress has been made in these areas, with decreasing numbers of children and mothers dying each year, more needs to be done to build on the global movement driving this change. That is why we continue to work closely with communities, governments, researchers and other non-government organisations in almost one hundred countries.

In many of the communities in which we work I have seen the differences that families and communities can make to their own health. The research in this paper utilises the expertise of the Burnet Institute and Compass: the Women's and Children's Health Knowledge Hub. It shows just how large a difference health action by families and communities can make.

In a country like Papua New Guinea, with limited resources and significant geographic obstacles, it is critically important to make maximum use of local resources.

I would like to thank the researchers who contributed to this paper and our colleagues in PNG who also provided input.

I hope it helps to build a more comprehensive response to the health needs of children and women in PNG and elsewhere.

Tim Costello

CEO, World Vision Australia





Acronyms

ANC	Antenatal care
ARI	Acute respiratory infection
CCM	Community Case Management for pneumonia
CBK	Clean birth kit, also CDK – clean delivery kit
CHW	Community Health Worker - in PNG, a professional cadre working in health centres and rural aid posts
DALY	Disability-adjusted life year
EPI	Expanded Programme on Immunization
FCC	Family and community health care
FP	Family planning
HIV	Human immunodeficiency virus
IMCI	Integrated management of childhood illnesses
IMR	National Institute for Medical Research
IPT	Intermittent preventive treatment for malaria
ITN	Insecticide treated (bed) net
IYCF	Infant and young child feeding
LiST	Lives Saved Tool
MDG	Millennium Development Goal
MMR	Maternal mortality ratio
NGO	Non-government organisation
NMR	Neonatal mortality rate
ORS	Oral rehydration solution
PPTCT	Prevention of parent-to-child transmission
PNG	Papua New Guinea
PPH	Postpartum haemorrhage
STI	Sexually transmitted infection
TBA	Traditional birth attendant
U5MR	Mortality rate for children under 5 years
VBA	Village birth attendant – a subset of VHVs
VHV	Village health volunteer – generic term for lay health workers in PNG
WHO	World Health Organization



FAMILY AND COMMUNITY HEALTH CARE – UNTAPPED POTENTIAL

Family and community health care (FCC) is the prevention and treatment of illness by family and community members, including trained lay health workers – known as Village Health Volunteers (VHVs) in Papua New Guinea (PNG). FCC in PNG is essential to maternal, newborn and child health and nutrition because:

- FCC can help prevent and treat many of the major health threats in areas where health services are not easily accessed; and
- FCC optimises the impact of all maternal, newborn and child health (MNCH) interventions by supporting timely care-seeking from health facilities and good home care afterwards.

Despite widespread application of FCC in PNG, coverage and support is patchy. There is a pressing need to increase the support for FCC within national planning and coordination processes, and to strengthen the connection between FCC and the peripheral health system.

For FCC to work well it needs to include proven evidence-based interventions, be widely practiced in communities, and have a strong connection to, and the support of, a functional local health system. Similarly, health system strengthening for better health centres and community health posts is unlikely to be effective without synchronised efforts to improve FCC. This paper summarises global and local evidence on the prevention and treatment services that could be provided by family and community members in PNG. We try to show what is known about the likely impact and relative costs of FCC interventions and summarise what is known about current levels of coverage in PNG. The aim is to estimate the benefits of greater FCC action, to provide local health program managers, whether government or non-government, with an expanded array of proven options to consider in their planning and to suggest ways that they could increase implementation of FCC interventions in line with the Government's National Health Strategy 2011-2020. We hope that this information can help PNG and donor health program managers align the content and processes of current and planned programs with international practice, and provide authoritative data to support expansion of FCC activities.

The evidence suggests that up to one third of maternal deaths, over two-thirds of newborn deaths and half of child deaths could be prevented through near universal coverage of the FCC interventions described here: delivered through informed community members, trained VHVs and supported by stronger local health centres and community health posts. The known cost-effectiveness data, and other relative cost estimates suggest that this would be a very high value investment, both economically and socially.

Up to **one third of maternal deaths**, over **two-thirds of newborn deaths** and **half of child deaths** currently occurring in PNG **could be prevented** through broad coverage of family and community health care (FCC). The relatively low costs make this a **high value investment**.

There is a need for:

- renewed central coordination and oversight to support broader application of FCC,
- careful trials of innovative community care linked to local health system strengthening and
- more detailed analysis of costs and impact using PNG data.



Current maternal and child health situation in PNG

PNG is not on track to meet Millennium Development Goals (MDGs) relating to reductions in child (MDG4) and maternal (MDG5) mortality.¹ Mortality in children under 5 years of age (U5MR) has improved from 90 deaths per 1,000 live births in 1990 to 61 in 2010,² however **neonatal mortality now constitutes a significant portion** of the U5MR, at a rate (NMR) of 39 deaths per 1,000 live births.³ The commonest causes of death in children are diseases in the early newborn period - pneumonia, malaria, and other infections.⁴ **Malnutrition contributes substantially** to childhood mortality and morbidity with prevalence of underweight, stunting, and wasting (depending on age) above public health significance cut-off points.⁵ **Maternal health is a priority** in PNG although estimates of the maternal mortality ratio (MMR) vary; in 2006 the National Demographic and Health Survey (DHS) reported 733 maternal deaths per 100,000 live births⁶, amounting to approximately 1500 maternal deaths each year (although the World Health Organization (WHO) MMR estimates are lower at 250).⁷ The total fertility rate has declined over the past forty years however remains high at 4,⁶ women's literacy rates are lower than that of men, and only half of all births are attended by an appropriately skilled health worker.²

Across all adult and child causes of death, **pneumonia, malaria, tuberculosis, diarrhoeal diseases, meningitis and HIV/AIDS remain common**,⁸ although non-communicable diseases are increasing. There is a generalised epidemic of HIV with a prevalence of 0.9 percent predominantly due to heterosexual transmission.⁸ The weak position of women has led to twice the prevalence rate in women compared to men in the group aged 15-29 years¹ which in turn places children at great risk.

Children* are dying because of **limitations on preventative and curative health services as well as gaps within families including insufficient knowledge on illness prevention and management, delayed care-seeking, and other deficiencies in healthy behaviours. Deaths of mothers and newborns are even more directly attributable to poor functioning of the formal health system.** Many causes of maternal and newborn deaths require skilled medical care within a short window of opportunity: up to 50 percent of maternal⁹ and almost 40 percent of newborn¹⁰ deaths occur within 24 hours after delivery. Presently, health services, particularly the life-saving skilled birth attendants and facilities adequately equipped for child birthing, are frequently too distant and of inadequate standard to respond to these emergencies. In this setting, **it is especially important to maximise any actions by the community** that the evidence-base shows are likely to be effective at reducing deaths.

In 2010 the Government of PNG released the National Health Plan for 2011-2020 that documents the **intention to improve maternal, neonatal and child health** through a tight focus on the relevant interventions that can improve survival for these groups. While the plan concentrates on the formal health system it does not exclude family and community care activities. The plan documents the Government's intention to improve collaboration between the formal health system and community-based initiatives, extend community-based health care and distribution systems, empower people to improve their own health and encourage community and family level care and the VHV program.¹¹

* Defined as those less than 5 years of age

What we mean by FCC

Family and community health care (FCC) is the prevention and treatment of illness by family and community members rather than by health professionals. Many of the major threats to maternal, newborn and child health can either be prevented by informed individuals and communities (for example through adequate nutrition, malaria prevention, birth spacing and hygiene) or treated by community members (eg diarrhoea and malaria treatments, self-administration of antibiotics, care of low birth weight babies, responses to postpartum bleeding). Some community members may be trained as lay health workers - in PNG the generic term is VHVs – to provide such care. **VHVs have a long history in PNG**, some have been trained as multi-function village health workers, some as birth attendants (Village Birth Attendants), and some for specific programs such as ‘marasin meris’ or ‘marasin men’ to distribute antimalarial medicines and as ‘community-based distributors’ of family planning information and materials.

These trained lay health workers are already functioning in communities with varying levels of support from outside organisations, church health services or local governments. In addition, ordinary community members in PNG are already doing their best to look after the health of their families and respond to illness, often paying from scarce family resources to seek care. **This paper acknowledges those organisations and individuals already engaged in FCC**, aims to help provide data for organisations to review their operations, and calls for stronger central coordination and support of civil society’s action in health. We also acknowledge that links to the local health system are essential – for example for distribution of medicines and provision of clinical supervision – and we call for FCC to be seen as an integral part of the strengthening of the local health system, especially at the health centre and community health post levels.

Methods used in this paper

A comprehensive literature review was undertaken, which aimed to include published papers up until March 2011 and grey literature made available to us through contacts within PNG. The support of World Vision and Burnet offices in PNG was very helpful. Both researchers established a framework for screening and selection of relevant data sources that included interventions feasible within FCC and/or that provided information on the relative efficacy of FCC interventions. We also screened available evidence of coverage of FCC interventions within PNG. To make a subjective ‘value for money’ judgement, both researchers reviewed data on costs, cost-effectiveness and cost-benefit in the published literature. This appears in a range of different measures (for example costs of improved life expectancy, costs of extended Disability Adjusted Life Years and others). To simplify the presentation in this paper, both researchers agreed on a rating of ‘good’ or ‘very good’ value for money, judging the published measures against generally accepted international standards. Interventions with lower ratings of cost-effectiveness were not included in this paper. Several drafts of the paper were reviewed internally within Burnet Institute and World Vision Australia, and also by external expert reviewers. Their input resulted in substantial revision and is gratefully acknowledged, although any errors or opinions remain the responsibility of the researchers. A more complete methodology is included in the longer paper available at www.burnet.edu.au or www.wchknowledgehub.com.au.



What Family and Community Care could achieve for maternal health

There is a **clear role for FCC before pregnancy and during the antenatal period** to provide education, and distribute preventive care. There are **limits to the role of FCC during childbirth and immediately afterwards**, because many causes of maternal death require emergency obstetric care for complete management. However, newer research suggests some medicines (particularly oxytocics and antibiotics) can be effectively distributed for community use at childbirth. Other experience in a number of countries shows that peer support for both men and women can also significantly improve maternal health outcomes.

A recent comprehensive review suggests that a **32 percent reduction in maternal mortality could be achieved** by care packages which can be delivered by family and community members including VHVs.¹² This would prevent around 480 of the estimated 1,500 maternal deaths each year⁹, as well as greatly reducing other maternal trauma. Few studies have assessed the cost of maternal FCC, but one publication has estimated US\$7.26 per birth as the program and commodity costs of a package similar to the listing below, implemented in a resource-poor setting analogous to PNG.

The highest impact FCC interventions **before pregnancy or during the antenatal period** include:

- Family planning counselling, supported referral and/or distribution of contraceptives to reduce numbers of pregnancies and increase birth spacing;
- Nutrition support including distribution of iron, folate, calcium and deworming medications;
- Counselling on birth-preparedness, place of birth, nutrition and testing for STIs (including HIV);
- Intermittent preventive treatment (IPT) of malaria.

FCC interventions that act **during childbirth or immediately afterwards (post-partum)** include:

- Distribution of clean birth kits (CBKs) for use in home births;
- Increase availability of oxytocics to prevent postpartum haemorrhage (PPH);
- Provision of oxytocics or antibiotics for treatment of PPH or postpartum sepsis.

Support of pregnant women by husbands or female family or community members has also been demonstrated to improve intervention effectiveness in a number of countries, both during the antenatal period, and in childbirth.

A 32% reduction in maternal mortality could be achieved by care packages that can be delivered by family and community members including village health volunteers (VHVs). Available cost data suggest **this is a high value investment**. Some aspects have implementation risks that, while outweighed by the benefits, do require introduction to be through a carefully measured trial.



FCC for maternal health does not negate the need for formal health services and must be accompanied by integrated health system strengthening interventions that encourage women to seek childbirth in health centres or hospitals that are sufficiently equipped and staffed to provide emergency obstetric care if needed. However in PNG the project of re-training staff and rebuilding rural health infrastructure is likely to take some time. FCC can both support this health system strengthening and help, to a degree, to fill gaps in health service access.

Some interventions such as oxytocic or antibiotic provision require significant training of VHVs, requiring well-monitored programs and support from local health services. For oxytocics, the options are distribution of misoprostol for self-administration by mothers (as prevention), or delivery of oxytocin in Uniject™† by trained health workers. These are both experimental and warrant careful pilots or trials as part of their introduction. Misoprostol has great potential in prevention of post-partum haemorrhage in the community and it has been shown to be feasible in settings as difficult as rural or remote PNG. However it is not without risks and its introduction must be in a carefully measured setting.

The table on page 10 summarises evidence of impact (globally and in PNG), current usage in PNG and a rating on value for money based on the variety of cost analyses detailed in the full paper. Many of these FCC interventions will also impact on newborn health and survival.



† Uniject™ is a compact, pre-filled autodisable injection device shown suitable for use by trained lay health workers

Table I Summary of maternal health interventions at FCC level

Intervention	Evidence of impact globally	Evidence of impact in PNG	Published evidence of their use in PNG	Value for money
Before pregnancy and antenatal – family planning, nutrition and preventive care				
Family Planning (FP) - community-based counselling and distribution of contraceptives	FP and safe abortion can avert 20% of maternal deaths. ¹³ Birth spacing of 24-36 months reduces the risk of neonatal death 2-3 times, ^{14, 15} maternal death by 30%, ^{16, 17} preterm birth by 40%. ¹⁷ Delayed first birth until age 20 reduces anaemia and LBW. ¹⁸	No impact studies reported.	9.5 ⁸ -32% ² women of reproductive age use modern contraception.	VERY GOOD
Iron and folate supplementation	Iron supplementation in pregnancy reduces anaemia and thus the risk of maternal death by 23%. ¹⁹ Peri-conception folate supplementation reduces the risk of neural tube defects by 72% and may reduce LBW deliveries. ²⁰	Nationally, 36% of women are anaemic though 80% received some iron tablets in pregnancy. ⁵ In one study 56%-91% of women were anaemic and community distribution of iron reduced this up to 33%. ²¹	VHV distribution of iron-folate tablets reduced anaemia in non-pregnant women from 91% to 84% and in pregnant women from 83% to 66%. ²¹	VERY GOOD
Calcium supplementation	Daily calcium supplements reduce pre-eclampsia by 55%, and preterm delivery by 24% in women with low intake. ²²	Not reported	Not reported	VERY GOOD
Deworming	Anthelmintic treatment may reduce maternal anaemia, ²³ LBW, preterm births and perinatal mortality ²⁰ although study results are mixed. ^{17, 24}	In one community trial impact on anaemia was not discernable due to concurrent iron supplementation. ²¹	National coverage not reported. 90% coverage has been achieved in a community-based program. ²¹	VERY GOOD
Nutrition counselling	Perinatal balanced energy-protein supplementation reduces intra-uterine growth retardation (IUGR) by 32% and stillbirth risk by 45%. ¹⁹	5.3% of women are underweight (BMI<18.5) ⁵ though prevalence ranges from 2.4-15% by region. ²¹	Not reported	NOT REPORTED
Intermittent preventive treatment (IPT) of malaria	Malaria in pregnancy is linked to maternal anaemia, preterm delivery, LBW and increased risk of neonatal death. ²⁰ IPT reduces risk 43% of IUGR in first & second pregnancies. ¹⁹	Earlier protocol (2 courses before 20 weeks of pregnancy) reduced malaria from 41% to 20% with 50% less reinfection after 12 months in Maprik. ²¹ Larger trials are underway in PNG, led by national IMR and partners.	Antimalarials in stock at 90% of health centres but only 44% of aid posts. ²⁵ IPT coverage is not reported.	VERY GOOD
Birth preparedness counselling	Group sessions by trained facilitators improves birth preparedness and newborn care practices, and reduces NMR by 25-50% and stillbirth rates. ²⁶	Not reported	Not reported	VERY GOOD
Intrapartum and postpartum interventions				
Clean birth kits (CBKs) and hygienic delivery	20%-29% reduction in infection-related maternal deaths with hygienic practices at 90% of home births. ^{12, 27}	Not reported	10,000 CBKs were supplied 22 provinces in 2008-2009. ²⁸	VERY GOOD
Misoprostol for either PPH prevention or treatment of PPH	May avert 13-21% of maternal deaths. ¹³ Standard PPH care plus oral misoprostol reduced severe PPH by 70% as treatment (800mg) and 81% as prophylaxis (600mg). ²⁹	Not reported	Misoprostol use is restricted to health facilities. It is not in the protocol for PPH care at community level. ³⁰	GOOD (PREVENTION) VERY GOOD (TREATMENT)
Referrals by village birth attendants (VBAs) and TBAs	TBA training improves referrals for skilled birth attendance. ^{31, 32} Family education and TBA referrals with transport to facilities in emergencies reduced NMR; 30.5 vs control 48. ³³	Training of VBAs for 3 weeks increased uptake of ANC and FP, referrals of antenatal complications, and health promotion activities. ³⁴	Skilled birth attendance for 53 ² -59% ⁶ of births. 52% of births take place at health facilities. ²	GOOD

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What Family and Community Care could achieve for newborn health

FCC interventions can play a major role in reducing newborn (in the first month of life) deaths especially those due to low birth weight or premature delivery and serious infections in the first week of life. Much of this can be achieved through better maternal care in pregnancy that prevents low birth weight and prevention of infections with use of clean birth kits (CBKs) and clean delivery (see maternal section). During childbirth FCC has a more limited role in preventing hypoxic damage because a major reduction in these deaths needs access to skilled birth attendance and emergency obstetric care. However some studies have shown the feasibility and impact of community-based newborn resuscitation for babies that are born at home.²⁰

After birth, important FCC interventions include:

- special care for low birth weight (LBW) babies, supporting referral for the smaller LBW (<1.5kg) babies and extra care with temperature support, hygiene and feeding for other LBW babies – possibly provided as the ‘kangaroo mother care’ package;
- prevention of low temperature with delayed bathing and thermal control, prevention of infection with hygienic care;
- promotion of breastfeeding that starts early (within one hour of birth) and is exclusive; and
- antibiotic treatment of newborn infections, supported by prompt recognition and referral.²⁰

Many of the interventions above are **best started from the first day of life** for best effect, and **home visits** within 24 hours of birth may be required to provide this for home births. There is now a large body of global evidence supporting home visits by outreach health staff or by trained lay health workers as an important means to reduce newborn deaths. ‘Kangaroo mother care’ for LBW babies includes nursing the baby skin-to-skin against the mother’s chest, care with hygiene, and special feeding of breast milk.

Of the estimated 5,300 newborn deaths each year in PNG, 30% could be prevented with a basic package of FCC and **up to 70% or 3,700 deaths could be prevented through maximum scale-up of FCC**. Cost estimates suggest all FCC interventions assessed rate as very good value for money.

Of the estimated 5,300 newborn deaths each year in PNG³ it is estimated that **up to 70 percent or 3,700 could be prevented** through these FCC actions. The impact varies, dependent on what package of interventions are provided, however a basic package feasible in PNG should avert approximately 30 percent of deaths. Between 370-740 (7-14%) of these lives could be saved through 90 percent coverage with the preventive FCC package, 530-1,270 (10-24%) could be saved with the addition of community-based special care of the LBW newborn, and up to 3,700 (70%) through the inclusion of antibiotic treatment for suspected sepsis.¹² The impact of FCC is most evident, and most needed, in settings with a neonatal mortality rate (NMR) greater than 45 per 1,000 live births.³⁵ This is likely to apply to many rural or remote settings in PNG. **Early and exclusive breastfeeding** is important for survival in both newborn and childhood (see below) periods. For newborns, this intervention alone could avert from 8 to 19 percent of neonatal deaths.^{36, 37}



A package of selected FCC interventions, at 90 percent coverage, was estimated (in global data) to cost US\$2,400 per death averted³⁸ and the addition of LBW care reduces this to approximately US\$1,600 per death averted.³⁸ The cost estimates show that **combined, or integrated, delivery of multiple interventions reduces the cost per life saved and is therefore the most cost-effective** means of delivering FCC.

The table below summarises evidence for impact (globally and in PNG), current usage in PNG and a rating on value for money based on the variety of cost analyses detailed in the full paper.

Table 2 Summary of newborn health interventions at FCC level

Intervention	Evidence of impact globally	Evidence of impact in PNG	Published evidence of their use in PNG	Value for money
Clean birth kits (CBKs) and clean birth practices	Reduce deaths from sepsis by 15%, tetanus by 30% with use in 90% of home births. ^{27, 39}	NMR from 19.4 down to 4.8 with CBKs used by village birth attendants. ⁴⁰	10,000 CBKs were distributed to trained TBAs and VBAs in 22 provinces in 2008–2009. ²⁸	VERY GOOD
Care for low birth weight (LBW) newborns	32%-66% reduced risk of neonatal death with community-based 'kangaroo mother care' for LBW newborns. ^{17, 41, 42}	Reduced hypothermia and increased weight gain for preterm babies given Kangaroo care in Hospital. ⁴³	10% of newborns LBW (< 2500g). ²	VERY GOOD
Newborn care packages (preventive and therapeutic activities)	Newborn care packages for prevention reduce NMR by 15%-54%. ²⁰ Adding oral and injectable antibiotics for community treatment of suspected sepsis reduces NMR up to 70%. ^{12, 20}	Not reported	In East Sepik coupling a post-natal care package with birth dose hepatitis B vaccination increased coverage from 18 to 83%. ⁴⁴	VERY GOOD
Neonatal resuscitation	83% of asphyxia cases could be revived and NMR reduced by 41% via mouth-to-mouth although impact can be greater with bag-and-mask. ²⁰	Not reported	Not reported	VERY GOOD
Promotion of breastfeeding	Breastfeeding within 24 hours of birth reduces neonatal deaths by 8-19%. ^{36, 37} Promotion and support of breastfeeding reduces deaths at 0-12 months by 12%, 12-24 months by 10%, and 24-36 months by 9%. ¹⁹	Not reported	45% given colostrum, 84% breast fed within 24 hours of birth, 35% exclusively breastfed until six months. ^{5, 45}	VERY GOOD



What Family and Community Care could achieve for child health

FCC in PNG, and elsewhere, has already proven it can reduce child deaths (those aged from one month to 5 years), however faster progress could be achieved through broader coverage of the most effective FCC interventions.

The important FCC interventions for child health include:

- **nutritional interventions**, including: promotion of breastfeeding, infant and young child feeding (IYCF) counselling, preventive vitamin A and zinc supplementation, deworming and iodine fortification;
- **preventive care**, including: support to families to facilitate full immunisation, distribution of insecticide-impregnated bed nets (ITN), intermittent preventive treatment of malaria (IPT), prevention of parent-to-child transmission (PPTCT) of HIV, access to clean water and improved sanitation and community education and mobilisation around healthy childhood;
- **community-based treatments** for pneumonia, diarrhoeal disease and malaria (noting that approaches to malaria treatment changed from late 2010).

Of the approximately 9,000 deaths of children aged 1 month to 5 years **between 15 and 50% of these lives could be saved** through 95% coverage with a combination of nutritional FCC and community-based management of pneumonia and diarrhoea.

Of approximately 9,000 deaths of children aged 1 month to 5 years between 1,350 and 4,500 (15-50%) of these lives could be saved through 95 percent coverage with a combination of nutritional FCC (biannual vitamin A dosing, preventive zinc supplementation, complementary feeding actions and nutritional status monitoring) and community-based management of pneumonia and diarrhoea. Community-based management of pneumonia includes assessment of severity, referral for oxygen and antibiotics if severe, and treatment with antibiotics if referral is not needed. Community-based management of diarrhoea includes use of new formulation of oral rehydration solution (ORS), zinc and special feeding (for those with persistent diarrhoea). This combination was estimated by the WHO in 2005 to cost US\$462 per disability-adjusted life year (DALY)[‡] saved in the Western Pacific region – a level which rates the package as highly cost-effective by global standards.⁴⁶

The table on page 14 summarises evidence for impact (globally and in PNG), current usage in PNG and a rating on value for money based on the variety of cost analyses detailed in the full paper.

[‡] The DALY is in common use to provide a more detailed measure of the benefits of interventions, similar to 'lives saved', and has been used in many of the cost-effectiveness estimations discussed in the full paper.

Table 3 Summary of child health interventions at FCC level

Intervention	Evidence of impact globally	Evidence of impact in PNG	Prevalence and program coverage in PNG	Value for money
Nutrition interventions				
Promotion of breastfeeding	Promotion and support of breastfeeding reduces deaths at 0-12 month by 12%, 12-24 months by 10%, and 24-36 months by 9%. ¹⁹	Not reported	35% exclusively breastfed until six months, 29% breastfed past 18 months. ^{5, 45}	VERY GOOD
IYCF counselling and growth monitoring	Complementary feeding support and education can reduce the odds of stunting by up to 75%. ¹⁹ There is no evidence for impact of growth monitoring on its own, without associated counselling.	In a highlands study early introduction of solids was strongly associated with pneumonia. ⁴⁷	Stunting is high: 38-44% of children 6-59; underweight is 25%-18%; wasting is 4%-4.5%. ⁵ Iron deficiency anaemia is 63% in children 6-24 months. ⁵ Only 34.5% start complementary feeding at 6 months. ⁵	GOOD
Vitamin A supplementation	Supplementing children aged 6-59 months with 2 doses annually reduces all-cause mortality by 24%, ⁴⁸ diarrhoea incidence by 15% and measles morbidity by 50%. ¹⁹	35% fewer febrile cases of malaria in children aged 6-60 months with vitamin A supplements every 3 months for a year. ⁴⁹	26% of children under 5 years of age are vitamin A deficient. ⁵ Coverage with 2 doses for children 6-59 months is 12%. ²	VERY GOOD
Zinc supplementation (preventive)	Zinc supplementation for 6-59 month olds reduces pneumonia incidence by 13%, ⁵⁰ diarrhoea episodes by 14% and persistent diarrhoea by 25%. ¹⁹ Preventive zinc reduces stunting by 15% ¹⁹ and risk of death by 50%. ⁵¹	38% fewer malaria episodes (P. falciparum) in 6-60 month olds given 10mg elemental zinc daily for 46 weeks. No effect on vivax malaria. ⁵²	26% of boys and 11% of girls aged 2-10 years from Wosera in PNG are zinc deficient and 76% have low zinc intakes. ⁵³	GOOD
Deworming	Single dose albendazole for children 12-59 months reduces anaemia rates by 5 ¹⁹ -60%, ⁵⁴ increases height and weight. ¹⁹	Not reported	Hookworm infestation of low level affects 4%-75% of children aged 24-59 months. ^{5, 55}	VERY GOOD
Iodised salt fortification or iodine supplementation	Antenatal iodine supplements by injection in areas of severe iodine deficiency reduces the risk of congenital hypothyroidism by 73% and infant mortality by 29%. ¹⁹	Infants in Highlands given intramuscular iodinated oil had 13% greater survival rates after 15 years. ⁵⁶	Iodine deficient: 30% of women, 22% of pregnant women, ⁵⁷ 68% of boys, 82% of girls aged 6-12 years. ⁵⁸ 54% households use iodised salt. ⁵	VERY GOOD
Preventive interventions				
Insecticide treated nets (ITNs)	ITNs reduce malaria episodes by 50% more than no nets, and 39% more than untreated nets. Saves 5.5 lives for every 1000 children using ITNs. ⁵⁹ Use in pregnancy reduces LBW by 23%. ¹⁹	With regular outreach clinics over 1 year ITN use increased from 77% to 78% in Maprik and 57% to 88% in Esa'ala. ²¹	68% of households own mosquito nets and use them to prevent malaria. ⁶ In Madang 98% of children sleep under ITNs. ⁴⁵	VERY GOOD
Malaria prophylaxis – intermittent preventive treatment (IPT)	IPT at 2-3 months of age reduces the risk of malaria by 25-48% and of anaemia by 23-46%. 99% coverage reduces deaths in ages 0-12 months by 2.4%, 12-24 months by 2.1%, 24-36 months by 1.9%. ^{19, 60}	Mothers comply with home administration because of perceived benefits and guidance from health workers. ⁶¹ Trials are now underway in PNG, led by national IMR and partners.	Malaria is endemic in every province. 1.5-1.8 million suspected adult and child malaria cases at health facilities annually. Case fatality is 9.7 per 100,000. ⁸	VERY GOOD
Prevention of parent-to-child transmission (PPTCT) of HIV	PPTCT counselling and care, prophylactic ARVs, care at delivery and appropriate breastfeeding reduces risk of transmission from 35% down to 2%. ⁶²	500 women tested HIV positive at ANC and 147 infants were infected; 29.4% transmission. ⁶² Note this regime as tested is no longer in use.	18,000 women and 3,100 children are living with HIV. ² In 2009, 45 of 270 facilities provided PPTCT [§] ; covering an estimated 14% of mothers needing it. ⁶³	GOOD
Access to clean water and improved sanitation	Improved hand washing, water quality, and sanitation reduces diarrhoea incidence by 30%. ¹⁹ For every diarrhoea episode averted stunting decreases by 4%. ¹⁹	Not reported	Clean water accessible to 41% (87% urban, 33% rural). Sanitation facilities used by 45% (71% urban, 41% rural). ⁶⁴	GOOD

[§] This data represents the latest coverage published although the PPTCT regime in PNG no longer incorporates nevirapine prophylaxis.

Intervention	Evidence of impact globally	Evidence of impact in PNG	Prevalence and program coverage in PNG	Value for money
Treatment interventions				
Community-based pneumonia management	Community case management with oral antibiotics can reduce pneumonia-mortality by 70% in 0-59 month olds. ⁶⁵	In Simbu, health workers managed ARI effectively in only 60% of cases. ⁶⁶	2.3% of under 3 year olds had ARI in the last 2 weeks. 65% treated at a health facility. ⁶	GOOD
Diarrhoeal disease management	Zinc and oral rehydration salts (ORS) reduce the incidence of dehydration by 40%, all-cause hospital admissions by 59%, care-seeking for diarrhoea by 40%, and antibiotic use for diarrhoea by 89% compared to ORS alone. ⁶⁷	Not reported	4.3% of under 3 year olds had diarrhoea in previous 2 weeks, 35% went untreated. ⁶	GOOD
Malaria treatment	Effective malaria treatment could prevent up to 5% of child deaths. ⁶⁸	Lower efficacy of older regime was noted in ages 6 months – 7 years. ⁶⁹ Newer regime matches international efficacy.	Malaria is endemic in every province. 1.5-1.8 million suspected adult and child malaria cases at health facilities annually. Case fatality is 9.7 per 100,000. ⁸	GOOD



IMPLEMENTATION OF FCC TO IMPROVE MATERNAL, NEONATAL AND CHILD HEALTH IN PNG

Deliver evidence-based FCC interventions through existing community health programs

Existing community health programs, some run by government, most by churches and other non-government groups, provide a solid foundation for more comprehensive and widespread coverage of FCC. Many of these programs work alongside, or as part of, integrated community development sponsored by communities, the Government's Department of Community Development or outside partners, including partnerships such as *Strongim Pipol Strongim Nesen*.⁷⁰

The most common FCC interventions currently in use by existing programs are:

- community mobilisation for health, such as formation and support of women's groups;
- community education on disease prevention, nutrition, and appropriate care-seeking;
- distribution of insecticide-treated nets;
- provision of antimalarials, antibiotics or oral rehydration for home treatment; and
- attendance at home births to promote a clean delivery and referral if needed.

The availability of these interventions varies greatly across PNG and **it is clear that many programs do not make full use of the FCC interventions** with highest impact discussed above.

The **National Health Plan 2011-20** implicitly promotes greater use of FCC type interventions. The focus is on the creation of community health posts and adding professionals including local health promotion officers. This will contribute significantly to FCC. However, at least during the time taken to rebuild the health system, mothers and children will continue to benefit from both **education functions and direct provision of health care by VHVs**. VHV programs can be expanded more quickly at lower cost and their activities can complement those of professional health workers.

Strategies to expand FCC, discussed below, include: the need to expand support networks, training and incentives for VHVs and optimise program linkages; delivering interventions efficiently as packages of the most cost-effective interventions; and utilising other outreach and education mechanisms.

FCC can support the National Health Plan through:

- **Closer integration** between VHV programs and local health services, including new community health posts
- **Strengthened central coordination** and oversight of VHV programs, especially those providing community care
- **Optimising** the inclusion of the **most effective FCC** interventions in existing community health programs.



Expand support networks, training, incentives and linkages for VHVs

Village health volunteers are a critical component of expanded FCC as they facilitate professional health service outreach, provide a number of direct interventions and impart educational information to communities. VHVs already play an important part in many health services in PNG. In 2004 there were 67 VHV programs, with over 6,000 active VHVs, reported in operation. If their role is to be consolidated, and perhaps grow, this will require expansion of support and training networks, more widespread integration of VHVs with professional community health services and resolution of existing issues surrounding workloads and adequate incentives.

Strong community health program linkages and high quality support from professional community mobilisation/health promotion officers, especially those based in community health posts, will be essential. **National linkages and networks for VHV and community programs could also offer potential to improve FCC** in a number of ways. The last reported National Department of Health (NDOH)-led coordination meeting across programs was in 2008. A revitalisation of a national coordination point for VHVs within NDOH could help to review and re-establish accreditation for newly trained VHVs, refine job descriptions in light of new FCC evidence, and provide updated descriptions of minimum standards. This is particularly important for VHV programs that provide community based care, in addition to education. A technical linkage between NDOH and broader community development focal points may be one means to support this.

Health system integration is crucial. To enable VHVs to provide therapeutic care and medicine distribution at the community level it is crucial to have an effective supply system. In PNG this must be at minimum a partially functioning local health system whereby health centres can act as stock points for medicines, and hubs for supervision and reporting. Given the importance of support, training, supervision and supply chains, FCC is best scaled up in synchrony with efforts for health system strengthening. Experience in PNG shows that VHV programs work best when VHVs:

- work closely together with local professional health staff, including during outreach;
- can receive supervision, support and supplies from local health centres;
- can receive at least some of their refresher training in local hospitals or health centres;
- include their activity in health centre reports.

Deliver interventions efficiently as packages of the most cost-effective interventions

Integrated approaches that efficiently provide a set of linked interventions are important to the provision of client-centred care in any setting, but are particularly important in resource-limited settings such as PNG.

Packaging of FCC interventions in PNG has been shown to be effective and has the potential to increase coverage of all interventions and save time, money and resources by allowing VHVs (or other health workers) to perform several activities in the one session.²¹ Table 4 o summarises various FCC interventions by packages appropriate to various points in the life cycle.



While these intervention packages work well together and help to maximise impact and efficiency, the expansion of FCC should not be delayed because some components are not yet available. It is unlikely that all interventions are immediately feasible in any one program, and careful judgement is needed as to what health workers are able to do. Part-time trained lay health workers, such as VHVs, need feasible work expectations and a balance between educational interventions and treatment interventions. The scale-up of treatment interventions will depend greatly on whether there is potential for integration with local health system strengthening. At a minimum, however, it may be worthwhile to screen the interventions currently being provided by a program, to see how they match up with the evidence presented in this paper.

Other outreach and education mechanisms

Schools offer another important avenue for health education for children directly and for their families and communities indirectly. There is currently considerable scope to expand health communication through schools across PNG.

Other avenues include local radio programs and increasingly through cellular phone networks. The latter can be an important tool for village health workers and a direct source of information for villagers including timed information for pregnant women, expectant fathers and parents.

Table 4 Summary of potential packages for implementation of FCC

Pre-pregnancy (young women)	Antenatal	Childbirth and newborn		Infancy	Childhood
	Antenatal (General)	Childbirth	First day and week of life		
Family planning counselling	Birth-preparedness counselling	Referral by VBAs and TBAs	Care for LBW newborns	Promotion of breast feeding	IYCF counselling and growth monitoring
Nutrition counselling	Nutrition counselling	CBK and clean birth practices	Education for thermal care, cord care, and illness danger signs	IYCF counselling and growth monitoring	Vitamin A supplementation
Iron and folate supplementation	Calcium supplementation	Newborn resuscitation	Promotion of breast feeding	Zinc supplementation	Zinc supplementation
Iodised salt	Iron and folate supplementation	PPTCT of HIV	PPTCT of HIV	Mosquito or Insecticide treated nets	Deworming
Mosquito or Insecticide treated nets	Deworming		Community-based management of pneumonia (and other infections)	PPTCT of HIV	Iodised salt
	IPT of malaria			Community-based pneumonia management	Mosquito or Insecticide treated nets
	Referral by VBAs and TBAs			Diarrhoeal disease management	IPT of malaria
	Iodised salt			Malaria treatment	Community-based pneumonia management
	Mosquito or Insecticide treated nets			Access to clean water and improved sanitation	Diarrhoeal disease management
	CBK distribution				Malaria treatment
	PPTCT of HIV				Access to clean water, improved sanitation and hygiene information
	Misoprostol distribution				



A note on the evidence in this report

The data in this report have a number of limitations – mainly due to the lack of specific research information about PNG and the need to extrapolate from the experience in other countries. As a result the estimated costs and benefits should only be considered approximate. This paper is not intended as a community health manual, and many aspects of the implementation discussion are abbreviated.

Future work could go further to calculate specific costs and impact for particular settings in PNG, perhaps by employing health system modelling tools currently in use by WHO, UNICEF and other organisations. However, this should not delay greater support for FCC given the significant maternal, newborn and child health needs in PNG and the evidence of FCC value for money in a wide range of settings.



CONCLUSION

It is suggested that this evidence can be useful to government and non-government health planners and managers at national, provincial and local levels in the following ways:

- as evidence for advocacy where needed to influence provincial health policy;
- to review current inclusions at a program level, and;
- as a guide to judge the relative cost-effectiveness of FCC interventions one with another and other forms of intervention.

This paper calls for:

- renewed national leadership on the role, standards and support of VHVs in community health programs;
- a review of current FCC programs regarding their alignment with international evidence;
- FCC to be seen as a vital part of local health system strengthening; and
- greater cooperation between church and non-government community health programs to share program experiences, training materials and other resources.

The global evidence is convincing that FCC can make a major contribution to the survival and health of mothers, newborns and children in PNG. Analysis of the situation in PNG provided here demonstrates that many government and non-government programs could do more to include the most cost-effective FCC interventions in their programs. Ultimately, health improvements and progress towards the MDGs will require both family and community-based care, working in synergy with health system strengthening.



References

1. Cossey M, Patricia Moccia P, Anthony D. The state of Asia-Pacific's Children 2008. New York: UNICEF 2008.
2. UNICEF and Inter-agency Group for Child Mortality Estimation (IGME) 2011 Levels and Trends in Child Mortality Report 2011.
3. Rajaratnam J, Marcus J, Flaxman A, Wang H, Levin-Rector A, Dwyer L, et al. Neonatal, postneonatal, childhood, and under-5 mortality for 187 countries, 1970-2010: a systematic analysis of progress towards Millennium Development Goal 4. *Lancet*. 2010;6736(10).
4. Black R, Cousens S, Johnson H, Lawn J, Rudan I, et al, for the Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality in 2008: a systematic analysis. *Lancet*. 2010;6736(10).
5. Department of Health Papua New Guinea, UNICEF, National Statistics Office, US Center for Disease Control and Prevention. Papua New Guinea National Nutrition Survey - preliminary results. Port Moresby 2005.
6. National Statistics Office Papua New Guinea. 2006 Demographic and Health Survey 2006.
7. World Health Organization, UNICEF, UNFPA, The World Bank. Trends in maternal mortality: 1990-2008. Geneva: WHO, UNICEF, UNFPA, The World Bank 2010.
8. World Health Organization, National Department of Health. Country Health Information Profile - Papua New Guinea 2010.
9. National Department of Health. Ministerial taskforce on maternal health in Papua New Guinea report: Government of Papua New Guinea 2009.
10. Lawn J, Kerber K, Enweronu-Laryea C, Cousens S. 3.6 million neonatal deaths—What is progressing and what is not? *Semin Perinatol*. 2010;34:371-86.
11. Government of Papua New Guinea. National Health Plan 2011-2020. Waigani NCD 2010.
12. Lassi Z, Haider B, Bhutta Z. Community-based intervention packages for preventing maternal morbidity and mortality and improving neonatal outcomes. Karachi, Pakistan: International Initiative for Impact Evaluation 2010.
13. Prata N, Sreenivas A, Greig F, Walsh J, Potts M. Setting priorities for safe motherhood interventions in resource-scarce settings. *Health Policy*. 2010;94(1):1-13.
14. Rutstein S. Further evidence of the effects of preceding birth intervals on neonatal, infant, and under-five-years mortality and nutritional status in developing countries: evidence from the Demographic and Health Surveys, .. Calverton, USA: Macro International Inc, USAID2008.
15. Allison A. Healthy timing and spacing of pregnancies: USAID, World Vision 2011.
16. Conde-Agudelo A, Rosas-Bermúdez A, Kafury-Goeta A. Effects of birth spacing on maternal health: a systematic review. *Am J Obstet Gynecol*. 2007;196(4):297-308.
17. Barros F, Bhutta Z, Batra M, Hansen T, Victora C, GAPPs Review Group. Global report on preterm birth and stillbirth (3 of 7): evidence for effectiveness of interventions. *BMC Pregnancy Childbirth*. 2010;10(Suppl 1):S3.
18. Banerjee B, Pandey G, Dutt D, Sengupta B, Mondal M, Deb S. Teenage pregnancy: a socially inflicted health hazard. *Indian J Community Med*. 2009;34(3):227-31.
19. Bhutta Z, Ahmed T, Black R, Cousens S, et al, for the Maternal and Child Undernutrition Study Group. Maternal and Child Undernutrition 3: What works? Interventions for maternal and child undernutrition and survival. *Lancet*. 2008;371(9610):417-40.
20. Bhutta S, Darmstadt G, Hasan B, Haws R. Community-based interventions for improving perinatal and neonatal health outcomes in developing countries: A review of the evidence. *Pediatrics*. 2005;115(2):519-617.
21. Morgan C. Enhancing pregnancy outcomes: Summary and interpretation of the research and evaluation findings. Melbourne: Burnet Institute, A joint program of UNICEF PNG and the PNG National Department of Health, implemented by the PNG National Institute of Medical Research 2008.
22. Hofmeyr G, Lawrie T, Atallah A, Duley L. Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. *Cochrane Database Syst Rev*. 2010;Aug 4(8):CD001059.
23. Smith J, Brooker S. Impact of hookworm infection and deworming on anaemia in non-pregnant populations: a systematic review. *Trop Med Int Health*. 2010;15(7):776-95.
24. Haider B, Humayun Q, Bhutta Z. Effect of administration of anthelmintics for soil transmitted helminths during pregnancy. *Cochrane Database of Systematic Reviews*. 2009(2).
25. National Department of Health Papua New Guinea. Yumi Rausim Malaria - PNG National Malaria Control Program. NDoH PNG; 2011 [20 June 2011]; Available from: <http://yumirausimmalaria.com/index.html>.
26. Lee A, Lawn J, Cousens S, Kumar V, Osrin D, Bhutta Z, et al. Linking families and facilities for care at birth: What works to avert intrapartum-related deaths. *Int J Gynaecol Obstet*. 2009;107:S65-S88.
27. Blencowe H, Lawn J, Graham W. Clean birth kits - potential to deliver? Evidence, experience, estimated lives saved and cost: Save the Children and Impact 2010.
28. Birthing Kit Foundation (Australia). Birthing Kit Foundation Projects; Papua New Guinea. Belair: Birthing Kit Foundation; 2009 [13 March 2011]; Available from: <http://www.birthingkitfoundation.org.au/projects/PapuaNewGuinea.aspx>.
29. Sutherland T, Meyer C, Bishai D, Geller S, Miller S. Community-based distribution of misoprostol for treatment or prevention of postpartum hemorrhage: cost-effectiveness, mortality, and morbidity reduction analysis. *Int J Gynaecol Obstet*. 2010;108(3):289-94.
30. Mapiira P, Bauze A. Consolidated site analyses: Potential for community-based maternal and newborn care in Papua New Guinea Burnet Institute 2010.
31. Sibley L, Sipe TA, Koblinsky M. Does traditional birth attendant training improve referral of women with obstetric complications: a review of the evidence. *Soc Sci Med*. 2004;59(8):1757-68.
32. Sibley L, Sipe T, Brown C, Diallo M, McNatt K, Habarta N. Traditional birth attendant training for improving health behaviours and pregnancy outcomes. *Cochrane Database Of Systematic Reviews*. 2007(3):1468-93.
33. Midhet F, Becker S. Impact of community-based interventions on maternal and neonatal health indicators: Results from a community randomized trial in rural Balochistan, Pakistan. *Reprod Health*. 2010;5(7):30.
34. Bettiol L, Griffin E, Hogan C, Heard S. Village birth attendants in Papua New Guinea. *Australian Family Physician*. 2004;33(9):764-5.
35. Gogia S, Sachdev H. Home visits by community health workers to prevent neonatal deaths in developing countries: a systematic review. *Bull World Health Organ*. 2010;88:658-66B.
36. Edmond K, Kirkwood B, Tawiah C, Owusu Agyei S. Impact of early infant feeding practices on mortality in low birth weight infants from rural Ghana. *J Perinatol*. 2008;28(6):438-44.
37. Mullany L, Katz J, Li Y, Khatri S, LeClerq S, Darmstadt G, et al. Breast-feeding patterns, time to initiation, and mortality risk among newborns in southern Nepal. *J Nutr*. 2008;138(3):599-603.
38. Darmstadt G, Walker N, Lawn J, Bhutta Z, Haws R, Cousens S. Saving newborn lives in Asia and Africa: cost and impact of phased scale-up of interventions within the continuum of care. *Health Policy and Planning*. 2008;23(2):101-17.
39. Friberg I, Bhutta Z, Darmstadt G, Bang A, Cousens S, Baqui A, et al. Comparing modelled predictions of neonatal mortality impacts using LIST with observed results of community-based intervention trials in South Asia *International Journal of Epidemiology*. 2010;39:i11-i20.
40. Alto W, Albu R, Irabo G. An alternative to unattended delivery-A training programme for village midwives in Papua New Guinea. *Social Science & Medicine*. 1991;32(5):613-8.
41. Sloan N, Ahmed S, Mitra S, Choudhury N, Chowdhury M, Rob U, et al. Community-based kangaroo mother care to prevent neonatal and infant mortality: a randomized, controlled cluster trial. *Pediatrics*. 2008;121(5):e1047-59.

42. Lawn J, Mwansa-Kambafwile J, Horta B, Barros F, Cousens S. 'Kangaroo mother care' to prevent neonatal deaths due to preterm birth complications. *International Journal of Epidemiology*. 2010;39:i144-i54.
43. McMaster P, Haina T, Vince J. Kangaroo care in Port Moresby, Papua New Guinea. *Tropical Doctor*. 2000;30(3):136-8.
44. Morgan C, Bisibisera L, Bauze A. Improving immunisation and newborn survival at the Aid Post level in Papua New Guinea, Angoram District, East Sepik Province. Melbourne, Australia: Centre for International Health - Macfarlane Burnet Institute 2010.
45. Schneider R. Madang Nutrition Education Project: Baseline Survey Results: World Vision Pacific Development Group 2010.
46. Tan-Torres Edejer T, Aikins M, Black R, Wolfson L, Hutubessy R, Evan D. Cost effectiveness analysis of strategies for child health in developing countries. *BMJ*. 2005;331(1177).
47. Anga G, Vince JD, Kaupa M. Early introduction of solids and pneumonia in young infants in Papua New Guinea: a case control study. *J Trop Pediatr*. 2008 2008 Jun (Epub 2007 Dec);54(3):192-5.
48. Imdad A, Herzer K, Mayo-Wilson E, Yakoob M, Bhutta Z. Vitamin A supplementation for preventing morbidity and mortality in children from 6 months to 5 years of age. *Cochrane Database Syst Rev*. 2010;8(12):CD008524.
49. Shankar AH, Genton B, Semba RD, Baisor M, Paino J, Tamja S, et al. Effect of vitamin A supplementation on morbidity due to *Plasmodium falciparum* in young children in Papua New Guinea: a randomised trial. *Lancet*. 1999 1999 Jul;354(9174):203-9.
50. Lassi Z, Haider B, Bhutta Z. Zinc supplementation for the prevention of pneumonia in children aged 2 months to 59 months. *Cochrane Database Syst Rev*. 2010;8(12):CD005978.
51. Baqui A, Black R, El Arifeen S, Yunus M, Chakraborty J, Ahmed S, et al. Effect of zinc supplementation started during diarrhoea on morbidity and mortality in Bangladeshi children: community randomised trial. *BMJ*. 2002;325(7372):1059.
52. Shankar A, Genton B, Baisor M, Paino J, Tamja S, Adiguma T, et al. The influence of zinc supplementation on morbidity due to *Plasmodium falciparum*: a randomized trial in preschool children in Papua New Guinea. *Am J Trop Med Hyg*. 2000;62(6):663-9.
53. Gibson R, Heywood A, Yaman C, Sohlström A, Thompson L, Heywood P. Growth in children from the Wosera subdistrict, Papua New Guinea, in relation to energy and protein intakes and zinc status. *Am J Clin Nutr*. 1991;53(3):782-9.
54. Rohner F, Zimmermann M, Amon R, Vounatsou P, Tschannen A, N'goran E, et al. In a randomized controlled trial of iron fortification, anthelmintic treatment, and intermittent preventive treatment of malaria for anemia control in Ivorian children, only anthelmintic treatment shows modest benefit. *J Nutr*. 2010;140(3):635-41.
55. World Health Organization. Review on the epidemiological profile of helminthiases and their control in the Western Pacific region, 1997-2008: Western Pacific Regional Office 2008.
56. Pharoah P, Connolly K. A controlled trial of iodinated oil for the prevention of endemic cretinism: a long-term follow-up. *Int J Epidemiol*. 1987;16(1):68-73.
57. Temple V, Haindapa B, Turare R, Masta A, Amoa A, Ripa P. Status of iodine nutrition in pregnant and lactating women in national capital district, Papua New Guinea. *Asia Pac J Clin Nutr*. 2006;15(4):533-7.
58. Temple V, Mapira P, Adeniyi K, Sims P. Iodine deficiency in Papua New Guinea (sub-clinical iodine deficiency and salt iodization in the highlands of Papua New Guinea). *J Public Health (Oxf)*. 2005;27(1):45-8.
59. Lengeler C. Insecticide-treated bed nets and curtains for preventing malaria: Review. *Cochrane Database of Systematic Reviews*. 2004(2).
60. Mockenhaupt F, Reither K, Zanger P, Roepcke F, Danquah I, Saad E, et al. Intermittent preventive treatment in infants as a means of malaria control: a randomized, double-blind, placebo-controlled trial in northern Ghana. *Antimicrobial Agents and Chemotherapy*. 2007;31(9):3273-81.
61. Pell C, Straus L, Phuanukoonnon S, Lupiwa S, Mueller I, Senn N, et al. Community response to intermittent preventive treatment of malaria in infants (IPTi) in Papua New Guinea. *Malar J*. 2010 22(9):369.
62. Rupali P, Condon R, Roberts S, Wilkinson L, Voss L, Thomas M. Prevention of mother to child transmission of HIV infection in Pacific countries. *Intern Med J* 2007;37(4):216-23.
63. National Department of Health Papua New Guinea. Operational Plan 2011-2015: Prevention of parent to child transmission of HIV and paediatric AIDS in Papua New Guinea. PNG: NDoH2010.
64. World Health Organization. Global Health Observatory Database; Papua New Guinea. Geneva 2011 [cited 8 April 2011]; Available from: <http://apps.who.int/ghodata/?theme=country>.
65. Theodoratou E, Al-Jilalawi S, Woodward F, Ferguson J, Jhass A, Balliet M, et al. The effect of case management on childhood pneumonia mortality in developing countries. *Int J Epidemiol*. 2010;39(Suppl 1):i155-71.
66. Brewster D, Pyakalya T, Hiawalyer G, O'Connell D. Evaluation of the ARI program: a health facility survey in Simbu, Papua, New Guinea. *Papua and New Guinea Medical Journal*. 1993;36(4):285-96.
67. Bhandari N, Mazumder S, Taneja S, Dube B, Agarwal R, Mahalanabis D, et al. Effectiveness of zinc supplementation plus oral rehydration salts compared with oral rehydration salts alone as a treatment for acute diarrhea in a primary care setting: a cluster randomized trial. *Pediatrics*. 2008;121(5):e1279-85.
68. Sanders D, World Vision International. The missing link: Saving children's lives through family and community care. Geneva: World Vision International 2010.
69. Marfurt J, Müeller I, Sie A, Maku P, Goroti M, Reeder J, et al. Low efficacy of amodiaquine or chloroquine plus sulfadoxine-pyrimethamine against *Plasmodium falciparum* and *P. vivax* malaria in Papua New Guinea. *Am J Trop Med Hyg*. 2007;77(5):947-54.
70. Government of Papua New Guinea, AusAID. Strongim Pipol Strongim Nesen. 2011 [20 June 2011]; Available from: <http://www.dgtp.org.pg/>.

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