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EDITORIAL

The Paediatric Society of Papua New Guinea: 40 years on and child health is at a turning point

Child health is at an important turning point in Papua New Guinea (PNG). We have just passed the Millennium Development Goals (MDG) target date of 2015, and are entering an era of the Sustainable Development Goals. Child mortality has been steadily falling over the last 15 years, but neonatal and infant mortality remain the highest in the Pacific, and among the highest in East Asia. Gross Domestic Product (GDP) is rising considerably, predominantly because of the energy extraction industries. Whether this economic transition will translate into much improved population health and community development is uncertain, but will be an important determinant of progress. We are at the cross-roads of the old and the new causes and determinants of child morbidity and mortality. The Paediatric Society of PNG is 40 years young, and has matured from a very small number of paediatricians in the 1970s and 1980s, with more than 30 young paediatricians graduating since 2000.

There have been significant achievements over the last 40 years. The continuous publication of the Standard Treatment Book of Common Illnesses of Children, now in the 10th Edition, is notable and of local, national and international significance. This small evidence-based book has provided guidance for health workers at all levels since 1974, and has strongly influenced the way other countries and the World Health Organization have written clinical guidelines over the last 2 decades. In the first 2 decades the Paediatric Society had a number of other major milestones: in the 1980s the development and introduction of an innovative vaccine against pigbel led to a sharp reduction in child deaths from this disease; and PNG was one of the first countries in the world to introduce legislation to support the promotion of breastfeeding of infants.

In 2006 PNG was one of the first countries in the Western Pacific to establish a Child Health Advisory Committee, an independent committee which oversees and monitors child health activities and outcomes. In 2008-

2009 the Paediatric Society and Department of Health developed a comprehensive Child Health Plan to 2020, now updated in 2015 (1). This comprised the child health component of the PNG National Health Plan.

Many of the activities and aims proposed for the first 5 years from 2009 in the Child Health Plan have been achieved. Outcomes include substantial reductions in child deaths from malaria, and the introduction of new vaccines: against hepatitis B and conjugate vaccines against *Haemophilus influenzae* type b in 2008 and *Streptococcus pneumoniae* in 2014. In the last decade there has been a slowing of the HIV (human immunodeficiency virus) epidemic overall, good progress in establishing early infant diagnostic services in rural areas and improved anti-retroviral treatment schedules for HIV-infected mothers that will be better for them and good for their babies. PNG was declared polio-free in 2000.

With the increase in Master of Medicine graduates since 2000, there are more paediatricians working in provinces, providing clinical paediatric care, supervising child public health programs and training junior registrars in paediatrics through the Diploma of Child Health. In addition more doctors working in district hospitals are being trained in rural health with skills in the care of sick children, through the University of Papua New Guinea (UPNG) Master of Medicine in Rural Health. Many paediatricians hold senior positions in health administration within provincial hospitals and the National Department of Health, and influence change from these offices. Some are involved in academic teaching and research at the UPNG.

In this decade there are better surveillance and outcome data at hospital level, through the Paediatric Hospital Reporting Program, which has documented disease burdens and outcomes in five annual reports since 2010 (2-6). There have been other service improvements: training in improved quality of hospital care, and the introduction of other interventions: zinc as treatment for diarrhoea, a

better approach to the management of severe malnutrition, introduction of vitamin A, oxygen concentrators for treatment of pneumonia and fixed-dose combination drug therapy for tuberculosis (TB) and HIV infection.

Importantly, there have been changes beyond the health sector: some provinces now provide free education, and primary school enrolments were up 300,000 in the latter part of the last decade.

Despite these achievements, many 'old conditions' are not controlled, especially those that are diseases of poverty or neglect or the result of failings of preventive care. Tuberculosis is more than ever the scourge of impoverished children and families; many children succumb to this infection or develop crippling disability or chronic ill-health. For many of these children there are missed opportunities for prevention or mitigation of such consequences. There is inadequate TB control in most provinces; and multidrug-resistant TB is a problem not only in adults, even though in children the problem is less visible because they are rarely sputum smear positive.

After nearly a decade of virtual interruption of measles transmission brought about by supplemental immunization activities, measles in 2014 again caused many preventable deaths in young children.

Pneumonia and severe malnutrition remain the twin major killers of children, and chronic gastrointestinal infections, including dysentery and typhoid, remain common – and in 2013 cholera appeared because of poor sanitation and weak public health surveillance. Malaria is on the improve, but global warming and higher temperatures in the highlands have brought new outbreaks, and other vector-borne diseases, including dengue and chikungunya, are not just emerging but are present with inadequate systems for outbreak detection.

These 'old' causes of mortality and morbidity will not be addressed by hospital-based medical models alone, but require greater emphasis on community and environmental health, education services and health education, empowerment of mothers, close involvement of responsible fathers, families taking responsibility for their own health and limiting family sizes, and communities

taking responsibility for their health services and living conditions for children. Excessive population growth that outstrips services, both health and education, and the TB epidemic risk undermining the gains that will be made in other areas.

In addition, there are many 'new' conditions that need addressing in serious ways in the 21st century: disability, the long-term care of children with chronic illnesses, adolescent health, childhood cancer, heart disease, obesity and child mental health. Children with chronic illness and disability have rights to optimum health and development, and access to quality services. Better management of chronic conditions results in prevention of long-term morbidity, improvement in quality of life and increased participation in education, employment and the community. In addition the renewed focus on newborn health is not just about improving survival from sepsis, perinatal asphyxia and low birthweight, but also about an improved quality of life through early identification of these new morbidities and early intervention.

With the passing of the Millennium Development Goals target year of 2015, there is a risk that child health will fall off the radar of international agencies. Therefore, it is even more important that the Paediatric Society of PNG and its principal partners, the National Department of Health and the School of Medicine and Health Sciences, develop even stronger capacities for implementation of services and programs, training, research and continuing professional development.

So now is a time to celebrate the progress of the first 40 years, identify the current gaps and shape the agenda of the next 2 decades. It is a time to re-set the goals for child health. Reducing preventable deaths remains a major goal, and it is likely that we will achieve our MDG targets for child mortality by around 2020. However, the goals should not be just a number but the development of comprehensive child health services for the 21st century, with achievable milestones along the way.

We are now at the mid-point of the 2009-2020 Child Health Plan (1). In June 2015 there was a review and update of the Plan to reflect the next 5 years, some components of which are listed in Table 1. It is now up to all stakeholders to align activities with this

TABLE 1

THE POST-2015 AGENDA

Neonatal health and survival
 Rural health services and rural development
 Education
 Tuberculosis and HIV
 Urban and environmental health
 Properly structured child health programs in provinces and districts
 Improving quality and safety of paediatric and neonatal care
 Management of chronic childhood conditions
 Child health nurses, paediatricians and leadership
 Reducing the unmet need for family planning
 Social and legislative protection for children
 New vaccines against pneumonia and diarrhoea
 Nutrition and malnutrition
 School and adolescent health
 Child health data, disease surveillance, outcome reporting and research
 Partnerships in child health in Oceania and Asia

HIV = human immunodeficiency virus

Child Health Plan, to disseminate the plan and explain it to provincial and district managers, all levels of Government and donor partners, to teach it to all child health workers, and to engage the community.

This edition of the PNG Medical Journal celebrates 40 years of the Paediatric Society. Kiromat and Vince reflect on this history (7) and describe some of the current problems from a wide range of perspectives. This edition also includes papers from research projects by trainee paediatricians that represent the increased capacity and relevance of child health research in PNG. Papers cover maternal and newborn mortality (8,9), paediatric TB and HIV co-infection (10), child sexual abuse (11), safety of blood transfusions (12), chronic ear infections (13), a new test for meningitis (14), adolescent health (15), childhood cancer (16) and the role

of zinc deficiency (17).

We think it is time to be very ambitious about what can be achieved for child health in PNG in the next 40 years.

Paediatric Society of Papua New Guinea

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The Paediatric Society of Papua New Guinea

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The Paediatric Society of Papua New Guinea

The Paediatric Society of Papua New Guinea (PNG) has been in existence for 40 years, and in that time has been involved in every significant child health initiative in PNG. The Society has grown from a small base to over 80 members and trainees. The Society has had a major role in developing guidelines and standards for paediatrics and child health. It has provided guidance to the Department of Health and the community on child health matters. The Society has worked closely with educational institutions to design and implement paediatric training for all cadres of health workers, and is a collegiate and friendly group supporting child health workers. This paper outlines a brief history of the Society, on its 40th anniversary.

Beginnings

Discussions about forming a Paediatric Society of Papua New Guinea began in 1975 with key players being Prof. John Biddulph, Dr Jeffrey Tuvi, Dr Peter Pangkatana and Dr Laupu Bussim. The inaugural meeting of the Society was held in the Postgraduate Room of the Port Moresby General Hospital (PMGH) Clinical Sciences block on 19 March 1975. At that meeting office bearers were appointed: Dr Jeffrey Tuvi as President, Prof. John Biddulph as Secretary/Treasurer and Dr Peter Pangkatana and Dr Laupu Bussim as executive members. The first executive meeting was held on 16 July 1975 and the first annual general meeting (AGM) on Nov 4th of the same year, shortly after Independence, at the Angau Memorial Hospital in Lae. At that meeting it was agreed that the Society should

affiliate with APSSEAR – the Association of Paediatric Societies of the South East Asian Region – for an annual fee of US\$50. Initially there was no membership fee for the PNG Paediatric Society. The 'pioneer' members of the Society are shown in Table 1.

It was agreed that it was important that paediatric nurses should be included. A successful paediatric nurse training program was being carried out at the time – led by Sr Dalai Farrow – and by 1977 the Society membership had increased to 29 with the inclusion of Drs Edwin Brown, Jean Hamnett, Peter Howard, Hapo Maliaki, Stephen Oppenheimer, Frank Shann and John Vince, and paediatric nurses Paul Bua, Bagire Gomara, Lim Malibun, Naomi Ora, Pauline Tarugege, Yvonne Tawia, Norma Thomas and Rose Tsiroats.

The Master of Medicine (MMed) Program in Child Health was introduced at the University of Papua New Guinea (UPNG) in 1975 and the first fully qualified PNG paediatricians, Dr Laupu Bussim and Dr Jeffrey Tuvi, graduated in 1979 and 1980. With the success of the MMed program, national paediatricians began to take over the Paediatric Units of the major hospitals, but expatriate paediatricians continued to play an important role in the Society and in child health. The names of the expatriates who have served as paediatricians since 1975 are listed in Table 2 and the national paediatricians in Table 3. Very few of the national paediatricians have opted to pursue an overseas-based career. Several have moved into senior positions with the national and provincial Departments of Health or major hospitals, or into academic roles in the University.

-
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TABLE 1

THE FOUNDING MEMBERS OF THE PAEDIATRIC SOCIETY OF PAPUA NEW GUINEA

Name	Position
John Biddulph	SSMO Paediatrics, Port Moresby
Cam Bowie	SMO Paediatrics, Goroka Base Hospital
Laupu Bussim	Child Health UPNG
Lenga Dopenu	SMO Paediatrics, Lae
Dalai Farrow	Paediatric Nurse Tutor, Port Moresby
Neville Henry	Medical Officer, Madang
Kathleen Murtagh	Lecturer Child Health UPNG
Margaret Neave	SMO Paediatrician, Lae
Brenda Payne	SMO Paediatrician, Mt Hagen
Peter Pangkatana	Lecturer Community Medicine UPNG
John Stace	SMO Paediatrics, Madang
Ambrose Suebu	Paediatric Registrar, Port Moresby
Jeffrey Tuvi	Paediatrician, Port Moresby
J Vall	-

SSMO = Senior Specialist Medical Officer

SMO = Specialist Medical Officer

UPNG = University of Papua New Guinea

The Presidents and Secretary/Treasurers of the Society are shown in Table 4.

Prof. John Biddulph, fondly referred to as the Father of Paediatrics and Child Health in PNG, first came to PNG in 1954 as a 3rd year medical student. In 1961 he was employed by the National Department of Health (NDoH) at Angau Memorial Hospital and then recruited to the fledgling Papuan Medical College. He was the Founding Professor of Child Health at the University of Papua New Guinea and was the inspiration for many of the developments in child health through the Paediatric Society and the National Department of Health, as well as being an educator and researcher of the highest calibre. He retired at the end of 1990 after 30 years of continuous service. He continued his interest in and contribution to the Paediatric Society and to child health until his death from leukaemia in 1998. His contributions are detailed in the PNG Medical Journal Memorial Issue (1). The acute Paediatric Ward in the PMGH was named 'The John Biddulph Ward' in 1994.

In 1979 the Paediatric Society became a member of the International Paediatric

Association (IPA) at its meeting in New Delhi. The Society later ceased its membership with both APSSEAR and IPA in light of the annual membership fees involved and the feeling that the Society did not gain a great deal from such membership.

The functions and achievements of the Society

The Society has maintained its broad view of child health as involving all levels of care – from tertiary hospital to aid post and community. It has been an advocate for child health and has achieved some memorable goals.

The first edition of the Paediatric Standard Treatment Book was introduced and warmly received in 1975. It set the standard for other disciplines to follow, and was regarded internationally as an important introduction to child health care management. By 2005 it was in its 8th edition – considerably more complex than the first (2) – and at the time of writing, preparation of the 10th edition is underway. The preparation of the Standard Treatment Books is a time-consuming and

TABLE 2

THE EXPATRIATE MEMBERS OF THE PAEDIATRIC SOCIETY OF PAPUA NEW GUINEA

Name	Position
John Biddulph	Lae, Port Moresby, UPNG
Cam Bowie	Goroka
Neville Henry	Madang
Kathleen Murtagh	UPNG/Port Moresby
Margaret Neave	Lae
Brenda Payne	Mt Hagen
John Stace	Madang
John Vince	Port Moresby/UPNG
Frank Shann	Goroka
Stephen Oppenheimer	Madang
Jean Hamnett	Port Moresby
Subbhash Sharma	UPNG/Port Moresby
Andrew Tulloch	Rabaul
Jane Barker	Kundiawa, Goroka
Keith Edwards	Rabaul, Wewak, UPNG/Port Moresby
Peter Poore	Lae
Pimbo Ogatuti	Rabaul
Panniker Samuel	Mt Hagen
Phillip Watt	Madang
Rob Primhak	UPNG/Port Moresby
Paul Gibson	UPNG/Port Moresby
Nick Brown	UPNG/Port Moresby
Graham Ogle	UPNG/Port Moresby
Adedeyo Kemiki	UPNG/Port Moresby
Hanny Friesen	UPNG/Port Moresby
Trevor Duke	Goroka, UPNG
Henry Welch	UPNG/Port Moresby

UPNG = University of Papua New Guinea

arduous exercise; the fact that it has remained an important tool for the provision of high-quality child health care is a tribute to all the paediatricians who have served on its editorial boards at various times.

1976 saw the 4th edition of 'Paediatrics for Health Extension Officers and Nurses' by John Biddulph and John Stace. The book was revised on 8 occasions – the 9th edition (1999) was co-edited by Dr Bob Danaya. It is an astonishingly good book, and is in urgent need of updating.

In 1982 Keith Edward's book 'Buk Bilong Helpim APO Lukautim Pikinini I Gat Sik' – a book designed specifically for aid post orderlies (APOs) – was produced and distributed.

The first edition of 'Paediatrics for Doctors in Papua New Guinea' was a collaboration between Frank Shann and John Biddulph – and incorporated some of John's earlier book, 'Paediatrics for Resident Medical Officers'. The book, using a problem-based approach and giving detailed information across the range of commonly and not so commonly

TABLE 3

THE NATIONAL AND PACIFIC ISLANDS* SPECIALIST-QUALIFIED MEMBERS OF THE PAEDIATRIC
SOCIETY OF PAPUA NEW GUINEA

Year	Name	Position
1979	Laupu Nageob Bussim (D)	UPNG
1980	Jeffery Owen Tuvi	Rabaul, NDoH
1986	Robert Tawa Danaya	PMGH, Government
1986	Benjamin Tahija	Kavieng, Mendi
1987	Joel Paruku Kia (D)	Lae
1987	<i>Cyril Pitakaka</i> (D)	Solomon Islands, PP
1987	Alphonse Benjamin Rongap (D)	Lae
1987	Nakapi Tefuarani	UPNG
1988	Langa S Garap	Rabaul, Kavieng
1989	Job Hawap (D)	Wewak, Vaimo, NDoH
1989	David K Mokela	Lae, PMGH, Administration
1989	Paulus Ripa	Mt Hagen, UPNG
1990	Kuria Nemba	O/S
1990	Hilda Polume	PMGH, NDoH, PP
1990	Theresia Georgina Rongap	Lae
1990	James Aini	O/S
1993	Materua James Amini	Lae, PMGH
1993	Gokoopa Peter Asuo	Goroka, O/S
1993	<i>Hensley Hudson Garae</i>	Vanuatu
1993	Guapo Kiagi	Rabaul, Kundiawa
1993	William Lagani	Popondetta, NDoH
1993	Mathias Tovilu	Buka
1996	Ilomo Hwaihwanget	Madang, Wewak, Goroka
1996	Momia Teariki-Tautea	O/S
1997	<i>James Auto Gugumae</i>	Solomon Islands
1997	Mobumo Sanga Kiromat	Lae, PMGH, Clinton Foundation
1997	Jerry Tanumei	Popondetta, NCD
1998	Patrick Robin Kiromat	Mt Hagen, Kimbe, Alotau
1998	Gilchrist Oswyn	Alotau
1998	Kauve Pohonu Pomat	Rabaul, Wewak
1999	<i>Divinal Ogaoga</i>	Solomon Islands
1999	<i>Herbert Ronnie Peters</i>	O/S
1999	Naomi Kori Pomat	Madang, Daru
2000	Mary-Julian Baki	PMGH, PP
2000	Louis Samban Samiak	Wewak, UPNG
2001	Cecilia Pakule	Madang
2003	Magdelene Kaupa	Mt Hagen
2003	<i>Titus Nasi</i>	Solomon Islands
2003	<i>Caleb Vangana</i>	Solomon Islands, PP
2003	Beryl Vetuna	Rabaul

2005	Wendy Pameh	Madang, Goroka, UPNG
2005	Francisca Failing	Lae
2006	Francis Wandl	Kundiawa, Goroka
2006	Stella Jimmy	Vanimu
2006	Dale Frank	Clinton Foundation
2006	Jonah Kurubi	Mt Hagen
2007	Cornelia Kilalang	PMGH
2007	Lucas Mauta	Private industry
2007	Harry Poka	Kundiawa
2008	Kone Sobi	PMGH
2010	Gwenda Anga	PMGH
2010	Roland Barnabas	PMGH
2011	<i>Carol Titulu</i>	Solomon Islands
2011	Tarcisius Uluk	Kimbe
2012	Joe Kumbu (D)	PMGH
2013	Martin Sa'avu	Mendi
2013	Jason Vuvu	PMGH
2014	Jimmy Aipit	Madang
2014	Angai Dama	Goroka
2014	Fiona Kupe	NCD
2014	Mary Ivagai	Tabubil, NCD
2014	Doreen Panauwe	Wabag
2014	Gamini Vali	PMGH
2015	<i>Betty TaoTaoWini</i>	Solomon Islands
2015	Stanley Hanap	Vanimu
2015	Michael Landi	PMGH
2016	Rosemary Kipalan	Lae
2016	Sharon Kasa Tom	PMGH, Enga

*in italics

D = dead

UPNG = University of Papua New Guinea

NDoH = National Department of Health

PMGH = Port Moresby General Hospital

PP = Private practice

O/S = Overseas

NCD = National Capital District

encountered conditions, and instructions for various procedures, was utilized widely by all levels of medical officers – and not only in Papua New Guinea. John Vince spearheaded the second edition of this book, published in 2003 supported by AusAID (Australian Aid) and the Health Services Support Program. The book incorporated many of the suggestions and developments emanating from the deliberations of the Paediatric Society.

1978 saw a major legislative milestone – the passing of the Baby Food Supplies Control

Act. This Act – the first legislation in the world to attempt to protect breastfeeding and to control the incursions of the infant formula companies – was promoted by the Paediatric Society. The Act which controlled the sale of infant feeding bottles was amended in 1984 to include feeding cups and dummies.

The Paediatric Society has from its beginning been an important contributor to the policies of the NDoH. Currently this is through its representatives on the Child Health Advisory Committee, which in turn advises the Senior Executive Management of the Department.

TABLE 4

PRESIDENTS AND SECRETARY/TREASURERS OF THE PAEDIATRIC SOCIETY
OF PAPUA NEW GUINEA

President	Term
Jeffrey Tuvi	1975-1976
Peter Pangkatana	1977-1978
	1983-1986
Laupu Bussim	1979-1980
Lenga Dopenu	1981-1982
Nakapi Tefuarani	1987-1988
	1992-1993
Bob Danaya	1994-1997
David Mokela	1998-2009
James Amini	2010-present
Secretary/Treasurer	
John Biddulph	1975-1991
John Vince	1992-1999
Mobumo Kiromat	2000-2008
James Amini	2008-2011
Cornelia Kilalang (Secretary)	2011-2014
Gilchrist Oswyn (Treasurer)	2011-2014
Beryl Vetuna (Secretary)	2014-present
Gwenda Anga (Treasurer)	2014-present

Important interventions driven by the Society include the introduction of oral rehydration solution in 1985, the introduction of measles vaccine into the immunization schedule in 1985 and hepatitis B vaccine in 1992. More recently the Society has championed the introduction of *Haemophilus influenzae* B vaccine and conjugate pneumococcal vaccine. It has been vocal in the development of services for the prevention, diagnosis and treatment of children exposed to, and infected with, HIV (human immunodeficiency virus) and in the introduction of fixed-dose combination treatment for tuberculosis (TB).

The Society has from its inception been involved in continuous medical education for its members. The annual Paediatric Symposia have been held every year since 1977. At these meetings research papers are presented and updates on important issues provided. Many of the postgraduate research projects have been subsequently published nationally in the

PNG Medical Journal and in the international child health literature and have informed national child health policy development. With the increasing membership and increasing complexity of the health services it became apparent that the annual meetings did not provide enough time to adequately consider major policy matters and a mid-year meeting specifically to discuss these issues was established around 2002. The obvious link between maternal and neonatal care led to the addition of a combined Obstetric Society and Paediatric Society day during the mid-year meeting.

One of the very important developments from the Paediatric Society meetings has been the 2009-2020 Child Health Policy and Plan, which is currently in the final stages of mid-term review. Various members of the Society have contributed to this, and all sections have been discussed by the membership. The plan is a very comprehensive document

covering the whole spectrum of child health from neonatal to adolescent care, and outlining ways towards improving child health services and outcomes across the spectrum of health care delivery services. Prof. Trevor Duke, the Adjunct Professor of Child Health at UPNG and the Director of the Centre for International Child Health at Melbourne University, who previously worked as a paediatrician in Goroka, has coordinated the development of this plan with Dr Bill Lagani, the Director of Family Health Services. Other developments which have occurred with the Paediatric Society's and Prof. Duke's involvement are increased use of oxygen concentrators, shown to significantly reduce infant and child mortality, the development of an electronic recording database for hospital admissions which allows ready access and analysis of admission, morbidity and mortality

data across the country, and the rolling out by provincial paediatricians of the World Health Organization's Hospital Care for Children Program.

The Society celebrates 40 years of its existence in 2015 (Figure 1). It has developed from a small beginning to a robust Society which through a very active membership and strong and clear leadership continues to make a major contribution to child health services in PNG and in the region.

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Figure 1. Members of the Paediatric Society of Papua New Guinea on the occasion of the 40th Anniversary in Goroka.

Child sexual abuse at Eastern Highlands Provincial Hospital: a prospective descriptive study

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SUMMARY

Child sexual abuse (CSA) is common throughout the world and has been recognized as a common presentation at the Eastern Highlands Provincial Hospital. The aim of this prospective study was to describe the presentations and outcomes of CSA in the hospital. A structured questionnaire was used to collect data from the guardians of 38 children aged between birth and 15 years presenting with a history of sexual abuse between February and August 2013. Children were followed up at three months to ascertain the presence of sexually transmitted infection and to determine how the issue of abuse was resolved by the family. There were 35 females and 3 males aged between 3 and 15 years with a median age of 5.5 years and interquartile range of 4-9 years. 28 (80%) of the 35 girls had been raped and one of the boys had been anally raped. Over half of the children's mothers were illiterate and lived a subsistence lifestyle. The perpetrator was known to the subject in 36 (95%) of the cases. Coercion was used by the perpetrators in 22 cases (58%). Gram stains of vaginal swabs from 28 children showed gonococci in 15 (54%). Compensation payments were used to resolve the issue of abuse in 13 (72%) of 18 cases at 3-month follow-up. There has been an increase in the number of children diagnosed with sexual abuse at the Eastern Highlands Provincial Hospital. There is an urgent need for existing child protection laws such as the Lukautim Pikinini Act to be robustly implemented and for the development of Family Welfare Centres to provide a holistic approach to the management and support of victims of CSA and their families.

Introduction

Child sexual abuse (CSA) is defined as the involvement of a child in sexual activity that he or she does not fully comprehend, to which he or she is unable to give informed consent, or for which the child is not developmentally prepared and cannot give consent, or that violates the laws or social taboos of society (1). CSA is a severe form of human rights abuse and the worst form of exploitation. It has severe consequences on the future of the child physically, emotionally and psychologically with serious and sometimes life-threatening sequelae (2).

CSA occurs throughout the world and is recognized by paediatricians and others to be common in the Eastern Highlands Province (EHP) of Papua New Guinea (PNG). There are many factors which lead to a child becoming a victim of sexual abuse. The low status of women and children, poverty, the lack of educational and employment opportunities, and inadequate protective legislation, support services and regulation were cited as contributing to Pacific children's vulnerability to sexual violence (2).

A recent study of CSA among urban secondary school pupils in Zimbabwe

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found that the most important factors consistently associated with child sexual abuse were parental absence, mother's low education status, parental domestic violence and parental substance abuse (3). The perpetrators are usually persons whom the child knows and who are in a position of trust. A study at Port Moresby General Hospital Children's Outpatient Department found that the perpetrator was a male relative or acquaintance of the child in 61% of the cases reported (4).

Over the past few years we have seen an increase in the number of child sexual abuse cases diagnosed at the Paediatric Ward of Eastern Highlands Provincial Hospital. In 2012 more than 30 children presented with complaints of having been sexually abused.

The aims of this study were to describe sexual abuse in children seen at Eastern Highlands Provincial Hospital. In particular we aimed to:

- ascertain the sociodemographic features of children who have been sexually abused,
- identify the types of sexual abuse,
- identify the common situations where children are sexually abused,
- identify the relationship between perpetrator and child,
- determine the frequency of sexual abuse,
- identify sexually transmitted infections (STIs) present, and
- discover how cases are resolved.

Subjects

Inclusion criteria:

1. A male or female aged from birth to 15 years:
 - a. presenting to the Eastern Highlands Provincial Hospital Paediatric Ward, Children's Outpatient Department or the Emergency Department who
 - b. may or may not have been seen by

other health workers before coming to the Paediatric Ward and who

- c. complained of being, or was reported by caregivers to have been, a victim of sexual abuse at any time in the past.
2. Any child who complained of any symptoms of a sexually transmitted infection and had a history of having been sexually assaulted.

Exclusion criteria:

Children whose parents/guardians were unable to communicate in Tok Pisin or English.

Methods

In this prospective study carried out over 6 months (February-August 2013) children presenting to the Children's Outpatient Department (COPD) or the Emergency Department (ED) with a complaint of having been sexually abused or with symptoms of sexual abuse were referred to the Paediatric Ward for assessment. Other subjects presented directly to the ward. During working hours the first author assessed the children with history taking and examination. Following pretest counselling by a trained nurse blood for HIV (human immunodeficiency virus) and Venereal Disease Research Laboratory (VDRL) testing was collected from all patients in whom there was penile-vaginal or penile-anal contact or who did not communicate clearly what sort of abuse had taken place. Urine for microscopy, and vaginal and anal swabs were collected when indicated. Medical treatment was given as per the Paediatric Standard Treatment Book (5). Caregivers providing informed consent were asked a set of structured questions about their sociodemographic background, the circumstances surrounding the abuse and information about the perpetrator.

At times when the investigator was not available patients were assessed by the attending medical officer, resident medical officer (RMO) or resident health extension officer (RHEO) in the Paediatric Ward. The first author administered the questionnaire the following day. The caregivers were advised to report the abuse to police if they had not already done so. The children were reviewed after a few days with the results of

the investigations.

The child and caregivers were referred to a nursing officer who is a volunteer Family and Sexual Violence Counsellor for advice regarding the implications of the abuse and the importance of involving the police. The nursing officer completed the medico-legal proforma, prepared a police medical report and took it to the police.

Caregivers were given an appointment for review after three months. Those who did not come in person were followed up via telephone where possible. For this review, a structured questionnaire was used to find out how the subject was doing, if he or she had any symptoms of a sexually transmitted infection and how the family had resolved or were resolving the issue of sexual abuse. HIV and VDRL tests were repeated for those children tested at presentation, and performed for those who had not been tested initially but who had symptoms such as abdominal pain or who were generally unwell. Children with symptoms of sexually transmitted infections were investigated and treated.

Data entry and analysis were done using Microsoft Office Excel 2007.

Ethical clearance

Approval for this study was given by the Eastern Highlands Provincial Hospital management.

Results

38 children had initial assessments and investigations performed but questionnaire data were not available for 7 whose caregivers did not attend the arranged interview. There were 35 females and 3 males with an age range of 3-15 years, a median of 5.5 years and an interquartile range of 4-9 years. This was consistent with data from 2012 (29 females and 2 males with age range of 2-14 years and a median of 5 years).

The type of sexual abuse suffered is shown in Table 1. Penile penetration of the vagina – child rape – was the main type of abuse, occurring in 19 girls, followed by compound sexual abuse including vaginal penetration in 9. In total 28 (80%) of the 35 girls had been raped, and one boy had been anally raped.

22 (71%) of the 31 interviewed victims lived in rural villages, while 4 (13%) came from urban Goroka and 5 (16%) came from the periurban settlements.

The children's caregivers at the time of the abuse are shown in Table 2. 21 (68%) of the children lived with both their biological parents at the time of the abuse while the rest lived with a single parent, adopted parents, grandparents or biological parent and step-parent.

Table 3 shows the literacy and occupation of the caregivers – either the biological or

TABLE 1

TYPES OF SEXUAL ABUSE (N = 38)

Type of sexual abuse	Number (%)
Penile penetration of vagina	19 (50)
Compound sexual abuse (fondling or oral sex plus vaginal penetration)	9 (24)
Fondling	4 (10)
Forced paraphimosis	2 (5)
Penile penetration of anus	1 (3)
Foreign object inserted into vagina	1 (3)
Unspecified	2 (5)

TABLE 2

CAREGIVERS OF SUBJECTS AT THE TIME OF THE ABUSE (N = 31)

Caregiver	Number (%)
Biological parents	21 (68)
Adoptive parents	4 (13)
Grandparents	3 (10)
Biological parent and step-parent	2 (6)
One biological parent	1 (3)

TABLE 3

LITERACY AND EMPLOYMENT BACKGROUND OF CAREGIVERS (N = 31)

Caregiver's* characteristics	Father Number (%)	Mother Number (%)
Literacy**		
Literate	16 (52)	14 (45)
Illiterate	11 (35)	17 (55)
Unknown	4 (13)	0
Occupation		
Formal	12 (39)	5 (16)
Self-employed	8 (26)	5 (16)
Subsistence	11 (35)	16 (52)
Homemaker	0	5 (16)

*Caregivers are biological and surrogate parents

**Literacy defined as – being able to do basic reading and writing

the surrogate parents. More than half of the female and a third of the male caregivers were illiterate. The places where the abuse occurred and the whereabouts of the caregivers at the time of the abuse are shown in Tables 4 and 5.

Table 6 shows the relationship between the subject and the perpetrator. In only 2 cases was the perpetrator reported as unknown to the victim. In 22 cases the perpetrator employed coercion during the abuse: 8 children were bribed with money, food or

sweets, 4 were tricked into playing 'games', 1 was made to feel guilty and 9 were threatened with violence.

Absence of testing materials and reagents and unavailability of counselling at the time of presentation limited the number of serological tests performed. 26 children were tested for HIV at presentation and all were negative. 7 children were tested for VDRL and all were negative. Those who were tested at follow-up also tested negative. 15 (54%) of 28

TABLE 4

PLACE WHERE ABUSE OCCURRED (N = 38)

Place of abuse	Number of Children
In child's home	4
Around child's home	6
In perpetrator's home	7
Around perpetrator's home	2
In the home which child and perpetrator share	4
Child's other relative's house	3
Other (playing field/coffee garden/riverside)	10
Not mentioned	2

TABLE 5

SITUATION OF CAREGIVERS AT TIME OF ABUSE (N = 31)

Situation of caregivers at time of abuse	Mother Number (%)	Father Number (%)
Unknown	8 (26)	8 (26)
At home	6 (19)	9 (29)
At work	5 (16)	6 (19)
Family activity	8 (26)	4 (13)
Community activity	4 (13)	4 (13)

TABLE 6

RELATIONSHIP BETWEEN SUBJECT AND PERPETRATOR (N = 38)

Perpetrator	Number (%)
Blood relative	13 (34)
Other relative	7 (19)
Acquaintance	16 (42)
Unknown	2 (5)

vaginal swabs were positive for *Neisseria gonorrhoeae*.

18 of the 31 children were followed up at three months (Table 7). Compensation had

already been paid in 3 cases, whilst 10 cases were awaiting compensation payments, 6 of these with police involvement. Only 2 of the perpetrators were in prison, 1 was out on bail, and 1 was yet to be arrested.

TABLE 7

OUTCOME/RESOLUTION AT 3-MONTH FOLLOW-UP (N = 18)

Progress of resolution	Number
Awaiting compensation and police involvement	6
Awaiting compensation and no police involvement	4
Compensation paid	3
Perpetrator in prison awaiting District Court hearing	2
Perpetrator out on bail awaiting court decision	1
Perpetrator yet to be arrested	1
No compensation – not reported to police	1

Discussion

This report is of a relatively small sample of CSA victims, but the number of cases seen in just a 6-month period and the severity of the abuse is greatly concerning. Although distance from Goroka and difficulties with phone communication resulted in less than half of the sample being reviewed at three months post admission we believe that sufficient data were obtained to provide a reliable picture of the situation in the province.

CSA occurs worldwide and affects large numbers of children. The World Health Organization (2004) estimated that 150 million girls and 73 million boys under 18 years of age experienced forced sexual intercourse or other forms of sexual violence during 2002 (6). Prevalence in developing countries is difficult to determine but in Australia the prevalence of CSA is reported to be 4.0-12% for penetrative sexual abuse in female children and 1.4-8.0% for penetrative sexual abuse in male children (7). During the time of our study in Goroka an average of 6 patients were seen each month. It is likely that many cases are not reported.

Girls are at higher risk of CSA than males (male:female ratio of 1:13). Penile penetration of the vagina – child rape – was the commonest form of CSA in our study, occurring in 28 (80%) of the 35 female victims. Child rape has been associated with the highest risk of psychiatric disorder in the future (8). There were 3 male victims. One of them was the subject of both receptive anal and oral sex by an adolescent male. The two others required surgical reduction of painful

severe paraphimosis. It has been suggested that children or adolescents who exhibit inappropriate or excessive sexual behaviour may be reacting to their own victimization or live in environments with stressors, boundary problems or family sexuality or nudity (9). Our study did not investigate the possibility of CSA in the perpetrators.

The majority of the victims in our study lived in rural villages with their biological parents. A study from the United States of America also showed that children who live in rural areas were almost twice as likely to be identified as victims of CSA than those in urban settings but it was not clear if this finding was the result of better coverage of maltreated children in the rural counties or higher rates of maltreatment (10).

Several studies have found that the presence of both parents acts as a buffer against the perpetration of CSA (3) and that not living with both biological parents places a child at high risk of CSA (8,11,12). In the PNG village setting children roam freely believing they are 'at home' and in a safe environment. In our study 36 children (95%) were abused by a relative or acquaintance. A previous study in Port Moresby found that 61% of the victims were abused by a relative or acquaintance (4) and a study from the United States of America found that 70%-90% of child sexual abuse offenders were known to the children (13). At the time of the abuse one or both parents were at or near the home when the abuse took place. This suggests a breakdown in previously strong traditional social and cultural systems. The perpetrator coerced the child in

over half of the cases and appeared confident that the victim would not disclose the abuse to parents or other people.

Illiteracy was common in the parents, particularly the mothers of the abused children. Studies from Zimbabwe (3) and the Pacific region (2) have also reported illiteracy to be common in the mothers of CSA victims. Perhaps mothers who are educated are more aware of the presence of child sexual abuse and therefore more likely to take prevention measures than their illiterate sisters.

15 (54%) of 28 vaginal swabs showed *Neisseria gonorrhoeae*, a finding consistent with other studies (14). All of the infected children received antibiotic treatment against gonococci and chlamydia in accordance with paediatric standard treatment (5), but only 4 of them came for review after three months. Persistent infection puts the child at risk of developing chronic pelvic inflammatory disease, becoming infertile, and having ectopic pregnancies. CSA puts the child at risk of other STIs including HIV (15) and human papillomavirus with the long-term association with cervical cancer. In a recent PNG study women who reported being victims of CSA were at increased risk of being in violent relationships, having a higher number of sexual partners and being HIV positive (16).

The follow-up of the patients provided hard data confirming that compensation is being widely used in resolving issues arising from CSA. 3 families had already been paid compensation by the families of the perpetrators whilst 10 others were involved in compensation negotiations. One case was settled in the form of K1000 cash, one with K2000 cash and 2 cartons of lamb flaps, and the third with K2000, 2 goats and 1 pig.

In our study the subject's family was encouraged to report to the police so that the perpetrator was arrested and justice could be done. Medical reports were not issued unless the matter was reported. However, the common response from the caregivers of the child was "tasol mipela femili yet na wanpela hauslain olsem na mipela bai stretim long ples" (But we are one family and one community so we will sort it out in the village).

Caregivers who do report the abuse initially can use the threat of police involvement to persuade the perpetrator's family to pay

compensation. They are likely to be more concerned about keeping peace in the village than having the perpetrator pay for what he has done by facing the legal justice system. The protection of perpetrators through the payment of compensation can contribute to them re-offending. The offender is never brought to justice when compensation is paid. There is also the unsavoury possibility that compensation payments may be regarded as a form of income for the victim's family rather than as a means of keeping the peace in the community.

The PNG government recognizes the need for children to be protected by law. The Lukautim Pikinini Act (2009) is the main child protection act designed to protect and promote the rights and wellbeing of children (17). Unfortunately it is clear from our study that this act is not serving its purpose. Only 3 perpetrators were arrested and after three months they were still awaiting court decisions.

Amendments to strengthen the Criminal Code and Evidence Act relating to sexual crimes against children were also made in 2003, including the institution of more severe penalties for offenders, but this does not appear to provide a deterrent.

The following case summary illustrates some of the difficulties in dealing with CSA.

Case study

An 11-year-old schoolgirl was repeatedly sexually abused for almost a year by her unemployed biological father, a marijuana smoker. The abuse in the form of sexual intercourse took place in the family home in the afternoons after school while the victim's mother was at work (shop assistant). The father threatened to kill her if she reported this to anyone so due to shame and fear she did not tell anyone of the abuse until one afternoon when she threatened to tell her mother. Her father beat her and she ran to her maternal grandfather's house and disclosed all that her father had been doing. Her two uncles (mother's brothers) were very angry and said they wanted 'the law to handle him'. They reported the matter to the police that same afternoon and the following morning the police went to the village and arrested the father. He was charged and sent to Bihute prison.

Four months after the arrest the father was

still in jail awaiting further court proceedings. The victim's mother was 6 months pregnant with their fifth child. When asked about the progress of the court action, the uncle who had initiated the arrest said that the court had indicated that the father may be sentenced to 15 years in prison. "That is a long time. Now there is another child in my sister's belly, how is she going to care for five children by herself? They have a father. He should come and take care of them. We in the village will gather and discuss this and ask the court to let the children's father go free."

This case scenario not only illustrates the requirements for a robust application of the existing laws, but also the need for Social Welfare Services support for the victims and their families. In PNG at present such support is rudimentary.

Conclusion

There is an urgent need for the establishment of Family Support Centres not only in Goroka but also throughout the country. Centres should be a 'one-stop-shop' where victims of abuse receive holistic care including medical treatment and counselling and where families can receive legal assistance and social support.

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Adolescent health in Papua New Guinea: time for action

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SUMMARY

The health of adolescents in Papua New Guinea requires urgent attention. At stake is the health and wellbeing of a sizeable proportion of a generation. Adolescence is defined by the World Health Organization as occurring between the ages of 10 and 19 years. For many this can be a time of working through issues and progressing their education to become happy, well-rounded adults. But young people without adequate guidance and education are vulnerable to negative influences and risk-taking, and these can have adverse consequences for health and wellbeing in the short and long term. Many adolescents with chronic mental or physical health currently do not get the services they need. This paper briefly outlines disease burdens for adolescents, and the challenges for health and education services.

Background

The health of adolescents in Papua New Guinea (PNG) has to be adequately addressed to reduce future non-communicable disease burden and poverty. The current socioeconomic situation and lifestyle factors faced by adolescents are contributing to the burden of sexual and reproductive health (SRH) problems and mental health problems among young people (1). The current health issues include teenage pregnancies and illegal abortions resulting in a high number of maternal deaths from pregnancy complications, and high rates of sexually transmitted illnesses and HIV (human immunodeficiency virus) risk (2-4). Additionally, alcohol and substance abuse among adolescents (5,6) and the early onset of smoking (7) increase the long-term risk of non-communicable diseases in adulthood, health care costs and early deaths. Alcohol and illicit drug use not only contribute to ill-health but also to crime, violence, accidents and productivity loss, which further increases the level of poverty, a sense of hopelessness and disrupted social cohesion. Furthermore, for adolescents with chronic health conditions, the current management models are inadequate, and transition from paediatric to

adult services is not well done. Adolescence provides an opportunity for the prevention of many life-style diseases in adulthood, and for promoting good health throughout life. For all these reasons optimizing the health and wellbeing of adolescents is important to the future of PNG. Without urgent and effective interventions by responsible government agencies and community organizations, opportunities to address these issues will be missed.

Service coordination

The National Department of Health (NDoH) has an important role in the coordination of efforts by different organizations and government agencies currently addressing aspects of adolescent health in communities in PNG (8). Several non-governmental organizations and churches are addressing adolescent health, mainly SRH and mental health (9-12). The Department of Community Development and its section of the National Youth Commission have developed the National Youth Policy of 2007 to 2017, which also addresses health issues (13) and the NDoH needs to support this. There is also an existing collaboration between the Department of Education and the school health section

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of NDoH in running the health-promoting schools and immunization programs and in teaching health-related topics in schools (14). It has been observed, however, that teachers may not be adequately trained in teaching and addressing important adolescent health issues such as SRH (15). A collaboration of intervention programs and activities targeting adolescents by governmental and non-governmental agencies is essential to reduce duplication of effort and enhance optimum community programs for adolescents.

Community care

At the community level, adolescent health intervention and harm prevention messages have to be sensitive and targeted towards their needs. Adolescents are defined by the World Health Organization (WHO) as those between the ages of 10 and 19 years (16). This is quite a wide range of ages with specific needs for those in the early, middle and late stages of adolescence. This further necessitates the targeting of programs, messages and health services to the stages of development within this age range. The collaboration of efforts from different agencies is required, especially at the community level. However, there has to be appropriate infrastructure in the form of drop-in centres and trained personnel who are receptive to the health and life skill needs of adolescents. Drop-in centres may be incorporated into existing community centres, church-run facilities or school facilities that are easily accessible and affordable. Such adolescent centres should include staff that are trained to deliver a non-judgemental health and life skill service to this vulnerable group of people. A collaborative effort is required to establish such services as well as adequate and continuous financing to ensure sustainability.

Clinical care

There is a lack of appropriate clinical care services for sick adolescents admitted to hospitals and health care centres in PNG. In PNG, those who are less than 13 years of age are being cared for in the paediatric wards by paediatricians whilst those above 16 years of age are cared for by adult physicians in their respective wards. The dilemma of this age cut-off clearly illustrates the gap in hospital clinical care of adolescents. There is currently no hospital in PNG that has an inpatient ward which is

specific for adolescents. Hospitalization to adult or paediatric wards has a major effect on young people as their needs differ from those of adults and children, especially for young people with chronic illnesses (17,18). Those who provide clinical care need to be adequately trained to also be sensitive, non-judgemental and equipped to manage them. Paediatricians, adult physicians and current nurses in paediatric and adult wards may not be able to provide adequate and optimum care for adolescents and may need other colleagues such as obstetricians and gynaecologists, psychiatrists and other mental health and social workers. In other words, a multidisciplinary team is required to provide adequate clinical care for sick adolescents. Having a multidisciplinary approach in clinical care will also contribute to long-term follow-up of chronically ill adolescents allowing for a smooth transition of care from paediatric to adult clinical care (18).

Way forward

The collaboration of efforts from all concerned, including governmental and non-governmental agencies, is essential. The NDoH should play a coordinating role ensuring that efforts are not duplicated but provide for optimum outcomes and equity in adolescent health programs. The NDoH and the Education Department have to provide for proper training of personnel in organizations involved in the dissemination and teaching of harm prevention messages to adolescents and health care service provision. Currently established adolescent health services and programs need to be strengthened and supported to promote collaboration and sustainability. Drop-in centres providing adolescent-friendly services and programs at the community level need to be established in areas of greatest need and supported with resources. The NDoH has an important role in supporting health personnel and school teacher training in the delivery of health care and harm prevention programs for adolescents. Hospitals have to consider establishing adolescent-appropriate clinical care and follow-up, especially for those with chronic illness. The establishment and support for these essential services will contribute to having healthier and more informed adolescents, delayed and fewer pregnancies, healthier babies and smaller families, better management of chronic diseases and reductions in non-communicable adult

diseases. All are very worthwhile aims and consistent with the Sustainable Development Goals.

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Paediatric cancer in Papua New Guinea: moving to the next stage

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SUMMARY

We reviewed the cases of paediatric malignancy at Port Moresby General Hospital (PMGH) over the 18 months between June 2014 and December 2015 and compared diagnoses and outcomes with previously reported data. Children with paediatric cancer account for 0.5-1% of admissions to the PMGH Paediatric Unit and around 0.4% of admissions to provincial hospitals. Efforts to improve outcome have included establishment of linkages with and practical experience at the Children's Cancer Centre of the Royal Children's Hospital in Melbourne. Appropriate modifications of treatment protocols have been introduced and practical supportive care measures established. Potentially curative chemotherapy was started on 26 of the 47 patients in the series, of whom 13 are known to have died. Better outcomes are possible within our setting. We have a paediatrician with considerable and appropriate expertise in paediatric oncology, linked to a centre of excellence in Australia, but we will need a dedicated Paediatric Cancer Unit, separate from the highly infectious paediatric wards and with its own staff. Local community support for such a unit will be required.

Introduction

The last detailed review of paediatric cancer in Papua New Guinea (PNG) was reported in 2004 (1). 64 children were seen at the Port Moresby General Hospital (PMGH) Paediatric Unit over the three and a half years between January 1998 and June 2001. There were equal numbers of children with lymphoma (predominantly Burkitt's lymphoma) and leukaemia and more than half of the leukaemias were classified as acute myelogenous (AML). 20 (31%) of the children presented either at a late stage or with a cancer with a poor prognosis and were not offered curative treatment. Treatment for their child was accepted by 38 families. Five years after the start of the study 24 (63%) were known to have died. Remission induction failed in 16 (67%), relapse followed remission in 3, and 5 died from infection. 2 children were under treatment, 7 were in remission and

the outcome for 5 was unknown. Infection occurred in 75% of the treated children and drug shortages were experienced in 25% of cases.

The report pointed out that whilst there are major difficulties in diagnosis and treatment of children with malignant disease, it is important to be positive – some children with some forms of malignancy (Wilms' tumour, retinoblastoma, Burkitt's lymphoma and L1 (level one) acute lymphoblastic leukaemia) have a relatively good prognosis if diagnosed early and treated appropriately, even in the PNG context. Taking into account the overall poor outcome, the cost of referral and repatriation and the major socioeconomic problems faced by the families of referred children, the authors suggested "a model in which children are treated at their nearest hospital by the provincial paediatrician with the assurance of regular supplies of appropriate drugs and the ready availability of

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advice from a centralized source" (1).

In this article we discuss the developments that have occurred since the 2004 review, the current stage of paediatric cancer services and likely future developments.

Methods

We analysed the data recorded for children with cancer admitted to the Children's Ward at PMGH between June 2014 and December 2015, and drew from data from the annual reports of the Paediatric Unit of PMGH (2,3) and from the National Child Morbidity and Mortality Reports for those years (4).

Results

In 2014 cancer accounted for 0.9% of admissions to the PMGH children's wards. There were 37 cases with 24 deaths in hospital – a case fatality ratio (CFR) of 65%. The overall CFR is not known, since some patients will undoubtedly have died at home. The CFR for the 21 cases admitted in 2013 (0.5% of total admissions) was 57%. The National Childhood Morbidity and Mortality reporting system documented 77 children with malignant disease in 12 provincial hospitals in 2014, 0.4% of the total admissions.

In the 18 months between June 2014 and December 2015 there were 47 cases – around 31 per year. Of these 23/47 (49%) were referred cases. This compares with 18 children per year in the previous study, in which 35% of children were referred from provinces other than the National Capital District (NCD) and Central Province.

A comparison of the diagnoses in the two time periods is shown in Table 1.

49 children were admitted with a provisional diagnosis of paediatric malignancy. One child initially diagnosed as a possible pilocytic tumour with a differential diagnosis of tuberculosis responded very well to TB treatment. At the request of the parents one child diagnosed to have retinoblastoma was referred overseas, where the diagnosis was not confirmed. 47 children had confirmed cancer diagnoses. 28 children received chemotherapy, including 2 who had palliative chemotherapy. The outcome of the four cancers deemed potentially curable in the PNG context is shown in Table 2. Chemotherapy

(and surgery as appropriate) was commenced in 19 of these children, with a known CFR 3 months after the study period of 11/19 (58%). The likely cause of death was febrile neutropenia and sepsis in 4 patients, and severe thrombocytopenia and bleeding in 3. 7 children with other cancers were subsequently commenced on potentially curative chemotherapy, 2 with rhabdomyosarcoma (alveolar and facial), 2 with Hodgkin's lymphoma, 2 with non-Hodgkin's lymphoma and 1 with chronic myeloid leukaemia. Both children with rhabdomyosarcoma died, 1 child with Hodgkin's lymphoma absconded and 4 are continuing treatment. In total, of the 26 children who received potentially curative chemotherapy 13 are known to have died, but it is too early to determine survival rates.

Discussion

Although the relatively small numbers in the series preclude making statements concerning change in patterns of cancer, three trends are of interest. Whilst the overall proportion of leukaemias is similar there is a shift from acute myelogenous leukaemia (AML) towards acute lymphoblastic leukaemia (ALL). Secondly, there is a reduction in the number of lymphomas and in particular the proportion of Burkitt's lymphoma. Thirdly, there appears to be an increase in the number of children with retinoblastoma. Whilst this may be the result of better diagnosis and referral, there are possibly different explanations for the apparent change in the proportions of ALL and Burkitt's tumour. The predominance of AML reported in the first series is consistent with data from a study which included 110 cases of childhood leukaemia diagnosed over two time periods, 1985-1993 and 1997-2001 (5). The predominance of Burkitt's tumour in the earlier series is also consistent with data from the PNG National Tumour and Leukaemia Registries during the period 1998-2004 (6). There are major differences in reported incidences of childhood cancer between different countries and ethnic groups (7,8), the explanations for which are by no means clear. Genetic factors as well as environmental influences are no doubt involved, and there have been suggestions that acute lymphoblastic leukaemia is linked to an unspecified infectious agent against which children living in conditions of poor hygiene are protected by their immunological responses (9). This hypothesis suggests that as socioeconomic conditions improve

TABLE 1

COMPARISON OF DIAGNOSES OF PAEDIATRIC CANCER IN TWO TIME PERIODS

1998-2001 (3.5 years)*		June 2014-December 2015 (1.5 years)	
Male:Female ratio	1.8:1	Male:Female ratio	1.35:1
Age (years): Median (IQR)	5 (3-7)	Age (years): Median (IQR)	5 (3-7)
Leukaemia:		Leukaemia:	
ALL	4	ALL	10
AML	11	AML	5
CML	4	CML	1
Total	19 (30%)	Total	16 (34%)
Retinoblastoma	6 (9%)	Retinoblastoma	8 (17%)
Lymphoma:		Lymphoma:	
Hodgkin's	2	Hodgkin's	2
Non-Hodgkin's	6	Non-Hodgkin's	2
Burkitt's	11	Burkitt's	4
Total	19 (30%)	Total	8 (17%)
CNS tumours	6	CNS tumours	4
Wilms' tumour	5	Wilms' tumour	4
Neuroblastoma	5	Neuroblastoma	3
Rhabdomyosarcoma	2	Rhabdomyosarcoma	2
Sarcoma (Ewing's)	1	Teratoma	1
Phaeochromocytoma	1	Hepatocellular carcinoma	1
Total	64	Total	47

*Reference 1

IQR = interquartile range

ALL = acute lymphoblastic leukaemia

AML = acute myelogenous leukaemia

CML = chronic myelogenous leukaemia

CNS = central nervous system

TABLE 2

TREATMENT AND OUTCOME IN FOUR POTENTIALLY TREATABLE CANCERS

Diagnosis	Number admitted	Number commenced chemotherapy	Died
Acute lymphoblastic leukaemia	10	8	7
Nephroblastoma (Wilms' tumour)	4	4	1
Retinoblastoma	8	5	2
Burkitt's tumour	4	2	1
Total	26	19	11

the incidence of ALL increases. It will be of interest to note if the predominance of ALL in the current series remains over the next few years. In relation to Burkitt's tumour, the reduction in morbidity and mortality from malaria that has occurred in many parts of Papua New Guinea and the close, albeit complex relationship of malaria to endemic Burkitt's tumour (10) may offer a plausible explanation for the possible reduction in the incidence of this tumour.

Whilst paediatric cancer is not in the top five leading causes of admission to Papua New Guinean hospitals it is certainly not a rare condition. The Child Health Policy and Plan 2009-2020 updated in 2015 indicates that adequate resources for the management of paediatric cancer should include the availability of effective chemotherapy and appropriate supportive care for children with the intent to cure and also humane palliation for children with complicated or advanced disease (11). It notes that the barriers to adequate management of paediatric cancers in PNG include:

- Late presentation and delayed diagnosis
- Inadequate diagnostic facilities and manpower
- Unavailability of standardized cancer protocols
- Unavailability of drugs for chemotherapy and for supportive and palliative care
- Inadequate supportive care and facilities
- No central database for cancer surveillance
- Poor social support for patients and their families
- Limited ward space for children needing radiotherapy referral.

Early diagnosis often rests on the ability of parents and health workers to recognize the early signs of malignant disease. Far too often children with retinoblastoma present with a necrotic tumour in the orbit, when the child could have been referred much earlier with an unexplained squint or mild proptosis.

A child with leukaemia may present with several weeks' history of fever unresponsive to antibiotics, or with unexplained fatigue, or atypical anaemia. Our health workers at all levels need to be aware of the possibility of cancer in children presenting with unusual signs or not responding to standard treatments.

PMGH is in the fortunate position of having ultrasound, X-ray and CT (computed tomography) facilities with experienced radiologists to assist in interpretation. Pathology services are stretched by the volume of work, but the employment of more service pathologists and the presence of training registrars can improve the turnaround time for pathology specimens including biopsies and bone marrow aspirates. Telemedicine offers the prospect of rapid diagnosis at provincial hospitals within the foreseeable future.

There has been an increasing interest in the issue of paediatric cancer in developing countries and efforts made to improve outcome (12). It has been shown that twinning arrangements between hospitals in developing and developed countries have the potential for improving childhood cancer survival. Such an arrangement between St Jude's Children's Research Hospital in Memphis, United States of America (USA), and a public hospital in Brazil which included guided treatment protocols together with a private community support group resulted in a marked reduction in treatment abandonment and relapse rates and improvements in event-free survival (12). Such programs of necessity require a local paediatric oncologist to drive not only the medical aspects of therapy but also the support that is required.

The first author spent one year in the Children's Cancer Centre of the Royal Children's Hospital in Melbourne, focusing particularly on aspects of care appropriate to the paediatric cancers which were deemed to be potentially curable if diagnosed early in PNG. Since her return she has been in regular contact with the senior staff in Melbourne discussing patients and protocols, and has instituted appropriate treatment regimens, based on those of the Société Internationale d'Oncologie Pédiatrie (SIOP), through its program for Pediatric Oncology in Developing Countries (PODC). These protocols, less toxic than those used in a western setting, are potentially successful, and we have worked

to improve the supporting systems necessary to ensure compliance and good outcomes at PMGH (13). Protocols adapted with the intent to cure were for ALL, Burkitt's lymphoma, retinoblastoma and Wilms' tumour. These 4 childhood cancers were chosen because the chemotherapy is not as intensive, yet is curative if given at the appropriate time, and all drugs are available. The main adverse events noted with the use of these regimens have been extravasation injuries, thrombophlebitis, sepsis, febrile neutropenia, mucositis, anaemia and thrombocytopenia.

The PNG protocols are available on the Paediatric Society of Papua New Guinea's website (13).

Paediatric cancer services require not only dedicated paediatricians but also dedicated paediatric nurses. In 2007 one of the paediatric nurses from PMGH spent 3 months in the Melbourne Children's Hospital, learning appropriate and safe techniques for the preparation and administration of chemotherapy and the role of the paediatric nurse in the care of children with cancer. She has kept in regular contact with the nurses in Melbourne, and has been able to pass on her knowledge and skills to her colleagues at PMGH. She plays a most important role in the Paediatric Unit.

SIOP has provided a list of what it regards as 18 essential and 8 ancillary drugs for the management of paediatric cancer patients in developing countries (14). Few countries in the developing world have all these drugs on their medical catalogues (15). Of the 26 drugs listed only 10 are currently listed in the PNG Medical Stores Catalogue (16). Treatment of children is often delayed or suboptimal because of unavailability of drugs which are listed and such delays obviously adversely affect outcome (17).

In the Pediatric Oncology in Developing Countries program SIOP has developed guidelines for supportive care of children with cancer in low-income settings (18). SIOP classifies settings as: Level 1 where only the minimal requirements for treatment with curative intent are available; Level 3 as a sophisticated 'Western' paediatric cancer unit with state-of-the-art diagnostic, treatment and supportive facilities; and Level 2 which is in between. PMGH would probably be classed as between Level 1 and Level 2.

The SIOP PODC specific recommendations for practical supportive care for children with cancer – applicable to all settings – are outlined below, with indications of how these recommendations are being implemented at PMGH.

Practical supportive care – specific recommendations

1. Hand washing or disinfectant hand gels are essential to prevent cross-infections. *Widely available alcohol hand wash has been instituted and is becoming part of routine.*
2. Implement nutritional assessment and nutritional support. *There has been some improvement in nutritional support over the last 12 months – but less than ideal.*
3. Ensure availability of oral morphine and use the World Health Organization (WHO) pain ladder. *We often have difficulties in acquiring morphine suspension.*
4. Invest in providing social support (travel money, free board and lodging). *Free hospital care and hospital food are already in place.*
5. Reduce the risk of extravasation of chemotherapy. *Chemotherapy drugs are prepared by a specifically trained paediatric nurse under standard precautions, and given under strict supervision. Of the 26 children who received chemotherapy, 4 (15%) had between 1 and 3 episodes of extravasation.*
6. Formulate and implement a local management plan for febrile neutropenia.
7. Avoid mucositis by not using significantly toxic regimens that cause this. *Highly toxic regimens are avoided.*
8. Children with HIV/AIDS (human immunodeficiency virus/acquired immune deficiency syndrome) and cancer can be treated like other patients. (Expert opinion)
9. Chemotherapy should not be delayed

in children with tuberculosis (TB).
(Expert opinion)

10. Anti-emetics may be needed to reduce vomiting. *Metoclopramide is usually available.*
11. Painful procedures should be performed in a separate room using proper medication. *No local anaesthetic cream is available for IV (intravenous) and LP (lumbar puncture) procedures. Bone marrow procedures are now currently done in theatre under ketamine anaesthesia.*
12. Blood transfusion guidelines must be adapted to local conditions. *There is reasonable access to blood and blood products including platelets.*

Important and locally practical guidelines for prevention of tumour lysis syndrome, for management of pain, nausea and vomiting, hyperleukocytosis and mucositis, for appropriate use of blood and blood products and for palliative care are now all available on the Paediatric Society's website.

A busy general paediatric ward is not the appropriate place in which to look after children with cancer. Nosocomial infections are inevitable and the needs of the affected children are often overlooked in the daily routines of admitting, treating and discharging children with acute infectious disease. As indicated in the Child Health Policy and Plan the number of children with cancer is sufficient to justify the establishment of separate units in the major hospitals, at least in Port Moresby and Lae. These units should be adequately staffed and should be provided with all the basic supportive requirements noted above. There will need to be more paediatric nurses with specialized training in cancer management. Efforts can be made to involve the local community in support for the units in terms of consumables and necessary drugs. Pressure can be applied on the National Department of Health (NDoH) to ensure that the essential drugs are listed in the Medical Stores Catalogue and that they are readily available. Ideally a dedicated social worker should be part of the paediatric cancer team. The Port Moresby unit should be the central data collection point for all paediatric malignant disease in the country so that accurate information of the burden of disease

can be generated. It should also be the coordinating centre for ensuring all hospitals have the appropriate drugs when needed, and should be the advice hub for the management of children with cancer. In addition it should be the focal point for educating the community and ensuring that the health work force is aware of the early presentations of paediatric cancer and the importance of early referral.

With early diagnosis, and treatment that should be available at PMGH carried out in a separate unit with reduced risk of nosocomial infection, we can expect relatively good outcomes for children with Wilms' tumour, Burkitt's tumour and retinoblastoma. Using relatively nontoxic and inexpensive regimens event-free survival rates for children with Burkitt's lymphoma as high as 100% for St Jude's stage 1, 60% for stage 2, 60% for stage 3 and 27% for stage 4 should be possible in SIOP Level 1 settings (19). A recent report from the paediatric cancer unit at the Tanzanian national cancer unit indicates that with staffing and facilities similar to those possible at PMGH an estimated 2-year event-free survival for all children diagnosed with ALL was 33%. The use of L-asparaginase (one of SIOP's essential drugs) in the induction phase was strongly associated with a reduced hazard for a clinical event independent of age, presenting white cell count and year of diagnosis (20). Although ALL is a complex disease, with variations in cell markers, chromosomal rearrangements and prognosis, the Tanzanian results should give us cause for a positive approach to the management of children with ALL.

Conclusion

The country now has a paediatrician with considerable and appropriate expertise in paediatric oncology, linked to a centre of excellence in Australia. Our treatment outcomes are not going to dramatically improve overnight, but with the current leadership, the support of the paediatric community, the hospitals and the local communities and the establishment of a dedicated paediatric cancer unit, outcomes will undoubtedly improve.

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Causes of neonatal admissions and in-hospital mortality at Modilon Hospital, Madang Province: a 5-year retrospective study

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SUMMARY

Approximately half of all childhood mortality in Papua New Guinea (PNG) occurs in the neonatal period – the first 28 days of life. In this 5-year retrospective study, causes of admissions and in-hospital mortality among 2426 neonates admitted to Modilon Hospital's Special Care Nursery in Madang Province were investigated. The neonatal case fatality rate was 15% (370/2426; absolute range between years 12-22%). Neonatal sepsis/infection (1017, 42%), prematurity (821, 34%) and birth asphyxia/meconium aspiration (396, 16%) were the leading causes of admissions (92% of total neonatal admissions) and deaths (96%). Many deaths were potentially avoidable but were often complicated by multiple contributing factors. To reduce neonatal mortality in PNG, health professionals, the government, policy makers and communities must appreciate that improving newborn survival and other neonatal outcomes is a responsibility for all.

Globally, newborn survival has attracted much public health attention in recent years. The Millennium Development Goal 4 (which aims to reduce under-5 childhood mortality by three-quarters from the year 1990 to 2015) has not been reached, in large part because of the slow reduction in neonatal mortality (1). Indeed, newborn deaths account for 40% of all under-5 mortality worldwide, with the majority occurring in low- and middle-income countries (2). In Papua New Guinea (PNG), despite the decreasing trend in under-5 mortality from about 90/1000 live births in the 1990s to 60/1000 in the last decade, neonatal deaths remain high, accounting for approximately 40% of all childhood mortality (3). Despite this, recent PNG data on trends in neonatal admissions and deaths are scarce in the published literature, particularly from provincial hospitals that often serve predominantly rural populations.

situated on the malaria-endemic north coast of PNG and functions as the main referral hospital in Madang Province. Although it has been the site of multiple clinical paediatric studies in recent years, mainly focussing on malaria and other infectious diseases, there has been only one published study on neonatal care, which was conducted more than a decade ago for the period 1995 to 1999 (4). Therefore, as part of ongoing paediatric patient care and clinical research at this setting, we aimed to document causes of admissions and deaths in neonates between January 2009 and December 2013. The present study is a retrospective hospital-based study. Hospital records of neonates admitted to the Special Care Nursery or the Paediatric Ward during the 5-year study period were reviewed. Approval to publish this work was obtained from the management of Modilon Hospital.

Modilon Hospital is a provincial hospital

Between 2009 and 2013, 2426 neonates

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(54% males) were admitted to Modilon Hospital with an overall 5-year in-hospital case fatality rate of 15.3% (370/2426; annual range 12.0% to 21.9%; Table 1). The majority (92%) of admissions were due to sepsis/infections (1017, 42%), prematurity (821, 34%) or birth asphyxia/meconium aspiration (396, 16%) (Table 1). Together, these conditions also accounted for a significant majority of deaths

(96%). 66 neonates (2.7% of the total) had extremely low birthweight (<1000 g), 188 (7.7%) had very low birthweight (1000-1499 g) and 567 (23.4%) had low birthweight (1500-2500 g). Case fatality rates were 86% (57/66), 31% (58/188) and 13% (74/567), respectively; thus low birthweight made up 51% (189/370) of all deaths, either as the main or contributing cause.

TABLE 1

CLINICAL DIAGNOSIS AND CASE FATALITY RATES IN NEONATES ADMITTED TO MODILON HOSPITAL FOR THE PERIOD 2009 TO 2013*

	2009	2010	2011	2012	2013
Total neonatal admissions (N = 2426)	418	375	485	632	516
Neonatal sepsis	95 (22.7)	57 (15.2)	132 (27.2)	268 (42.4)	181 (35.1)
Neonatal pneumonia	19 (4.5)	28 (7.5)	17 (3.5)	33 (5.2)	24 (4.7)
Cord sepsis	3 (0.7)	4 (1.1)	25 (5.2)	4 (0.6)	2 (0.4)
Neonatal meningitis	30 (7.2)	21 (5.6)	25 (5.2)	9 (1.4)	6 (1.2)
Neonatal jaundice	33 (7.9)	17 (4.5)	11 (2.3)	11 (1.7)	7 (1.4)
Birth asphyxia or meconium aspiration	41 (9.8)	57 (15.2)	102 (21.0)	93 (14.7)	103 (20.0)
Congenital heart diseases	3 (0.7)	3 (0.8)	1 (0.2)	0 (0)	2 (0.4)
Neonatal malformations	2 (0.5)	7 (1.9)	10 (2.1)	6 (0.9)	5 (1.0)
Neonatal bowel obstruction	2 (0.5)	1 (0.3)	0 (0)	0 (0)	0 (0)
Neonatal tetanus	0 (0)	1 (0.3)	2 (0.4)	2 (0.3)	1 (0.2)
Anaemia	20 (4.8)	13 (3.5)	18 (3.7)	14 (2.2)	6 (1.2)
HIV infection	0 (0)	1 (0.3)	0 (0)	3 (0.5)	3 (0.6)
Neonatal diarrhoea	0 (0)	1 (0.3)	0 (0)	2 (0.3)	1 (0.2)
Congenital malaria	0 (0)	1 (0.3)	1 (0.2)	3 (0.5)	4 (0.8)
Congenital syphilis	1 (0.2)	1 (0.3)	1 (0.2)	4 (0.6)	1 (0.2)
Extremely low birthweight (<1000 g)	9 (2.2)	15 (4)	20 (4.1)	11 (1.7)	11 (2.1)
Very low birthweight (1000-1499 g)	28 (6.7)	27 (7.2)	40 (8.2)	58 (9.2)	35 (6.8)
Low birthweight (1500-2500 g)	132 (31.6)	120 (32)	80 (16.5)	111 (17.6)	124 (24.0)
Deaths (Case Fatality Rate)	50 (12.0)	82 (21.9)	73 (15.1)	93 (14.7)	72 (14.0)

In some cases more than one diagnosis was present but only the primary diagnosis is presented here

*Data are presented as numbers (%)

HIV = human immunodeficiency virus

The present study shows that neonatal sepsis/infection, prematurity and birth asphyxia/meconium aspiration remain significant causes of admissions and deaths in newborns admitted to the Special Care Nursery of Modilon Hospital with an overall in-hospital case fatality rate of 15%. This suggests no changing trends compared to a previous report from this setting (4). However, despite this situation, there is evidence that the introduction of inexpensive minimal standard of neonatal care in provincial hospitals has the potential to significantly reduce in-hospital mortality (5). Although mortality due to conditions such as birth asphyxia, meconium aspiration and extremely low birthweight may require expensive and sophisticated equipment to keep newborns alive, the majority of neonatal deaths in PNG remain preventable or treatable by basic interventions but are often compounded by other factors, for instance, late presentation to hospital and unsupervised deliveries. These limitations can be a result of many other wider issues such as distance from health care services, neglected health systems, poor quality of early newborn care, poor maternal and family education, low status of women, poverty, and unplanned or unwanted pregnancies. Indeed, at the time of childbirth, when the risk of newborn and maternal mortality are highest, only 50% of PNG mothers have supervised deliveries (3).

Additionally, countrywide coverage of many other basic life-saving interventions that have been shown to reduce avoidable deaths, such as chlorhexidine for cord care, antenatal corticosteroids for premature labour to promote neonatal lung maturation, and injectable antibiotics for newborn sepsis (6), are often unavailable, particularly in rural health care facilities, and many newborns do not receive early essential newborn care (drying, early breastfeeding, prolonged skin-to-skin contact with the mother). This indicates that limited access to an acceptable level of health care services remains one of PNG's major causes of poor neonatal survival.

In conclusion, the majority of neonatal deaths at Modilon Hospital and most probably other similar settings in PNG are avoidable but also dependent on multiple factors in causality and prevention. Neonatal mortality cannot be addressed in isolation, but only with planned parenthood and a range of health service reforms. As part of the 40th anniversary

celebration of the Paediatric Society of PNG, we call on health professionals, the government, policy makers and communities within PNG to appreciate that improving newborn survival is a responsibility for all.

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Trends in maternal and perinatal mortality in a provincial hospital in Papua New Guinea: a 6-year review

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SUMMARY

In recent years, there have been increased efforts to reduce the high maternal mortality ratio (MMR) in Papua New Guinea. This retrospective study conducted at Modilon Hospital in Papua New Guinea documented maternal and perinatal mortality over the 6 years from 2009 to 2014. In-hospital maternal mortality, though still high, significantly declined by over 50% from 24/2598 (924 per 100,000) in 2009 to 12/3217 (373 per 100,000) in 2014 ($p < 0.001$) while stillbirth rates and early neonatal death rates remained unchanged. There is a need for an approach with interventions aimed at reducing both maternal and perinatal mortality. While monitoring and auditing of maternal deaths should be possible throughout the entire country, in settings where there is limited capacity to monitor population-based perinatal and neonatal mortality, an emphasis on improved data quality as part of hospital- and health centre-based surveillance can provide important information.

Introduction

The risk of a woman dying from obstetric complications is estimated to be over 100-fold higher in some developing countries than in developed countries (1). Additionally, adverse pregnancy outcomes leading to perinatal mortality have attracted much public health attention globally. Stillbirths and early neonatal deaths account for nearly half of all infant childhood deaths (2). Papua New Guinea (PNG) has one of the highest maternal mortality ratios (MMRs) with figures as high as 733 deaths per 100,000 live births being previously reported (3). The high MMR is similarly accompanied by high rates of perinatal mortality (4). Consequently, in recent years there have been increased efforts, particularly in the form of training and funding, to prevent these deaths (5).

However, recent evidence suggests that significant discrepancies exist between various PNG mortality estimates, primarily

due to a lack of reliable monitoring systems (3). Furthermore, the heterogeneity in mortality estimates even within the same province is likely to make national estimates unreliable (6). Because of such limitations, most internationally derived estimates of maternal and perinatal mortality, particularly over the past 30 years, have been based on mathematical models that may incorrectly estimate mortality rates depending on the independent variables employed by the model (3).

In PNG, where 85% of the population reside in rural settings with limited access to health care services, there is a need for locally relevant data generated from ongoing health facility surveillances to guide mortality estimates that will in turn inform policy. In light of this, we conducted a six-year hospital-based review, documenting trends in maternal and perinatal mortality in a provincial hospital in PNG.

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Methods

This study was a retrospective review of all pregnancy-related deaths at Modilon Hospital, the only referral hospital in Madang Province. Modilon Hospital serves a predominantly rural provincial population of approximately 450,000. In the present study, the obstetrics and gynaecology death registry was used to identify patients who were admitted to the maternity unit during childbirth between 1 January 2009 and 31 December 2014. The Special Care Nursery registry and Labour Ward admission books were also examined to document perinatal deaths for the same period. Data analysis was performed using STATA version 11.0 (Stata Corp, College Station, USA). The annual MMR was calculated per 100,000 live births while the perinatal mortality rate (early neonatal deaths and stillbirths >24 weeks gestation) was calculated per 1000 births. This study was approved by the Modilon Hospital Ethics Committee (MHEC 15.03) and the management of Modilon Hospital.

Results

During the study period, 16,624 pregnant

women delivered 17,427 babies at Modilon Hospital with a multiple pregnancy rate of 4.8%. Their median age was 25 (interquartile range 22-30) years and the majority of women (74%) were rural residents. Maternal mortality significantly declined over the 6-year study period: 24/2598 (924 per 100,000) in 2009 versus 12/3217 (373 per 100,000) in 2014; Fisher's Exact test $p < 0.001$ (Table 1). As previously reported (7), post-partum haemorrhage and septicaemia remained leading causes of death, accounting for 47% (37/78) of all maternal deaths. The overall institutional MMR for the 6-year period was 78/16915: 461 deaths per 100,000 live births.

Perinatal deaths varied between 33 and 56 deaths per 1000 births over the study period (Table 1). Of the 756 perinatal deaths, 32% (244/756) were early neonatal deaths. The majority of the 512 stillbirths were macerated (62%; 317/512). A significant majority of perinatal deaths occurred in babies of unbooked mothers (79 per 1000 births versus 25 per 1000 births; $p < 0.001$).

Discussion

The findings from the present study show

TABLE 1

MATERNAL AND PERINATAL OUTCOMES IN WOMEN WHO DELIVERED AT MODILON HOSPITAL BETWEEN 2009 AND 2014

	2009	2010	2011	2012	2013	2014
Total number of deliveries	2689	2767	2857	2947	2858	3309
Live births	2598	2662	2754	2885	2799	3217
Total perinatal deaths	132	154	145	97	95	133
Perinatal mortality rate per 1000 births	49	56	51	33	33	40
Stillbirths	91	105	103	62	59	92
Stillbirth rate per 1000 births	34	38	36	21	21	28
Early neonatal deaths (ENND)	41	49	42	35	36	41
ENND rate per 1000 live births	16	18	15	12	13	13
Total maternal deaths	24	20	8	6	8	12
Institutional MMR per 100 000 live births	924	751	290	208	286	373

MMR = maternal mortality ratio

a decline in MMR at Modilon Hospital. The overall institutional MMR was 461 deaths per 100,000 live births, but this declined during the 6-year period, and in the second half of the reported observational period was less than 400/100,000 live births. We had previously reported a ratio of 588 deaths per 100,000 live births for the period 2008 to 2012, which overlaps with the currently reported period (7). The most probable reason for this reduction in institutional MMR is the presence of personnel. Modilon Hospital did not have a specialist obstetrician for the periods 2008 to 2010. The arrival of an obstetrician in 2011 provided the leadership, direction and ongoing professional development for all cadres of health workers in the obstetrics unit. This further attracted registrars and residents, subsequently leading to a significant improvement in patient care.

Despite this, perinatal mortality remains a major challenge. The factors that contribute to the high rates of perinatal mortality at Modilon Hospital are multifactorial and can be classified as pre-hospital and in-hospital. Pre-hospital factors include geographic remoteness of villages, logistics and infrastructure difficulties preventing easy access to health care, as well as factors such as illiteracy, traditional beliefs and poverty that can delay presentation for both the mother and her baby. Consequently, there is a high rate of fetal death in utero, or babies are often born before arrival, and/or the mother may present with prolonged labour, at which time the focus of the obstetric team is on saving the life of the mother.

In-hospital factors include poor turnaround time for emergency caesarean sections from the time of decision to incision, limited vital support services such as laboratory and blood bank as well as logistic challenges such as the difficulties of assembling the nursing team, anaesthetic team, laboratory team and the obstetric team, particularly during after-hours emergencies. Furthermore, the low number of midwives to match high patient numbers with deliveries exceeding an average of 3000 per year remains a profound challenge for a small provincial hospital such as Modilon. Additionally, throughout Madang Province, there is a great need to improve on the proportion and quality of supervised deliveries as well as appropriate newborn care.

In conclusion, this study highlights that perinatal survival remains a major challenge at Modilon Hospital. Access to an acceptable

level of health care services necessary for both maternal and newborn survival needs to be improved and sustained. The present study also shows that in settings where there is limited vital registration of births and deaths, and a lack of monitoring capacity, data collected as part of hospital-based surveillance can provide a useful measure of mortality to inform wider health policy and planning.

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The prevalence of chronic suppurative otitis media in children in Port Moresby public clinics

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SUMMARY

This prospective descriptive study aimed to determine the prevalence of chronic suppurative otitis media (CSOM) in children presenting to 5 urban clinics and the Children's Outpatient Department of the Port Moresby General Hospital. 395 children between the ages of 6 months and 12 years were included. 70 (18%) had some form of ear disease. Of the 28 children with CSOM (7%), 18 had unilateral and 10 had bilateral ear pathology. Only 8 of these children presented because of discharging ears. An additional 4 children had dry perforation, 1 had cholesteatoma and 2 had mastoiditis. The high prevalence of CSOM indicates that it is an issue of major public health importance. Risk factors for the development of CSOM were common in the children assessed. Prompt recognition of the problem and management by way of thorough and regular ear wicking should be stressed. Consideration should be given to making ciprofloxacin ear drops available. All clinics should have a functioning auriscope and front-line health workers should be trained to be able to diagnose and treat CSOM. Communities need education about the importance of early diagnosis and management of CSOM.

Introduction

Chronic suppurative otitis media (CSOM), classified as a neglected tropical disease, is defined by the World Health Organization (WHO) as a chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges (or otorrhoea) through a tympanic perforation lasting for 2 weeks or more (1,2). CSOM may affect as many as 31 million people, the majority in the developing world. It usually begins in childhood as a complication of acute otitis media (AOM) or otitis media with effusion (OME), with the highest incidence in the 1-4 year age group (2,3). Countries and ethnic groups are rated based on their prevalence of CSOM ranging from lowest (<1%) to highest (>4%). The highest prevalence rates indicate a very important public health problem requiring urgent attention. Countries and groups with the highest prevalence include Tanzania, India, Solomon Islands,

Guam, Indigenous Australians, Greenland and Indonesia (1,4). Indigenous Australians have the highest prevalence of perforation (reports ranged from 15% to 28-43%) among all the populations surveyed (1,4). In high-prevalence populations such as Indigenous Australian communities, early intense carriage of pneumococcus and non-typeable *Haemophilus influenzae* (NTHi), similar to the situation in Papua New Guinea (PNG), is a risk factor for otitis media (OM), and disease starts very soon after birth (5,6). Leach and colleagues reported in 1999 that by 2 years of age most Australian Indigenous children would have had 3 episodes of OM and early onset of AOM is a recognized risk factor for CSOM (7-9). The sequelae of CSOM can be serious and include death from intracranial extension of infection. It is a significant cause of deafness – and in many communities it is the major cause of hearing loss with impaired language development, poor school performance and low quality of life. In a study

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from Greenland, 91% of children with CSOM developed a permanent hearing loss (8).

Relatively little is known about CSOM in PNG. In an editorial in the PNG Medical Journal of 1981 Smith reported that OM was common in the Asaro Valley in the Eastern Highlands Province of PNG and that almost 25% of community school children from rural communities had evidence of eardrum pathology (10). Bunker reported hearing loss in 6% of students in their first year at four Eastern Highlands high schools (11). Hearing loss was present in 18% of attendees at the Port Moresby General Hospital Ear Nose and Throat (ENT) Clinic in the late 1980s and early 1990s and OM was the most common identified cause (12). The introduction of measles vaccine may have reduced the prevalence of OM – but there is no evidence to confirm this. In a recent neonatal pneumococcal conjugate vaccine trial in the Asaro Valley 49 (16%) of the 312 participants had a purulent ear discharge at some stage during follow-up to age 18 months (D. Lehmann, personal communication).

We present the first study of CSOM in Port Moresby and the surrounding area. The primary aim was to determine the prevalence of CSOM in children aged 6 months to 12 years presenting to the Children's Outpatient Department (COPD) at Port Moresby General Hospital and 5 other urban clinics in the National Capital District (NCD). Subsidiary aims were to observe the prevalence of known risk factors for CSOM in the study population and the presence of other types of ear disease.

Methods

This study was conducted between May and August 2014 at 5 public clinics in the NCD and the COPD at Port Moresby General Hospital. Every third child between 6 months and 12 years of age presenting for any reason, and a small number of accompanying siblings, were recruited in the triage area by the first author. Information about the study was given to the caregiver and, following verbal consent, demographic information was obtained and recorded on a pre-tested questionnaire. This included the availability of in-house toilet facilities, the level of mother's education, father's employment status and regular exposure to passive smoking in the home. Information relating to any ear discharge

was also obtained and a thorough auroscopic examination of both ears performed by VS and details recorded. Where examination of the ear was difficult due to purulent pus discharge, syringing of the ears with sterile water was done to properly view the tympanic membrane. No attempt was made to clear wax obstructing the tympanic membrane. The use of antibiotics within the previous month was also recorded.

CSOM was strictly defined as chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharge (or otorrhoea) through a tympanic perforation lasting for 2 weeks or more. We included dry perforation, cholesteatoma and mastoiditis in a broader definition. We used the definitions of other middle ear diseases described in the recommendations for clinical care guidelines in Aboriginal and Torres Strait Islander populations of 2010 (13). In particular, AOM is defined as presence of fluid behind the eardrum and one of the following: bulging eardrum, red eardrum, recent discharge of pus, fever, ear pain or irritability, and OME (glue ear) as presence of fluid behind the eardrum without any acute symptoms, which may be episodic or persistent.

All children recruited in the study with other co-morbidities were managed according to their clinical presentations as per the guidelines in the PNG Standard Treatment for Common Illnesses of Children, 2011 edition (14).

For those diagnosed with CSOM, advice of daily ear wicking and prescription for 2 weeks of treatment with ciprofloxacin ear drops was given, along with arrangements for follow-up. Children with large perforations were referred to the ENT surgeons for follow-up and treatment.

SPSS Statistical software package (Version 20) and OpenEpi were used to analyse the data. Results are summarized as frequencies and percentages. Groups are compared using the Chi-squared test.

Ethical clearance for the study was obtained from the School of Medicine and Health Sciences Research Committee.

Results

200 children from COPD and 200 from

urban clinics were recruited – 234 males and 166 females. No parents refused to take part. One child presented on two occasions and data from the second presentation were excluded. The median age (interquartile range [IQR]) of the study children was 3 years (1-6 years). Auriscopic examination of 5 children was not possible because of poor cooperation.

Figure 1 illustrates the study outline. Details of the auriscopic findings in both ears of the 395 patients examined are shown in Table 1. 28 children were identified with CSOM of whom 18 had unilateral and 10 had bilateral ear pathology. There were 4 children with dry perforations, 1 with possible cholesteatoma

and 2 with mastoiditis subsequently confirmed following admission to hospital and managed with surgery and intravenous antibiotics. Assuming that the children whose tympanic membranes were not visualized because of wax did not have CSOM, the prevalence of CSOM among this study sample was 7% but when dry perforation, cholesteatoma and mastoiditis were included the prevalence was 9%. The prevalence when children in whom both tympanic membranes were obscured by wax were excluded was 10% and 13% when dry perforation, cholesteatoma and mastoiditis were included.

The mean age of the 28 children with CSOM was 3.0 years and was 3.6 years for the group

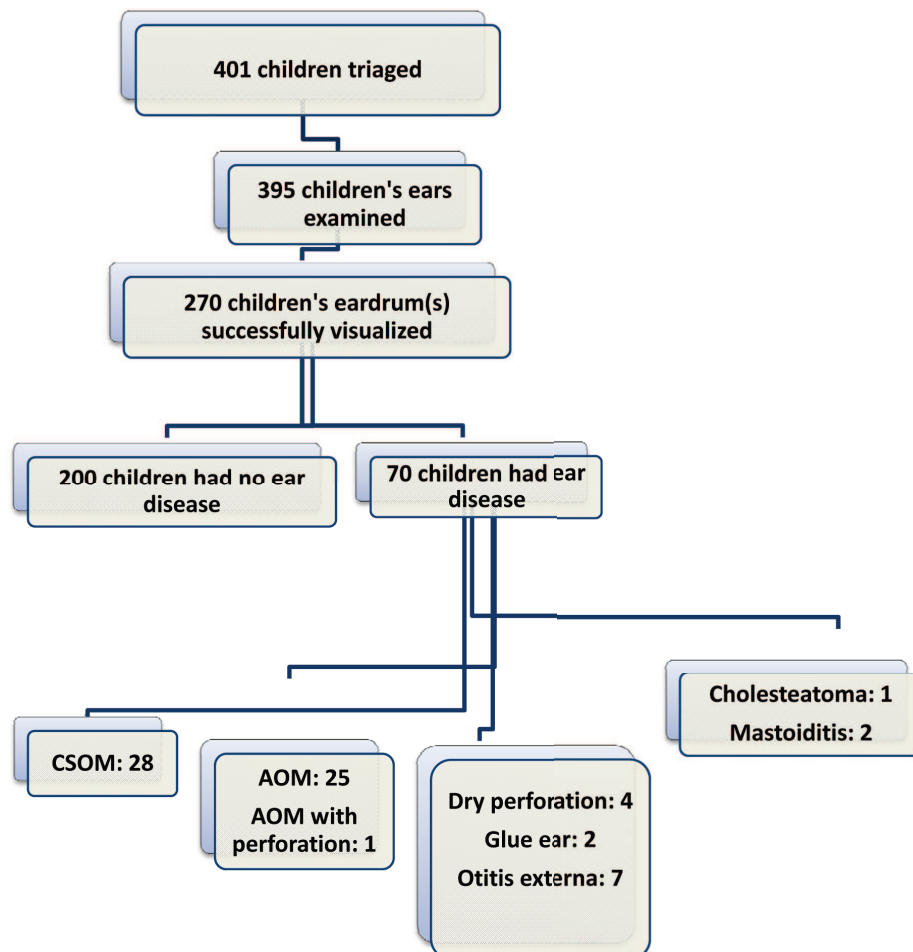


Figure 1. Outline of the study.
CSOM = chronic suppurative otitis media
AOM = acute otitis media

TABLE 1

RESULTS OF AURISCOPIC EXAMINATION OF 395 CHILDREN*

Findings	Children (N = 395) Number (%)
No ear pathology, normal	200 (50.6)
Wax obstructing both tympanic membranes	122 (30.9)
Otitis externa	7 (1.8)
AOM	25 (6.3)
AOM with perforation	1 (0.3)
Dry perforation	4 (1.0)
CSOM	28 (7.1)
Cholesteatoma	1 (0.3)
Mastoiditis	2 (0.5)
Foreign body	3 (0.8)
Glue ear	2 (0.5)

*Where both ears were adequately examined the diagnosis for the ear with the more severe disease is recorded here

AOM = otitis media

CSOM = chronic suppurative otitis media

including dry perforation, cholesteatoma and mastoiditis.

Table 2 indicates the diagnoses post triage. 13 of the children were well siblings of children who were brought to the clinic. 70 (18%) were diagnosed with some form of ear disease. 35 children presented with ear problems or swelling behind the ears; only 8 (2%) presented because of discharging ears.

21 (75%) of the 28 children with CSOM had co-morbidities, which are shown in Figure 2. There was a measles outbreak in the city at the time of the study.

Table 3 shows sociodemographic and recognized risk factors for CSOM for the whole study group, for those with CSOM (including dry perforation, cholesteatoma and mastoiditis) and for the children with normal ears, with a comparison between the latter two subgroups. Sex distribution, toilet facilities, mothers' education level, fathers' employment status and exposure to tobacco smoke were similar in the two groups, while exposure to antibiotics in the preceding month was more common in the CSOM group.

Discussion

The study was done at 6 different locations providing a spectrum of the communities served by the public health system in the city. The study found a prevalence of CSOM of 7% or 9% with the inclusion of dry perforation, cholesteatoma and mastoiditis. The exclusion of children whose tympanic membranes were obscured by wax raised the prevalence to 10% and 13%. This study was clinic based and does not necessarily reflect the population prevalence in the wider community. Nevertheless it has shown that the prevalence of CSOM in children living in Port Moresby and accessing the public health services is likely to be well above the 4% regarded by WHO as being of serious public health importance and requiring urgent attention.

The aetiology of CSOM is multifactorial and high prevalence rates of CSOM are associated with well-recognized risk factors such as early onset of OM, poor socioeconomic status and exposure to tobacco smoke (9,15-17). Although not designed to determine the role of risk factors in CSOM our study showed

TABLE 2

DIAGNOSIS POST TRIAGE

Presenting disease	Frequency
Simple cough	47
Pneumonia	36
Tuberculosis	25
Other respiratory	8
Clinical measles	21
Gastroenteritis	44
Febrile illness	31
Skin infections	22
Abscess/ulcers	16
Fractures/trauma related	9
Urinary tract infection	6
Clinical typhoid	3
Seizures	6
Lymphadenitis	7
Urogenital issues	5
Clinical malaria	2
Joint problems	5
Acute flaccid paralysis	1
Leprosy	1
Malnutrition	1
Eye disease	2
Thalassaemia	2
Abdominal swelling	3
Others miscellaneous	5
Missed information on the form	9
Siblings accompanying	13
Total	330
Ear disease	70* (18%)
Total study sample	400

*35 children presented with ear problems or swelling behind the ears; only 8 of the 28 patients with CSOM presented with discharging ears

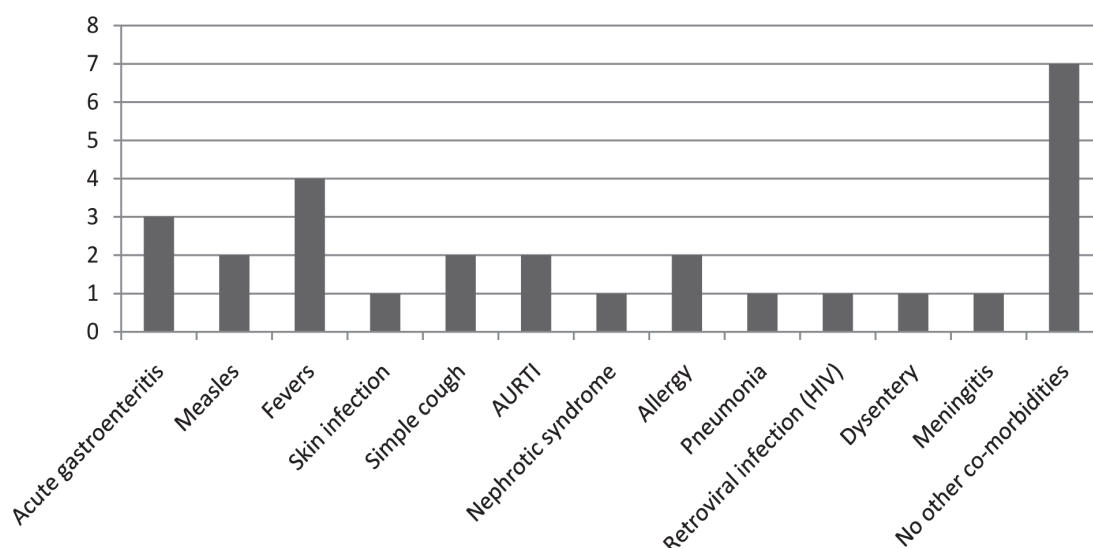


Figure 2. Number of co-morbidities in children with chronic suppurative otitis media.
 AURI = acute upper respiratory tract infection
 HIV = human immunodeficiency virus

TABLE 3

SOCIODEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

	Total study group of 400 Number (%)	CSOM group of 35* Number (%)	Normal ear group of 200 Number (%)	p value
Males	234 (59)	23 (66)	109 (55)	0.23
Pit latrine	218 (55)	23 (66)	117 (59)	0.42
Mothers education: Secondary or higher	58 (15)	6 (17)	37 (19)	0.85
Father unemployed	84 (21)	11 (31)	43 (22)	0.24
Exposure to smoking	273 (68)	22 (63)	143 (72)	0.26
Antibiotic use in preceding month	106 (27)	19 (54)	40 (20)	<0.001

* Includes children with dry perforation, cholesteatoma and mastoiditis
 CSOM = chronic suppurative otitis media

that a high proportion of the children seen at the clinic – and presumably representative of the surrounding communities – live in environments which place them at high risk for developing CSOM. More than 50% of the children lived in houses with pit toilets (and almost certainly poor hygiene), and only 15% of the mothers were educated above primary school level. Almost 70% of children were exposed to passive smoking. The risk of OM in Aboriginal children exposed to environmental tobacco smoke was more than 3 times that in non-exposed children (17) and it is very likely that this is a contributing factor in PNG children. A recent study from the Australian Northern Territory found that the presence of additional children in the household (the norm for most PNG communities) was also a risk factor for OM (18). Perhaps not surprisingly previous antibiotic use in the previous month was much more common in the children with CSOM than in those with normal ears.

Although ear disease (including CSOM) accounted for 18% of the post triage diagnoses, only 8 (2%) presented to the clinics because of a discharging ear or ears. It was apparent that many parents think that a discharging ear is a normal part of growing up which does not warrant medical attention and they may be unaware of the potential sequelae. Early diagnosis and management of CSOM is imperative to improve outcome. This requires front-line health workers who are aware of the problem and who have the means of adequate examination (a working auriscope). In the absence of an auriscope, health workers should ask guardians about ear discharge and should examine the outer ear to check for pus – which would almost always be due to middle ear disease. They should understand the importance of clearing the ear secretions (by earwicking with tissue paper or syringing) and suitable ear drops should be available. Regrettably at the time of this study, none of the urban clinics had functioning auroscopes, and ear drops were not available. The management of CSOM is time consuming and prescription of oral antibiotics is not the answer. In the first place it requires careful and thorough ear cleaning with tissue paper spears or gentle syringing and – most importantly – caregivers need training and encouragement to continue this process until the ear is dry and whenever there is any further discharge, and to take preventive measures where possible. The role of topical antibiotic eardrops in assisting in achieving ear dryness

is clear. Topical ciprofloxacin is currently the antibiotic of choice for CSOM in Australian Aboriginal children (19) and is better than antiseptic (boric acid in alcohol) (20). The addition of oral antibiotic has not been shown to offer any long-term advantage (21-24) and indeed evidence of long-term benefits of the standard ciprofloxacin topical treatment is lacking. Having noted that ciprofloxacin is the topical antibiotic of choice, it should be pointed out that it is not on the current PNG Medical Stores catalogue, and is prohibitively expensive for most people at the lower end of the socioeconomic scale. This makes it even more important that health workers and carers follow the Paediatric Standard Treatment Guidelines which recommend ear cleaning with tissue paper and the application of boric acid in alcohol ear drops. Undoubtedly many cases of CSOM are undetected leading to morbidity and in some cases potentially avoidable mortality. There are no published data from community studies of hearing loss in PNG children. In retrospective reviews of complications of CSOM in Port Moresby between 1993 and 2007 Dubey and colleagues reported serious extracranial and intracranial pathology. These included mastoid abscess, post-auricular fistula, facial palsy, and 32 cases of CSOM with intracranial pathology including meningitis, lateral sinus thrombosis, and cerebellar, epidural and perisinus abscesses. The case fatality rate in the patients with intracranial pathology was 31.2% (25,26).

This study excluded children less than 6 months of age. Future research could well focus on this group to elucidate the prevalence – which is likely to be high – and characteristics of CSOM/AOM in this age group.

5% of the world's population, including 32 million children, suffer from deafness (27). CSOM is a particular burden in poor socioeconomic conditions and in turn helps to perpetuate low socioeconomic status as a result of poor education. Our study has found a high prevalence of CSOM in the community, poor understanding of the importance of ear disease, limited knowledge of ear disease among health workers, inadequate facilities for the diagnosis of ear disease and limited treatment options for treatment of CSOM. Whilst the reduction in incidence of AOM and CSOM is likely to be a slow process involving improved socioeconomic and educational status and public health interventions such

as improved sanitation and high vaccination coverage, there are interventions that can be done in the short term to reduce the long-term morbidity and mortality. We need to focus on the training of our health workers in ear diseases, and to ensure that the facilities for diagnosis and adequate treatment are always available.

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The Binax NOW *Streptococcus pneumoniae* test for the diagnosis of pneumococcal meningitis in children

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SUMMARY

BACKGROUND: Identifying the causes of childhood meningitis is difficult. Conventional diagnostic tests (culture, bacterial latex and Gram staining) have limitations, especially in settings where many children receive antibiotics prior to presentation. A point-of-care test called Binax NOW detects meningitis due to *Streptococcus pneumoniae* in 15 minutes and is not affected by pre-test antibiotic use. **METHODS:** A prospective study was conducted among children with suspected bacterial meningitis at Angau Memorial General Hospital to evaluate the usefulness of the Binax NOW *S. pneumoniae* test in comparison with conventional tests: cerebrospinal fluid (CSF) bacterial culture, Gram stain and latex agglutination. Latex antigen testing was done for *S. pneumoniae*, *Haemophilus influenzae* and *Neisseria meningitidis*. We analysed the CSF of all children who had a lumbar puncture done for clinical suspicion of meningitis. **FINDINGS:** 132 children were enrolled in the study, of which 3 were excluded because of insufficient CSF sample to do the Binax NOW test. 5 CSFs were culture positive, all for *S. pneumoniae*. 13 (10%) of 129 CSF specimens had organisms seen with Gram staining; 7 had Gram-positive cocci and 6 showed Gram-negative bacteria. Latex antigens were positive in 20 cases: for *S. pneumoniae* (11), *H. influenzae* (8), *N. meningitidis* (1). Using the 3 conventional tests combined (culture, Gram stain and antigens) 14 cases of *S. pneumoniae* meningitis were detected. Binax NOW was positive for *S. pneumoniae* in 19 cases (15% of meningitis cases); the 14 samples positive by conventional methods and a further 5 cases that were not detected by conventional methods. **CONCLUSION:** The Binax NOW test increases the diagnostic yield for pneumococcal meningitis on CSF. This may be important in surveillance for the effectiveness of pneumococcal conjugate vaccine introduced in Papua New Guinea (PNG) in 2014, and in clinical diagnosis. *H. influenzae* is rarely identified on culture in PNG provincial hospital laboratories, so latex antigen testing is still needed for the accurate diagnosis of *Haemophilus meningitis* and monitoring of the effectiveness of *Haemophilus influenzae* type b vaccine.

Introduction

Meningitis is one of the common causes of childhood morbidity and mortality. Childhood meningitis is caused by both bacteria and viruses. The predominant causes of bacterial meningitis in children more than 2 months

of age are *Streptococcus pneumoniae*, *Haemophilus influenzae* type b (Hib) and *Neisseria meningitidis*. *Streptococcus pneumoniae* is a major pathogen in children that also causes pneumonia, septicaemia and otitis media. In 2005 it was estimated that *S. pneumoniae* causes 11% of all deaths in

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children aged 1-59 months, with most of these deaths occurring in developing countries (1).

In Papua New Guinea (PNG), meningitis is in the top ten causes of childhood morbidity and mortality and has a case fatality rate of about 18% (2-6). At least 15% of those who survive have moderate or severe neurological sequelae (7), and outcomes are worse for children in rural areas (8). Mortality rates for meningitis have remained largely unchanged for nearly 50 years (9,10). In the 1980s to 2000s, *Streptococcus pneumoniae* caused 36%-43% of cases of bacterial meningitis (11,12), and pneumococcal meningitis was associated with the highest rates of brain injury among survivors.

Pneumococcal meningitis can now be prevented with the pneumococcal conjugate vaccine (PCV) (13-15). The PNG Department of Health introduced this vaccine in 2014 with assistance from the Global Alliance for Vaccines and Immunization (GAVI) (16). The effect of the introduction of this vaccine on meningitis needs monitoring. This requires accurate aetiological tests for meningitis that are appropriate for developing countries. A point-of-care test would also help clinical decision-making for children with bacterial meningitis.

The laboratory methods of diagnosing bacterial meningitis include cerebrospinal fluid (CSF) culture, Gram staining and bacterial antigen agglutination tests (17,18). These conventional diagnostic methods have limitations. Bacterial culture is traditionally the gold standard for identification of organisms in CSF. However, empiric treatment before culture means that culture is often negative even when *S. pneumoniae* (or other bacteria) is the cause of the meningitis, and many hospitals in PNG do not have culture facilities. Gram stain may also fail to detect bacteria, with a lower sensitivity in patients who have already been given antimicrobial therapy (17). Bacterial antigen testing in CSF provides a useful adjunct to culture-based diagnosis. It also allows aetiological diagnosis in patients who have received empirical treatment. However, latex antigen testing has limitations: the test kits are expensive (19) and have a relatively short shelf-life, particularly in tropical climates.

Polymerase chain reaction (PCR) techniques which detect the *LytA* gene of

S. pneumoniae in CSF are sensitive for pneumococcal meningitis (19,20). However, they require advanced facilities and expertise, and are not available in many countries.

An immune chromatographic (ICT) membrane assay has been developed, the Binax NOW *Streptococcus pneumoniae* Urinary Antigen Test (BINAX, Portland, ME, USA) (21). This is an in vitro rapid test which detects antigens associated with the C-polysaccharide component of the cell wall, which is common to all strains of *S. pneumoniae*. The test is simple to perform and provides results within 15 minutes. It was approved by the US Food and Drug Administration (FDA) in 1999 for the diagnosis of pneumococcal pneumonia using urine samples. It has since been approved for use with CSF samples for suspected meningitis patients.

Following the introduction of pneumococcal vaccine there would be value in a test that is fast, accurate and not influenced by the use of antibiotics to improve the diagnosis of pneumococcal meningitis and surveillance of the effect of pneumococcal vaccine. We evaluated the diagnostic yield of the Binax NOW ICT among children with meningitis at Angau Memorial General Hospital, in comparison with bacterial culture, Gram stain and latex agglutination tests.

Methodology

A prospective study was conducted in Angau Memorial General Hospital from October 2012 to January 2014. The study population was children with a clinical suspicion of acute bacterial meningitis who had a lumbar puncture. Suspected bacterial meningitis was defined as history of fever, convulsions, poor feeding, irritability, vomiting and headache. On examination: fever (temperature $\geq 37.5^{\circ}\text{C}$) and at least one of the following meningeal signs: altered level of consciousness, starry eyes, bulging fontanelle in infants, neck stiffness; poor feeding, irritability; lethargy; petechial or purpuric rash.

Verbal consent for inclusion in the study was obtained from all parents of participating children prior to lumbar puncture.

Laboratory procedures

Cerebrospinal fluid was collected from all

study subjects using normal sterile technique. Children aged more than 18 months had a fundoscopy done to exclude papilloedema before lumbar puncture was performed. The specimens were sent to the microbiology laboratory for microscopy, Gram stain, bacterial culture and latex agglutination.

The Binax NOW ICT was performed on all CSF specimens that had any white cells seen on microscopy. The test consists of a hinged device in which rabbit anti-pneumococcal antibody is adsorbed on to a nitrocellulose membrane (the sample line) and goat anti-rabbit IgG is adsorbed on to the same membrane as a second stripe (the control line). A second set of rabbit anti-pneumococcal antibodies are conjugated to gold particles dried on to an inert fibrous support. A swab is dipped into the CSF sample and inserted into the test device; a citrate buffer is added to facilitate antigen flow and closes the device. In the absence of pneumococcal antigens, the antibodies conjugate in excess and are captured by immobilized goat anti-rabbit IgG forming the control line. If, however, pneumococcal antigen is present in the specimen, it binds to the gold-conjugated rabbit antibodies and the resulting antigen-antibody conjugated complex is captured by the immobilized rabbit IgG stripe (anti-*S. pneumoniae* antibodies) forming the sample line. Results are read visually after 15 minutes, with the appearance of the control line only signifying a negative test and the appearance of both the control and sample lines a positive test.

Data collection and analyses

Data were collected using a questionnaire, entered into a spread sheet and analysed using SPSS program version 20.0. Using two by two tables, the proportion of CSF specimens positive for *S. pneumoniae* by the Binax NOW test was compared individually with bacterial culture, Gram stain and latex antigen. The Binax NOW test was also compared with all three conventional tests combined to identify the additional yield of *S. pneumoniae* over the optimum currently available tests.

The study was approved by the hospital through the office of Director, Medical Services and ethical clearance was given by the Medical Research Committee of the School of Medicine and Health Sciences, University of PNG. Funding for the Binax

NOW ICT kits was provided by the World Health Organization.

Results

This study was conducted from October 2012 to January 2014. 132 children were eligible based on the clinical criteria. In 3 cases no Binax NOW test was done due to insufficient CSF samples, so 129 cases were included in the analysis. 91 (69%) of the cases were males and 41 (31%) were females. The median age was 6 months; 7 (5%) were older than 5 years.

By conventional methods, an organism was identified from 27 CSF specimens. Of the organisms identified by the three currently available tests, 14 patients had pneumococcal meningitis confirmed by CSF latex agglutination, CSF Gram staining or CSF culture; 8 patients were positive for Hib; 1 patient was positive for *N. meningitidis* from latex agglutination only; and 4 patients had Gram-negative organisms seen but no bacteria detected from latex agglutination or culture.

When the Binax NOW test was included, an organism was identified in 25% of patients (32 of 129 patients). The Binax NOW test identified all 14 patients who had pneumococcal meningitis that were diagnosed using the three conventional methods. Binax NOW also detected an additional 5 patients with *S. pneumoniae* which would have been missed by the three conventional tests (Table 1).

84 cases (65% of the study population) had latex agglutination testing done. The remaining cases had no latex agglutination test done due to non-availability of reagents at the time of presentation. 20 (24%) of those tested had a positive latex agglutination test. The latex agglutination test positive results were: 11 (55%) were positive for *S. pneumoniae*; 8 (40%) were positive for Hib; and 1 (5%) was positive for *N. meningitidis* (Table 1).

CSF culture was positive in 5 of 129 patients (4%); all 5 were *S. pneumoniae*. The Hib cases that were identified by latex bacterial antigen testing were not grown on culture.

13 (10%) of 129 CSF specimens had organisms seen with Gram staining. Of

TABLE 1

SUMMARY OF CSF RESULTS AND FINDINGS

Tests	Number of CSF specimens tested	Number and type of organisms identified
Binax NOW	129	n = 19 (15%) All <i>Streptococcus pneumoniae</i>
Culture	129	n = 5 (4%) All <i>S. pneumoniae</i>
Gram stain	129	n = 13 (10%) 7 = Gram positives 6 = Gram negatives
Latex agglutination	84	n = 20 (24%) 11 = <i>S. pneumoniae</i> 8 = <i>Haemophilus influenzae</i> type b (Hib) 1 = <i>Neisseria meningitidis</i>

CSF = cerebrospinal fluid

the 13, 7 had Gram-positive cocci while 6 showed Gram-negative bacteria. While the Gram stain results do not clearly distinguish between types of Gram-positive pathogens, all the CSF specimens which showed Gram-positive cocci were positive for *S. pneumoniae* with the Binax NOW test.

Of the 129 CSF specimens tested with Binax NOW, 19 (15%) were positive. Tables 2-5 show the diagnostic yield of Binax NOW with the three conventional tests individually and then the three tests combined.

The Binax NOW test was able to identify all the positive *S. pneumoniae* meningitis cases that were identified by latex agglutination. In addition, it identified an extra 4 cases of *S. pneumoniae* meningitis which latex agglutination missed (Table 2).

Gram staining identified 7 Gram-positive organisms. Binax NOW identified all 7 to be positive for *S. pneumoniae*. In addition, the Binax NOW test was able to identify an extra 12 cases of meningitis caused by *S. pneumoniae* (Table 3).

Culture identified 5 cases of *S. pneumoniae* from the total of 19 pneumococcal meningitis identified using other tests. Binax NOW identified 19 cases of *S. pneumoniae*

meningitis, 14 cases more than was identified on culture (Table 4).

Of the total 19 children diagnosed with *S. pneumoniae* meningitis by investigation, the three conventional tests combined identified 14 cases (74%). The Binax NOW test was able to identify 5 additional cases of pneumococcal meningitis. The diagnostic precision of Binax NOW compared to the three other available tests combined were: sensitivity 100%; specificity 96%; positive predictive value 74%; negative predictive value 100% (Table 5).

Discussion

Bacterial meningitis is a common cause of childhood morbidity and mortality in PNG, but aetiological diagnosis is difficult because of poor bacterial culture facilities in most hospitals, high rates of pre-presentation antibiotics, and the cost and non-availability of other tests. In our study, Binax NOW was compared against tests that are sometimes available in PNG hospitals, and identified 5 extra cases of *S. pneumoniae* meningitis which would have been missed if only the conventional tests were done.

Since its approval by FDA in the United States of America, studies have investigated the Binax NOW ICT for the detection of *S.*

TABLE 2

BINAX NOW VERSUS LATEX AGGLUTINATION

		Latex agglutination		Total
		Positive	Negative	
Binax NOW	Positive	11	4	15
	Negative	0	69	69
Total		11	73	84

TABLE 3

BINAX NOW VERSUS GRAM STAIN

		Gram Stain		Total
		Gram positives	No Gram-positive bacteria detected	
Binax NOW	Positive	7	12	19
	Negative	0	110	110
Total		7	122	129

TABLE 4

BINAX NOW VERSUS CULTURE

		Culture		Total
		Positive for <i>Streptococcus pneumoniae</i>	No growth or negative for <i>S. pneumoniae</i>	
Binax NOW	Positive	5	14	19
	Negative	0	110	110
Total		5	124	129

TABLE 5

BINAX NOW VERSUS CULTURE + GRAM STAIN + LATEX ANTIGEN

Binax NOW Test		Any available conventional test		Total
		Positive	Negative	
	Positive	14	5	19
	Negative	0	110	110
Total		14	115	129

pneumoniae antigen in urine of patients with community-acquired pneumonia (21). Studies have also used Binax NOW on nasopharyngeal secretions (22), middle ear effusions (23), broncho-alveolar lavage fluid, pleural fluid and blood (17).

Other studies have evaluated Binax NOW in the detection of *S. pneumoniae* in CSF in children with suspected bacterial meningitis (19,24-26). The diagnostic precision of Binax NOW compared to the three other available tests combined was: sensitivity 100%; specificity 96%; positive predictive value 74%; negative predictive value 100%. These calculations are not optimal as they depend on the quality and availability of the other tests and, as always, depend on prevalence. Other studies have demonstrated high sensitivity and specificity compared to bacterial culture, and in children with purulent CSF in Bangladesh Binax NOW was as sensitive as PCR (19). In our study the sensitivity and specificity assumes that a positive result with Binax in the face of negative other tests is a false positive. However, such a positive result is more likely to represent a higher yield, as the 3 other tests are not an ideal gold standard. This is why the main metric we reported was additional yield from Binax over the 3 other tests, rather than sensitivity and specificity compared with any individual diagnostic test.

In our study, culture of CSF did not grow any *H. influenzae* even though latex agglutination testing identified 8 cases of Hib. Generally *Haemophilus* species are more difficult to grow than *S. pneumoniae*; while *S. pneumoniae* can be cultured using chocolate

agar or blood agar, *H. influenzae* can only be grown using chocolate agar. The haemophili also have a stricter requirement for elevated atmospheric carbon dioxide. Although the appropriate atmospheric conditions are easily and cheaply obtained using a candle jar, isolates may lose viability if culture is not carefully conducted.

This study has demonstrated the potential benefit of using the Binax NOW test in surveillance sites for meningitis throughout PNG. However, Binax NOW cannot replace the current conventional diagnostic tests, as it is specific for pneumococcus and surveillance for Hib must continue. *H. influenzae* surveillance can best be monitored with latex antigens. Although latex antigen identifies some *S. pneumoniae*, our study showed that others were missed. Adding Binax NOW in meningitis diagnosis and surveillance would help us monitor the effectiveness of the introduction of PCV in PNG. Meningitis due to *N. meningitidis* is less common in PNG, but requires Gram stain and culture facilities, or newer latex agglutination assays for diagnosis.

Binax NOW has some limitations in detailed pneumococcal surveillance. It is not a test for antibiotic susceptibility and it can still be positive days after antibiotics have sterilised the CSF. Further, as it detects C-polysaccharide cell wall antigen that is common to all strains of *S. pneumoniae* it cannot identify specific serotypes. This means that while the vaccine covers 13 antigenic strains of *S. pneumoniae*, Binax NOW cannot be used to distinguish vaccine from non-vaccine strains, so will not enable an

understanding of the relative effect of PCV on reducing disease from vaccine strains, and the potential for serotype replacement with non-vaccine strains.

There is an urgent need to improve the quality and availability of basic blood, urine and CSF culture, and antibiotic susceptibility testing in provincial hospitals. Few hospital laboratories have a functioning autoclave or make bacterial culture medium. Rising resistance rates make this need more urgent. Without basic bacteriology evidence-based antibiotic prescribing is difficult, and rising antibiotic resistance is only evident in patients failing standard antibiotic treatment and in unexpected deaths.

In conclusion, the Binax NOW test for *S. pneumoniae* on CSF increased the identification of pneumococcal meningitis, and would be useful in pneumococcal surveillance and evaluating the effectiveness of the newly introduced pneumococcal conjugate vaccine.

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The use of blood and blood products in the Paediatric Unit of Port Moresby General Hospital

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SUMMARY

This prospective descriptive study aimed to document the use and the quality of delivery of blood products in paediatric patients at the Port Moresby General Hospital. Paediatric patients transfused in the Paediatric Ward, the Special Care Nursery, the general Intensive Care Unit, the full Nursing Care Ward and the Children's Outpatient Department were included. 555 transfusion requests were dispensed from the blood bank to paediatric patients during the six months from the end of February to August 2012. Detailed information about age, sex, diagnosis, indication for transfusion and whether or not this followed standard indications, timeliness of transfusion and the quality of the transfusion procedure was recorded for a convenience sample of 64 patients, 37 males and 27 females, with a median age of 33 months and an interquartile range of 9-72 months. The most common indication for transfusion was infection-related anaemia. 50% of patients transfused did not meet standard indications for this intervention. In 86% of cases there was a delay in blood transfusion, blood shortage being an important contributing factor. Adequate monitoring of transfusion occurred in only 20% of the patients. No major adverse reactions were reported. It is highly recommended that a blood transfusion checklist be designed to improve the quality of blood transfusion practices and monitoring. Clinicians need to improve their prescribing of blood in accordance with established guidelines.

Introduction

Blood transfusion became part of clinical practice early in the 20th century with the discovery of blood group antigens and methods for typing and matching donor to recipient (1). Blood and blood products are used to relieve symptoms of physiological dysfunction resulting from deficiencies of one or more blood components. When used correctly and safely blood and blood products are of major therapeutic value and are often lifesaving. In resource-rich countries blood transfusion has evolved into a complex therapeutic discipline, requiring the skills of highly trained specialists to regulate its practice and to ensure its safety. Increased knowledge of the risks of transmitting serious infections such as HIV

(human immunodeficiency virus) and hepatitis and of other potential risks has resulted in the introduction of routine screening methods for blood donors and their blood which have largely eliminated the risks of transfusion. The blood transfusion service is recognized by the World Health Organization (WHO) as an essential arm of hospital services and its Programme on Blood Transfusion Safety provides detailed guidelines for achieving safe and available blood transfusion (2). Nevertheless in poorly resourced countries blood transfusion services may not be available or may be rudimentary and transfusion may be associated with significant risks. In all countries, however, blood transfusion should only be used for specific indications and monitoring is necessary to detect early signs

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of transfusion-associated ill-effects and to avoid potentially fatal complications.

Blood transfusion is generally considered to include the use of concentrated (packed) red blood cells, whole blood and other blood products such as platelet concentrate, fresh frozen plasma and cryoprecipitate.

In tropical paediatric practice, packed red blood cells are used to increase the oxygen-carrying capacity of blood in patients with anaemia not accompanied by hypovolaemia, for example in a neonate with anaemia or a child with severe malaria or other infection, heart failure, kwashiorkor or hereditary blood disorders such as thalassaemia, sickle cell disease or spherocytosis. Whole blood transfusion is indicated mainly for treatment of anaemia associated with hypovolaemia, and fresh whole blood is used for exchange transfusion in neonatal hyperbilirubinaemia. Fresh frozen plasma and cryoprecipitate are used for the replacement of clotting factors and platelets are used for the temporary correction of thrombocytopenia.

The transfusion of a blood component can never be taken lightly. It should only be given for a good reason after careful evaluation of the clinical situation. Transfusion should be targeted to the clinical problem, whether blood loss, anaemia, or both, thrombocytopenia or coagulopathy. Only the most appropriate blood component should be ordered and transfused. It is important that patients being transfused are monitored carefully so that potential problems can be detected early and dealt with appropriately.

Guidelines for blood transfusion are determined by the Paediatric Society of Papua New Guinea (PNG) and are clearly stated in the Standard Treatment Book for Common Illnesses of Children (3) and in the widely distributed PNG paediatric textbook (4). Indications for packed cell transfusion are based on haemoglobin (Hb) level. Guidelines are as follows:

Packed red cells

Neonates

2 weeks old:	Hb <10 g/dl
3-4 weeks old:	Hb <10 g/dl if baby is sick

Hb <8 g/dl in a well baby

Infants and children

Hb <6 g/dl in a sick child with haemolysis, with severe infection, in heart failure or with severe malnutrition

Severe anaemia any child with Hb <3 g/dl.

Whole blood

Acute blood loss – need for transfusion is assessed by estimating the amount of blood loss rather than on Hb

Pigbel if the Hb <6 g/dl.

Quantities of blood transfused should be based on the child's weight. The recommended duration of transfusion is between 3 and 4 hours (5).

The aim of this study was to document the use of blood and blood products within the Paediatric Unit of Port Moresby General Hospital (PMGH) and to assess the quality of delivery of this vital clinical service. The objectives were to determine:

- the number of blood transfusions carried out within the period of study
- the indications for blood transfusion
- the different blood products used
- the reasons for delayed transfusion
- wastage of blood products
- adequacy and safety of blood transfusion practices
- the number and nature of blood transfusion reactions encountered
- the outcome of patients receiving blood transfusion.

Methods

This was a prospective descriptive study carried out in the Paediatric Unit of the Port

Moresby General Hospital between the end of February 2012 and August 2012. Patients from the age of 1 week to 12 years were recruited on a convenience sampling basis from the general Intensive Care Unit, the full Nursing Care Ward, the Paediatric Ward, the Children's Outpatient Department and the Special Care Nursery. The study did not include children transfused in the surgical wards.

Information was gathered using a proforma completed during or after each blood transfusion. For patients receiving more than one transfusion information was collected only for the first during the time period. In addition to the patients' personal details the following data were recorded:

- Indication for transfusion
- Most likely cause of anaemia
- Blood products used
- Degree of urgency
- Delay in blood transfusion
- Blood wastage – volume ordered compared to the volume actually transfused
- Monitoring practices
- Duration of transfusion
- Blood transfusion reactions
- Outcome.

Monitoring transfusion was assessed by pre-transfusion vital signs and hourly routine observations measured and recorded.

The total number of blood transfusion requests for paediatric patients during the study period was determined from the records of the hospital blood transfusion service.

Data analysis

Data from the information sheet were transferred on to Microsoft Excel and then analysed using SPSS version 10.

Ethical clearance

Approval for the study was given by the

School of Medicine and Health Sciences (SMHS) Research and Ethical Committee.

Results

555 transfusion requests were dispensed from the blood bank to paediatric patients during the six months from March through August 2012. In the five months from March to July during the study period (excluding the month of August during which the Operation Open Heart took place) there were 467 transfusion requests dispensed to paediatric patients – 11% of the 4155 dispensed overall. Some patients (eg, those with thalassaemia and malignant disease) would have been transfused on more than one occasion. 65 patients were recruited into the study, but blood was not available for one of them.

Details of the patients and the indications for transfusion are shown in Table 1.

Of the 64 patients, 37 (58%) were males and 27 (42%) females. The median age was 33 months with an interquartile range (IQR) of 9-72 months and a range of 1 week to 12 years. 62 patients received packed red blood cells, 1 received platelets and 1 fresh whole blood.

Anaemia associated with infection was the commonest reason for transfusion (44%). Children with thalassaemia accounted for 19%. 30 children received packed cells in accordance with standard treatment guidelines, 6 (10%) with a Hb <3 g/dl, 18 (29%) with a Hb <6 g/dl in the presence of severe illness, and 6 (10%) neonates with a Hb <10 g/dl. 31 patients (50%) who did not meet the standard indicators for transfusion nevertheless received this intervention.

Details of delay between ordering and transfusion of blood are outlined in Table 2. Of the 63 transfusions with appropriate information 18 (29%) were classified by the ordering clinician as being required immediately, 20 (32%) as being required within an hour, 16 (25%) within 12 hours and 9 (14%) within 24 hours. In only 9 cases (14%) was the transfusion carried out within the time specified. Unavailability of blood of the correct group was recorded as a cause of delay in 12 cases, delay in collecting the blood from the blood bank was recorded for one, but reasons for delay in the remaining cases were not documented.

TABLE 1

DETAILS OF PATIENTS, DIAGNOSTIC CLASSIFICATION AND INDICATIONS FOR TRANSFUSION

Patients

Sex	Males 37 : Females 27
Age (months): Median (IQR)	33 (9-72)
Age range	1 week to 12 years

Diagnostic classification (N = 64)

	Number	(%)
Infection	28	(44)
Thalassaemia	12	(19)
Preterm neonate	9	(14)
Malignancy	5	(8)
Malnutrition	2	(3)
Chronic renal failure	1	(2)
Undetermined	7	(11)

Indications for packed cells (N = 62)

	Number	(%)
Hb <3 g/dl	6	(10)
Hb <6 g/dl and sick child	18	(29)
Neonate Hb <10 g/dl	6	(10)
Standard indication not present	31	(50)
Data incomplete	1	(2)

IQR = interquartile range

TABLE 2

DELAY IN TRANSFUSING

Urgency	Delay in transfusion from time of ordering					Total
	No delay	<1 day	1-2 days	2-3 days	>3 days	
Immediate	-	9	5	2	2	18
Within 1 hour	2	-	10	3	5	20
Within 12 hours	1	-	8	3	4	16
Within 24 hours	6	-	2	-	1	9
Total	9	9	25	8	12	63

Of the 63 patients for whom the information was available 48 (76%) received the volume of blood ordered, whilst 15 received less.

Details of transfusion practices and monitoring are shown in Table 3.

Pre-transfusion vital signs were recorded adequately in less than half of the patients, and hourly monitoring was complete in only 1 patient and not done at all in 51 (80%).

There were no major adverse reactions encountered. Fever thought to be transfusion related was recorded in three patients.

46 patients (72%) who received a blood transfusion recovered and were well on discharge; 1 left hospital at their own risk and information for 3 patients was missing. 14 (22%) of those who received a transfusion died; however, these deaths were thought to be related to the underlying disease rather than to blood transfusion. None of the deaths

occurred within 24 hours of the transfusion.

Discussion

An average of 92 transfusions of blood or blood products were administered each month – around 3 per day – to patients in the Paediatric Unit of the hospital over the six months of the study. Blood transfusion is generally regarded as a routine intervention. However, blood is a precious and sometimes scarce commodity and transfusion is not a simple exercise because of the adverse reactions that can arise, including immune-mediated sensitivity reactions and infection transmitted in the blood or acquired during the procedure. A recent study from Kenya found nosocomial infection to be significantly associated with blood transfusion in children without severe anaemia (6). Indications for transfusion and correct transfusion procedures should be followed and careful monitoring of transfused patients before and during the transfusion is necessary to ensure a safe outcome. Our

TABLE 3

TRANSFUSION PROCEDURES AND MONITORING

Transfusion procedures (N = 64)	Number (%)
Premedication	
Frusemide	57 (89)
Antimalarials	24 (38)
Pre-transfusion vital signs recorded	
Complete	27 (42)
Incomplete	14 (22)
Not recorded	23 (36)
Routine hourly monitoring	
Complete	1 (2)
Incomplete	12 (19)
Not done	51 (80)
Duration of transfusion (N = 63)	
<3 hours	8 (13)
3-4 hours	16 (25)
>4 hours	13 (21)
Not recorded	26 (41)

study of a small sample of patients under paediatric care has clearly documented that in the country's major hospital indications for transfusion are not being followed, resulting in unnecessary transfusions of a valuable and sometimes scarce commodity and exposing the recipients to unnecessary risks.

12 (19%) of the patients sampled in the study had thalassaemia. This group of patients is probably over-represented because of their need for regular transfusions and the fact that they are usually transfused electively during the day and thus more likely to be included in the sampling. Current guidelines are to transfuse these patients if their Hb drops below 9 g/dl with the aim of keeping their Hb above 8.5 g/dl, but 10 of the 12 patients had Hb below 6 g/dl.

In our study blood was sometimes administered to children on the basis of a Hb less than 6 g/dl irrespective of clinical condition but there is no evidence that transfusion is beneficial to children with Hb between 4 and 6 g/dl who are otherwise well and it has the potential for harm. A Cochrane review concluded that "there is insufficient data to be sure whether routinely giving blood to clinically stable children with severe anaemia in endemic malarious areas reduces death or results in higher haematocrit measured at one month" (7). In otherwise stable anaemic children it is important, as far as resources allow, to determine and to appropriately treat the cause of the anaemia, such as iron deficiency or malaria.

The indications for transfusion in children in Papua New Guinea which are clearly set out in the Paediatric Standard Treatment Book are similar to those recommended in the World Health Organization guidelines (8). More than 20 years ago a Kenyan study showed that the frequency of blood transfusion could be reduced and overall survival enhanced by targeting children with severe anaemia and respiratory distress early in the course of their hospitalization (9). The WHO guidelines indicate that transfusion is only associated with improved survival in children with Hb <5-6 g/dl if there are clinical signs of cardiac and respiratory compromise and state that "the decision to transfuse should not be based on Hb alone but also on a careful assessment of the child's clinical wellbeing". The guidelines take into account clinical evidence of poor oxygen delivery. Specifically they give the

indications for transfusing children with Hb between 4 and 6 g/dl as the presence of acidosis (usually manifest by dyspnoea), impaired consciousness or hyperparasitaemia (8).

Our study showed that transfusion procedures are very far from adequate. Pre-transfusion vital signs were completely recorded in less than half of the patients and monitoring was not done in 80% of them. Minor adverse events may well have been missed, and it may well have been some time before staff were made aware had severe events occurred. We were perhaps fortunate that while some of the patients in the study died no deaths were directly ascribed to transfusion.

The poor quality of the transfusion procedure is of very great concern. It is one of several areas (including infection control, rational antibiotic prescribing, appropriate oxygen therapy and nutrition support) in which key quality and safety standards for hospital practice are not met. It should, however, be viewed in context. Staffing levels in the paediatric wards are far from optimal and it is unrealistic to expect hourly monitoring of patients in a general ward of 56 patients or in the observation ward of a busy outpatient department. Nevertheless it should be possible to very markedly improve pre-transfusion assessment and the regularity of patient monitoring. Staffing levels are generally better during the day than the night, and it is therefore best, as far as possible, to plan transfusion accordingly.

There were major delays between ordering and receiving blood. It is likely that the indications of urgency given by the ordering doctor were inappropriate in some cases. However, the delays were potentially serious and in 12 cases resulted from a shortage of the appropriate blood group. Shortages of blood and blood products are common in hospitals throughout the country and PNG is still some way from meeting the WHO definition of self-sufficiency in safe blood and blood products based on voluntary non-remunerated blood donation (VNRBD). This definition states that "the national needs of patients for safe blood and blood products, as assessed within the frame-work of the national health system, are met in a timely manner, that patients have equitable access to transfusion services and blood products and that these products are

obtained from VNRBD of national, and where needed, of regional origin, such as from neighbouring countries" (10).

Relatively little information is available concerning the quality of blood transfusion in paediatric practice in resource-poor countries. A recent unpublished study from the Solomon Islands found that compliance to the policy indications for transfusion was reasonable, but did not report the quality of transfusion practice (11). A cross-sectional hospital-based study done in two district hospitals in Tanzania recorded that blood was sometimes not available when indicated and that when it was available transfusion orders were not always fulfilled, that time to initiate and complete transfusion was often unacceptably long and that monitoring of vital signs was poor (12). A study of the effectiveness of blood transfusions and risk factors for mortality in children in the Democratic Republic of the Congo concluded that transfusion is a frequent practice but that its use could be rationalized and indications restricted (13). In contrast, the introduction of a paediatric transfusion protocol in a busy Emergency Department in South Africa was associated not only with good transfusion procedures but also with a reduction in avoidable transfusions (14).

It is only recently that the National Blood Transfusion Service of Papua New Guinea has focused on the production of National Guidelines for the appropriate use of blood and blood products (15). Such a policy on the clinical use of blood is an essential component of a strategy to ensure that blood and blood products are transfused only to treat conditions that lead to significant morbidity or mortality and that cannot be treated effectively by other means.

Conclusions and Recommendations

In Papua New Guinea's major teaching hospital clinicians do not adhere to the standard indications for transfusing paediatric patients. Monitoring of the procedure and of the patients is very poor.

We recommend that:

- clinicians should be strongly encouraged to adhere to the standard indications for blood transfusion
- a standard checklist for blood

transfusion procedures and monitoring be established and used

- blood transfusions should only be carried out during the day unless urgently indicated
- the recently developed National Guidelines for the Use of Blood and Blood Products should be widely distributed and followed
- regular refresher courses on blood transfusion should be given to ward staff
- annual reviews of the blood transfusion service should be performed and reported to senior clinical medical and nursing staff
- hospitals should consider the establishment of a Blood Transfusion Committee similar to that now in place at PMGH.

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The prevalence of HIV co-infection in children diagnosed with tuberculosis attending Angau Memorial General Hospital

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SUMMARY

HIV (human immunodeficiency virus) disease and tuberculosis (TB) are among the leading causes of infectious morbidity and mortality worldwide. Globally, an estimated 13% of TB patients are co-infected with HIV, but the co-infection rate is as high as 80% in some Sub-Saharan African countries. Data on HIV and TB co-infection in Papua New Guinea (PNG), especially for children, are lacking. This study aimed to determine the prevalence of HIV co-infection in children with suspected TB at Angau Memorial General Hospital (AMGH) in Lae. In this prospective study, from July to December 2014, 7 (5%) of 150 children diagnosed with TB tested positive for HIV.

Introduction

The estimated prevalence of tuberculosis (TB) in Papua New Guinea (PNG) is over 300/100,000 with an annual incidence of TB disease estimated at 250/100,000 (1). In 2009 there were 13,000 newly diagnosed cases. About one-third of TB cases are in children. In 2005 the World Health Organization (WHO) estimated that 9.7% of PNG adults with TB were co-infected with HIV (human immunodeficiency virus), while in Port Moresby the estimate was considerably higher, at 23% (2). UNAIDS estimated that in 2014 there were 4300 HIV-positive children in PNG (3).

The Government of PNG introduced the Prevention of Parent To Child Transmission of HIV (PPTCT) program in 2004. In 2014 the Joint United Nations Programme on HIV/AIDS (UNAIDS) estimated that about 41% of HIV-positive pregnant women were receiving antiretroviral therapy (ART) in a program that has been substantially scaled up by the Clinton Foundation and individual hospitals (3).

HIV and TB have overlapping clinical manifestations which can lead to missed or late diagnoses (4). Whilst the introduction of polymerase chain reaction (PCR) testing for

viral deoxyribonucleic acid (DNA) has made it possible to make an accurate diagnosis of HIV in infants and young children, the difficulty of precise diagnosis of TB in children confounds an accurate understanding of the burden of the disease in children and the HIV-TB co-infection rate. Diagnosing a child with smear-positive TB is uncommon because they rarely cough out sputum and because of the paucibacillary nature of TB in children. Most children are registered as having 'smear-negative PTB' even though the smear has not been done.

The purpose of this study was to find the prevalence of HIV-TB co-infection in children presenting to the paediatric section of Angau Memorial General Hospital (AMGH).

Methods

The study was carried out over 6 months from July to December 2014. Children aged from 6 weeks to 15 years who were diagnosed with TB at the Children's Outpatient Department (COPD), the consultation clinic, health centres or wards were included.

Provider-Initiated Counselling and Testing (PICT) was carried out in a private and secure room, maintaining confidentiality at all times. Consent was signed before testing took place

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using the standard AMGH consent form for HIV testing. For children less than 18 months of age dried blood spot (DBS) samples were tested using PCR for viral DNA. For children older than 18 months a rapid antibody test was done, and confirmed, if positive, with a STAT PAK for HIV antibody. Consenting parents/guardians also had HIV testing. Children diagnosed with HIV infection were commenced on ART according to the current treatment guidelines. Ethical clearance for this study was given by the School of Medicine and Health Sciences Research Committee. Approval was given by the AMGH administration before commencing the study.

Data were entered and analysed using the SPSS (version 10) program. Descriptive statistics were generated, and a BMI Calculator in Children was used to calculate body mass index (BMI) and growth percentiles according to age and gender. The nutritional status was assessed by mid-upper arm circumference (MUAC) and height and weight for age.

Results

150 children (79 males and 71 females) who had been diagnosed with TB were enrolled. Their median age was 22 months (interquartile range [IQR] 11.8-72 months). The majority were from Momase (57%) and the Highlands (36%) Regions. 57% of the families lived in settlements across the city, only 38% had access to clean or treated water, 21% used septic toilets, and 49% of fathers and 97% of mothers were unemployed. 110 children were confirmed by scar or immunization record book to have received BCG vaccination. Of 137 children in whom it was recorded, 77 (56%) had a MUAC less than 12.5 cm. 24 boys (41%) and 17 girls (33%) had weight for age less than -3 standard deviation(s) (SD) from the standard mean, indicating severe malnutrition, and 22% and 20% respectively had a weight-for-age between -2 and -3 SD, indicating moderate malnutrition. 38% of boys and 45% of girls over the age of 5 years fell below the 5th centile for BMI. 135 children were newly diagnosed with TB, and 15 had relapsed or had defaulted previously. 87 children had pulmonary TB and 63 had extrapulmonary TB – 39 central nervous system (CNS) TB, 11 lymph nodes, 3 abdominal, 4 pericarditis, 1 bone and 5 disseminated TB.

7 children, 6 males and 1 female, had

HIV co-infection (4.7%). The mothers of all 7 children were HIV positive. 4 were newly diagnosed and 2 had died but were known to have been HIV positive. Only 2 of the mothers had been on ART during pregnancy. The HIV status for the fathers of 4 of these children was unknown, 1 father was confirmed HIV positive but had died, and 2 fathers tested HIV negative. 3 of the 7 children with HIV-TB co-infection came from polygamous families. The clinical features in the co-infected children included oral thrush (4 children), hepatosplenomegaly (3 children), alopecia, rashes and pustules. 14 (9.3%) of the TB cohort of 150 children, including one child with HIV-TB co-infection, died during the study.

Discussion

This study found a prevalence of HIV co-infection in children with TB at AMGH of 5%. This is lower than might be expected, but may reflect the effectiveness of the PPTCT program, and the non-specificity of TB diagnosis. Only 3 of 7 HIV-positive patients had been tested for HIV prior to the study, whilst active screening resulted in another 4 patients diagnosed and commenced on ART. Only 2 of the HIV-infected mothers had been on ART during pregnancy. Reducing the viral load during pregnancy and especially at the time of delivery markedly reduces the rate of HIV transmission. Many studies have shown that children with HIV-TB co-infection have more severe disease and higher mortality than HIV-negative children who have TB (4,5). Whilst the present study is too small to demonstrate this association, this has also been the common experience in PNG. On a more positive note, 6 of the 7 co-infected children survived throughout the study period.

Malnutrition and poverty were major problems in the TB study cohort overall. The majority of families were from a low socioeconomic background, without access to treated water or sanitation, living in settlements and with high rates of unemployment. Poverty alleviation must be an integral component of TB control efforts in PNG. Poverty facilitates the transmission of tuberculosis, primarily through poor living conditions, such as overcrowded houses and poorly ventilated homes, delayed presentation and diagnosis, and increased vulnerability due to malnutrition and HIV. TB incidence in the Asia-Pacific region is broadly associated with poverty and limited public health infrastructure (5). Major gains

in TB epidemic control reported for the region have been driven mainly by socioeconomic improvements in China, and to some degree in India (5), but PNG lags behind. Endemic TB risks undermining gains made in all other areas of health and development.

This study confirms the need for increased access to early diagnosis of HIV and ART for parents and children, strengthening PPTCT, continued measures to address malnutrition in TB and HIV-positive patients, and political and socioeconomic measures to lift families out of poverty.

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Zinc status of children aged 12 to 59 months resident in the National Capital District, Papua New Guinea

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SUMMARY

Zinc deficiency is a major public health problem in some resource-limited countries. This study assesses the zinc status of 90 pre-school-age children, aged 12 to 59 months, resident in the National Capital District (NCD), Papua New Guinea. Children attending the Children's Outpatient Clinic at Port Moresby General Hospital participated in this cross-sectional study. Informed consent was obtained from parents before using blood samples from their children. Flame atomic absorption spectrometry was used to measure the serum zinc concentration. C-reactive protein (CRP) in serum was measured by enzyme immunoassay and used to interpret the serum zinc data. The median serum zinc concentration for all the children was 83.6 µg/dl and the interquartile range was 64.6-103.7 µg/dl. The prevalence of serum zinc deficiency (Zn <65.0 µg/dl) among all the children was 26%; and 42% had elevated serum CRP level. Serum zinc deficiency was present among 31% and 20% of the children in the 12 to 24 months and over 24 months age groups respectively. The prevalence of serum zinc deficiency among the male and female children was 28% and 25% respectively. The high prevalence of zinc deficiency among the children may be caused by the high rate of subclinical infection and low bioavailability of absorbable zinc in the popular foodstuffs that they are consuming. The prevalence of zinc deficiency among the children with and without elevated serum CRP strongly suggests the need for continuous monitoring of the zinc status of pre-school-age children in the NCD.

Introduction

Micronutrient deficiency can compromise the effective utilization of macronutrients and ultimately leads to malnutrition (1,2). Thus an otherwise adequate diet, rich in macronutrients but deficient in micronutrients, may result in 'hidden hunger' – a condition whose subclinical signs are not easily detected (2-5). Hidden hunger can suppress the immune system, increasing the risk of developing infectious diseases, and often leads to stunted growth in children, impaired physical, cognitive and psychomotor function, and, consequently, reduced capacity for critical thinking and impaired learning ability (2-8). Hidden hunger is one of the most serious health risk factors contributing to the global burden of disease among children (2-8). The deficiencies of iron,

vitamin A, iodine and zinc (Zn) were identified as the major causes of hidden hunger (2-8). The inclusion of zinc is justified because it is a component of over 200 metallo-proteins involved in major biochemical pathways (9-12). Recent scientific evidence associates zinc deficiency with low birthweight, stunted growth in childhood, abnormal motor development, reduced immune competence and increased susceptibility to bacterial, viral and fungal infections, diarrhoeal diseases and acute lower respiratory tract infections (10-13).

Currently, the serum or plasma zinc concentration is the recommended biomarker for assessing the zinc status in a target population, because it is the only biochemical indicator with acceptable reference data for

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all age groups (12,14-18). Flame atomic absorption spectrometry (FAAS) is one of the recommended analytical methods for the assay of zinc in serum, because of its high sensitivity, reproducibility, specificity and precision (12,16,18). Appropriate precautions are required to prevent contamination of serum samples by ambient sources of zinc during collection, processing and analysis (12,16,18). Some criteria to be considered when interpreting the serum zinc data for children in the less than 10 years age group include diurnal variations and nonspecific decrease in serum zinc concentration caused by systemic infections, inflammation or trauma (12,14,19,20). Some authors have indicated that among children with malaria infection, the serum or plasma zinc concentration is usually very low and is inversely correlated with serum C-reactive protein (CRP), body temperature and parasite density in peripheral blood (21-23). The reduction in serum zinc concentration is partly caused by the redistribution of zinc during the acute phase response; the release of cytokines activates hepatic metallothionein synthesis leading to hepatic sequestration of circulating zinc (10,12,14,22). Thus, to control for clinically silent infections and inflammation the serum concentration of CRP should be measured (10,12,14) and used for appropriate interpretation of the zinc status (10,12,17,19,20).

In some resource-limited countries like Papua New Guinea (PNG) staple foods consist mainly of cereals, legumes, tubers and vegetables; thus the bioavailability of dietary zinc is low because of the high content of phytate, oxalate and fibre in the diet (24-27). Some researchers have indicated that children in these countries usually do not show obvious signs of zinc deficiency, but have often been found to have low serum zinc levels compatible with subclinical zinc deficiency (24-27). These authors stressed the need to monitor the zinc status of these children, because there is no functional reserve or body store for zinc, which means that an adequate dietary intake of zinc is required on a regular basis.

Published data on the zinc status of children in PNG are scanty (21,25,28-30). Results of a preliminary study by Ross et al. (28) in the Wosera area of PNG indicated that the dietary intake of zinc was lower than the requirement for children recommended by the World Health Organization (WHO).

In a cross-sectional study of children aged 24 to 120 months in Wosera, Gibson et al. (25) assessed the dietary zinc intake, and also determined anthropometric parameters, haemoglobin, hair zinc and the presence of malaria. The dietary intake of zinc among 76% of the children was lower than the WHO-recommended daily allowance for children. It was also found that the prevalences of stunting and low hair zinc concentrations were gender related. They concluded that stunting in Wosera children was related to chronic deficits in energy and protein and was exacerbated in the older male children by suboptimal zinc status (25). In another cross-sectional study among school-age children in Wosera, Shankar et al. showed an inverse association between zinc status and *Plasmodium falciparum* parasitaemia (21,29). Zinc deficiency was prevalent in 24 to 28% of the children. The PNG National Nutrition Survey (NNS) in 2005 indicated high prevalence of stunting (43.9%) and anaemia (48.1%) and moderate status of vitamin A deficiency (25.6%) among children less than 5 years of age (30). According to the WHO, the International Zinc Nutrition Consultative Group (IZiNCG) and the United Nations Children's Fund (UNICEF) Expert Committee, the risk of zinc deficiency in a population is considered to be of high public health concern when the prevalence of stunting among children less than 5 years of age is greater than 20% (10,16,20). Thus the need to monitor the zinc status of children in PNG cannot be overemphasized.

Currently there are no available published data on the zinc status of children in the National Capital District (NCD), PNG. The major objective of this study was to evaluate the zinc status of pre-school-age children resident in the NCD, which is the capital city in PNG.

Subjects and Methods

Study site

The Children's Outpatient Clinics at Port Moresby General Hospital (PMGH) were the primary sites for this study. The PMGH is the major public general, specialist and reference hospital in the NCD and PNG; it is also the teaching hospital for the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG). The patients represent a cross-section of the

NCD population.

Sample size

The sample size was calculated using a design effect of one, relative precision of 10%, confidence level of 95% and assumed prevalence rate of 15%. The sample size of 120 was considered acceptable for a predicted non-response rate of 20% (31).

Study design and sampling

This was a hospital outpatient-based cross-sectional study, because of the difficulty obtaining ethical clearance and permission to collect blood samples from healthy children in the NCD for research. All children between 12 and 59 months of age who attended the Children's Outpatient Clinics including the Well-baby Clinic in PMGH between March and July 2013, from whom blood was being collected, were eligible for enrolment in the study. Simple random sampling, using a table of random numbers, was used to select the children for participation in the study after their examination by the paediatricians.

Exclusion criteria

Children with diarrhoea, pneumonia, malaria, high fever and other significant illness, those admitted to the wards, and those who were not resident in NCD were excluded from the study.

Collection of blood samples and questionnaire data

The purpose of the study was explained to the accompanying parent of each child before requesting their signed informed consent. About 0.5 ml non-fasting blood sample obtained by venipuncture was transferred into a labelled sterile micronutrient-free polypropylene tube, placed inside a cool-box kept at 4-8°C and transported to the Micronutrient Research Laboratory (MRL) in the SMHS, UPNG. The clotted blood samples were centrifuged at 3500 rpm at 4°C for 30 minutes, after which an aliquot of each serum sample was separated into two labelled sterile micronutrient-free Eppendorf vials and kept frozen at -70°C until required for analysis. Special precautions were taken to avoid contamination of each sample by ambient sources of zinc (10,12,16,18). A self-designed pretested questionnaire was used

to collect specific information, including date of birth, sex, time of last meal eaten, type of meal eaten, time of sample collection and residential location of each child.

Assay of serum samples

The serum samples were transported to the PNG National Agricultural Research Institute (PNGNARI) micronutrient laboratory for the quantitative assay of zinc in serum using the Varian AA 240 Flame Atomic Absorption Spectrometer. The recommended procedures and precautions for assay of serum zinc were implemented, including the use of four levels of standard serum samples for internal quality control (16,18). The FAAS parameters used were: wavelength 213.9 nm, slit width 1.0 nm, lamp current 4.0 mA, burner height 10.0 mm, acetylene flow 2.0 l/min, air flow 13.5 l/min and aspiration time 5 seconds (32). The assay of C-reactive protein in serum was carried out in the MRL in the SMHS, UPNG. A commercial enzyme immunoassay (EIA) kit for the in-vitro-diagnostic quantitative determination of CRP in serum was used (33). The controls provided by the manufacturer were used to determine the inter- and intra-assay coefficients of variation (CV), which were 3.0% and 2.4% respectively.

Data analysis and interpretation

The statistical package for social sciences (SPSS) version 20 for Windows and Excel MS data pack software were used for statistical analysis of the data. The Kolmogorov-Smirnov test was used to assess distribution of the data; the Mann-Whitney U test, Wilcoxon rank sum tests and Chi-squared test (or Fisher's Exact test) were used as appropriate. The recommended criteria proposed by the IZiNCG Expert Committee were used for interpretation of the data (10,12,19,20). Serum zinc concentration below 65.0 µg/dl (9.94 µmol/l) indicates zinc deficiency among children below 10 years of age. Risk of a public health problem is indicated when the prevalence of zinc deficiency is between 10 and 20% of the target population; a prevalence of above 20% indicates a severe public health problem (10,16,20). A serum CRP level below 8.0 µg/ml indicates normal CRP level (33).

Ethical clearance

Ethical clearance and approval for this study was obtained from the Ethics and

Research Grant Committee in the SMHS, UPNG, and the Medical Research Advisory Committee (MRAC), National Department of Health (NDoH) of PNG. Permission was obtained from the Chief Executive Officer and Director of Medical Services of PMGH. Oral and signed informed consent was obtained from the parents of each of the children. Only the blood samples from children whose parents gave signed consent were used in the study.

Results

The consent for their child to be included in the study was obtained from 100 of the 120 mothers randomly selected. The non-response rate was 16.7%, which was lower than the predicted non-response rate of 20% used to calculate the sample size.

A total of 10 blood samples were excluded from analysis because of the rigorous implementation of the exclusion criteria. The justification for exclusion of 10 of the 100 blood samples collected was because the children

had low-grade fever and tested positive for malaria, which may depress their serum zinc concentration and elevate their serum CRP level (21-23).

The median age of the 90 children was 24.0 months and the interquartile range (IQR) was 16.3 to 48.0 months. The Kolmogorov-Smirnov test ($p = 0.004$; $df = 90$) for normality indicated that the serum zinc concentration for all the children was not normally distributed. The box plot of their serum zinc concentrations is shown in Figure 1. The median serum zinc concentration was 83.6 $\mu\text{g/dl}$ and the IQR was 64.6-103.7 $\mu\text{g/dl}$ (Table 1). Of the 90 children, 67 (74%) had serum zinc concentration ≥ 65.0 $\mu\text{g/dl}$ indicating normal zinc status and 23 (26%) had serum zinc concentration less than 65.0 $\mu\text{g/dl}$ indicating zinc deficiency (Table 1). There was a significant inverse correlation between the serum zinc concentration and serum CRP level for all the children (Spearman $\rho = -0.575$, $p = 0.01$).

The serum zinc concentrations for the 90 children were separated according to their

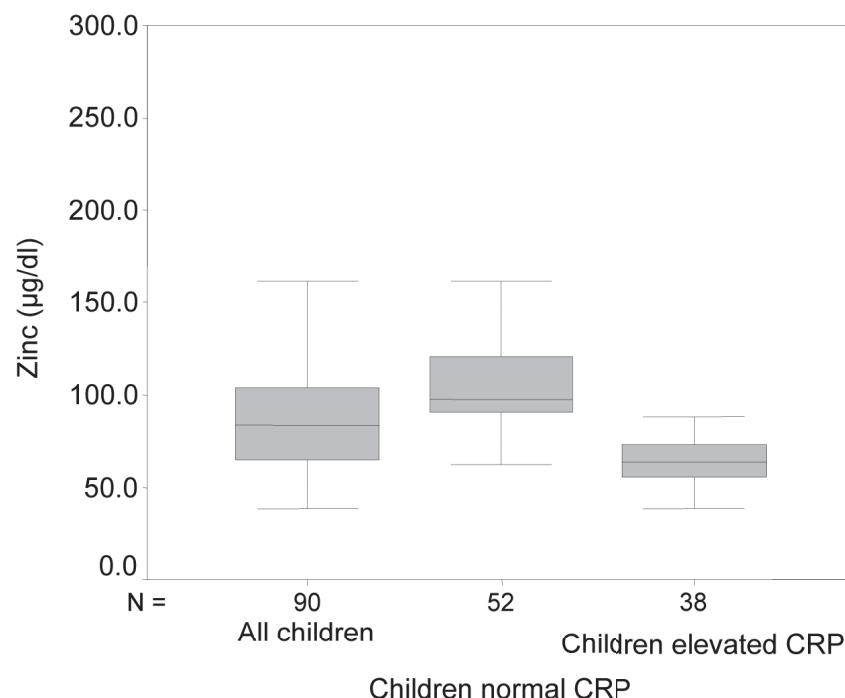


Figure 1. Box plots of serum zinc concentration ($\mu\text{g/dl}$) for all the study children and for those with normal and elevated serum C-reactive protein (CRP) levels.

TABLE 1

SERUM ZINC CONCENTRATION ($\mu\text{g/dl}$) FOR ALL THE CHILDREN AND FOR THOSE ABOVE AND BELOW THE CUT-OFF POINT ($\text{Zn} < 65.0 \mu\text{g/dl}$) INDICATING ZINC DEFICIENCY

	All children	Children with serum zinc concentration above cut-off point	Children with serum zinc concentration below cut-off point
Number (%)	90	67 (74.4%)	23 (25.6%)
Median ($\mu\text{g/dl}$)	83.6	91.6	56.9
IQR ($\mu\text{g/dl}$)	64.6-103.7	78.8-115.4	50.1-62.3
Mean ($\mu\text{g/dl}$)	88.7	100.3	55.0
Standard deviation	34.3	32.2	7.7
95% CI ($\mu\text{g/dl}$)	81.5-95.9	92.4-108.1	51.6-58.3

Zn = zinc
IQR = interquartile range
CI = confidence interval
NB: divide $\mu\text{g/dl}$ by 6.54 to convert to $\mu\text{mol/l}$

corresponding serum CRP levels. Normal serum CRP level was prevalent among 52 children (58%) compared to 38 (42%) with elevated ($\text{CRP} > 8.0 \text{ mg/l}$) serum CRP. The distribution of the serum zinc concentration in these two groups of children is also presented in the box plots in Figure 1; the concentrations were not normally distributed. Table 2 shows the medians and IQR of the serum zinc concentrations for children with normal and elevated serum CRP levels. The Mann-Whitney U and Wilcoxon W tests indicated that the serum zinc concentration for the children with normal serum CRP was significantly ($p = 0.001$, 2-tailed) higher than for those with elevated serum CRP levels. Zinc deficiency was prevalent among 4% of the children with normal CRP compared to 55% of those with elevated CRP.

For further analysis the 90 children were separated into two age groups. There were 49 children (54%) in the 12 to 24 months age group and 41 (46%) in the over 24 months age group. The median and IQR serum zinc concentrations for children in the 12 to 24 months age group were $79.0 \mu\text{g/dl}$ and 63.3 to $92.3 \mu\text{g/dl}$ respectively. The corresponding values for children in the over 24 months age group were $91.0 \mu\text{g/dl}$ and 69.9 to $115.6 \mu\text{g/dl}$ (Table 3). The serum zinc concentration

for children in the 12 to 24 months age group was significantly lower ($p = 0.01$, 2-tail, $\text{df} = 88$) than for those in the over 24 months age group. The prevalence of zinc deficiency among the children in the two age groups is presented in Table 3. The serum CRP levels were normal in 53% and 63% of the children in the 12 to 24 months and the over 24 months age groups, respectively. The serum zinc concentration and percent below the cut-off point that indicates zinc deficiency for the children with normal and elevated serum CRP in the two age groups are presented in Table 3.

The median serum zinc concentration of the children with normal serum CRP in the 12 to 24 months age group was lower than that for children with normal serum CRP in the over 24 months age group; the difference, however, was not considered significant ($p = 0.055$). In both age groups, the serum zinc concentrations were significantly higher ($p < 0.05$) in the children with normal serum CRP than in their counterparts with elevated serum CRP.

The 90 children were separated according to sex; 50 (56%) were males with a median age of 24.0 months (IQR = 17.0-48.0 months) and 40 (44%) were females with a median

TABLE 2

SERUM ZINC CONCENTRATION ($\mu\text{g/dl}$) FOR THE CHILDREN WITH NORMAL AND ELEVATED SERUM C-REACTIVE PROTEIN (CRP) LEVELS AND PERCENT BELOW CUT-OFF POINT THAT INDICATES ZINC DEFICIENCY

	Children with normal serum CRP	Children with elevated serum CRP
Number (%)	52 (57.8%)	38 (42.2%)
Median ($\mu\text{g/dl}$)	97.5	63.5
IQR ($\mu\text{g/dl}$)	90.3-121.3	55.2-73.3
Mean ($\mu\text{g/dl}$)	106.9	63.8
Standard deviation	33.7	12.9
95% CI ($\mu\text{g/dl}$)	97.5-116.3	59.5-68.0
Percent (number) with serum Zn ≥ 65.0 $\mu\text{g/dl}$	96.2% (50)	44.7% (17)
Percent (number) with serum Zn < 65.0 $\mu\text{g/dl}$	3.8% (2)	55.3% (21)

IQR = interquartile range

CI = confidence interval

Zn = zinc

age of 24.0 months (IQR = 15.8-40.5 months). There was no significant difference between the ages of the male and female children.

The serum zinc concentrations for the male and female children were not normally distributed. The median and IQR serum zinc concentrations for the male children were 82.1 $\mu\text{g/dl}$ and 64.5-110.5 $\mu\text{g/dl}$, respectively (Table 4). The corresponding values for the female children were 88.9 $\mu\text{g/dl}$ and 67.8-95.7 $\mu\text{g/dl}$. There was no significant difference ($p = 0.075$) between the serum zinc concentration of the male and female children. Zinc deficiency was prevalent among 28% of the male children compared to 25% of the female children. The Spearman (ρ) correlation indicates a significant inverse relationship between the serum zinc concentration and serum CRP level for the male ($\rho = -0.551$; $p = 0.01$) and the female ($\rho = -0.57$; $p = 0.01$) children.

Results for the male and female children were separated according to their serum CRP levels. Of the 50 male children, 30 (60%) had normal and 20 (40%) had elevated serum CRP levels. For the 40 female children, 22

(55%) had normal and 18 (45%) had elevated serum CRP levels. The medians and IQRs of the serum zinc concentrations for the male and female children with normal and elevated serum CRP levels are presented in Table 4. The table also shows the percent of children in each group with serum zinc concentration below the cut-off point that indicates zinc deficiency. The median serum zinc concentration for the male children with normal serum CRP was significantly ($p = 0.01$) higher than for those with elevated serum CRP. A similar result ($p = 0.01$) was obtained for the female children.

No significant difference ($p = 0.654$) was obtained when the serum zinc concentration for the male children with normal serum CRP was compared with the serum zinc concentration of the female children with normal serum CRP. The prevalence of zinc deficiency was 7% among the male children with normal serum CRP and zero among the female children with normal CRP. The prevalence of zinc deficiency among the male children with elevated serum CRP (60%) was similar to that of the female children with elevated serum CRP (56%).

TABLE 3

SERUM ZINC CONCENTRATION ($\mu\text{g/dL}$) FOR THE CHILDREN IN THE TWO AGE GROUPS AND FOR THOSE WITH NORMAL AND ELEVATED SERUM C-REACTIVE PROTEIN (CRP) LEVELS AND PERCENT BELOW CUT-OFF POINT THAT INDICATES ZINC DEFICIENCY

	Children aged 12 to 24 months			Children aged >24 months		
	All	Normal CRP	Elevated CRP	All	Normal CRP	Elevated CRP
Number (%)	49	26 (53.1%)	23 (46.9%)	41	26 (63.4%)	15 (36.6%)
Median ($\mu\text{g/dl}$)	79.0	91.9	63.7	91.0	114.0	63.2
IQR ($\mu\text{g/dl}$)	63.3-92.3	82.1-107.3	55.8-73.7	69.9-115.6	93.3-126.7	55.1-70.9
Mean ($\mu\text{g/dl}$)	84.5	102.7	63.9	93.7	111.2	63.5
Standard deviation	36.4	40.3	14.6	31.4	25.7	10.3
95% CI ($\mu\text{g/dl}$)	74.0-95.0	86.4-119.0	57.6-70.2	83.8-103.6	100.8-121.6	57.8-69.2
Percent (number) with serum Zn $\geq 65.0 \mu\text{g/dl}$	69.4% (34)	92.3% (24)	43.5% (10)	80.5% (33)	100.0% (26)	46.7% (7)
Percent (number) with serum Zn <65.0 $\mu\text{g/dl}$	30.6% (15)	7.7% (2)	56.5% (13)	19.5% (8)	0	53.3% (8)

IQR = interquartile range

CI = confidence interval

Zn = zinc

TABLE 4

SERUM ZINC CONCENTRATION ($\mu\text{g/dl}$) FOR MALE AND FEMALE CHILDREN AND FOR THOSE WITH NORMAL AND ELEVATED C-REACTIVE PROTEIN (CRP) LEVELS AND PERCENT BELOW CUT-OFF POINT THAT INDICATES ZINC DEFICIENCY

	Male children			Female children		
	All	Normal CRP	Elevated CRP	All	Normal CRP	Elevated CRP
Number (%)	50	30 (60.0%)	20 (40.0%)	40	22 (55.0%)	18 (45.0%)
Median ($\mu\text{g/dl}$)	82.1	101.9	63.5	88.9	94.3	62.2
IQR ($\mu\text{g/dl}$)	64.5-110.5	81.5-121.3	55.2-73.7	67.8-95.7	90.7-117.1	56.0-70.7
Mean ($\mu\text{g/dl}$)	87.9	103.1	65.0	89.7	112.1	62.4
Standard deviation	28.7	26.1	13.0	40.7	42.1	13.0
95% CI ($\mu\text{g/dl}$)	79.7-96.1	93.4-112.8	58.9-71.1	76.7-102.7	93.4-130.8	56.0-68.8
Percent (number) with serum Zn $\geq 65.0 \mu\text{g/dl}$	72.0% (36)	93.3% (28)	40.0% (8)	75.0% (30)	100.0% (22)	44.4% (8)
Percent (number) with serum Zn $< 65.0 \mu\text{g/dl}$	28.0% (14)	6.7% (2)	60.0% (12)	25.0% (10)	0	55.6% (10)

IQR = interquartile range
 CI = confidence interval
 Zn = zinc

Discussion

In the present study the median serum zinc concentration for all the children was 83.6 µg/dl and the interquartile range was 64.6-103.7 µg/dl. The prevalence of serum zinc deficiency (Zn <65.0 µg/dl) among all the children was 26%; and 42% had elevated serum CRP level. Serum zinc deficiency was present among 31% and 20% of the children in the 12 to 24 months and over 24 months age groups respectively.

The 26% prevalence of serum zinc deficiency among the children in the present study was between the 24.0 to 28.0% prevalence among the children in the control group in north Wosera District in East Sepik Province, PNG reported by Shankar et al. (21). It was higher than the 18.3%, 19.6%, 21.4%, 22.0% and 24.0% prevalence reported for children in Riyadh City (34), Iran (35), Mexico (36), Saudi Arabia (34) and Bangladesh (37) respectively. The 26% prevalence was lower than the 28.0% among children in East Iran (38), the 30.0% and 33.8% among children in the slums in India (39,40), the 32.0% among children in Adelaide, Australia (41), the 46.0% among children in an informal settlement in poor periurban South Africa (42), the 47% among children in Northwest Ethiopia (43), the 48% in Sokoto, Nigeria (44) and the 63% in South-East Nigeria (45).

The 31% and 20% prevalence of serum zinc deficiency among the children in the 12 to 24 months and over 24 months age groups, respectively, in our present study were higher than the 10.8% and 19.3% prevalence reported in Iran (35), but lower than the 37.0% and 36.9% prevalence reported in India (40), and the 32% and 40% prevalence reported in Adelaide, South Australia (41) for children in similar age groups.

The data obtained in our present study indicate that children in the 12 to 24 months age group were at a higher risk of zinc deficiency than those in the over 24 months age group. The serum zinc concentration for the younger children was also significantly lower than that of the older children (Table 3). Our results are consistent with current scientific opinion, which has highlighted the lack of agreement on the variation in serum zinc concentrations in the various pre-school-age groups (40,46,47).

Our results also indicated a prevalence of serum zinc deficiency in 28% of male and 25% of female pre-school-age children. These values were higher than the 26.0% and 11.0% prevalence reported among male and female pre-school-age children in Wosera District in East Sepik Province of PNG (21). They were also higher than the 18.8% and 20.1% prevalence reported among male and female pre-school-age children in Iran (35), but lower than the 32.7% and 40.9% among male and female pre-school-age children in the slums in India (40), the 51.9% and 41.7% among male and female children in Northwest Ethiopia (43) and the 39.0% and 36.0% among the male and female children in Sokoto, Nigeria (44). These results did not reflect the serum CRP levels in the pre-school-age children.

According to the WHO- and IZiNCG-recommended criteria (10,12,19,20) the status of serum zinc deficiency should be characterized as a public health problem among children aged 12-59 months in NCD at the time of this study. This should be of concern to program planners, because it may indicate a prolonged status of Zn depletion among pre-school-age children in the population. Serum zinc concentration remains within the normal range during short-term zinc depletion, because of the efficient homeostatic mechanisms in the metabolic system; however, measurable changes may occur during prolonged mild-to-moderate zinc deficiency. These changes are made worse by diarrhoea, infection or inflammation without adequate dietary intake of zinc or zinc supplementation (10,12,20).

However, this characterization needs to be interpreted with caution, because of the inverse correlation obtained between the serum zinc concentration and serum CRP level (Spearman rho = -0.575, p = 0.01). The high percentage (42%) of study children with elevated serum CRP level indicates a high prevalence of subclinical infection.

In most of the published studies on zinc status of pre-school-age children the authors (22,23,34-36,40,42-44) did not stratify their results using serum or plasma CRP level as recommended by WHO and IZiNCG; this may lead to incomplete interpretation of their data.

The prevalence of zinc deficiency among the children with normal serum CRP was 4%, which indicates normal zinc status. Among

the children with elevated serum CRP the prevalence of zinc deficiency was 55%, indicating a severe public health problem.

Recurrent infections, inadequate dietary intake of absorbable zinc, low bioavailability of zinc caused by anti-nutritional factors in ready-to-eat foods, poor food choices, poor socioeconomic status, religious or cultural practices, inadequate knowledge of dietary requirements and improper food preparation practices are some of the causes of suboptimal intake of dietary zinc, which may lead to high prevalence of zinc deficiency in a population group (10-14).

Although the dietary intake of zinc was not estimated in the present study, analysis of the information in the questionnaires indicated that the children in the study regularly consume the popular foodstuffs in NCD, which include tubers, root crops, legumes, cereals and leafy vegetables, but are lacking in micronutrient-rich foodstuffs like fish, meat, poultry, eggs, dairy products and a variety of fruits. Some of the roots, tubers, nuts and vegetables contain anti-nutritional factors, such as phytate, oxalate, tannins, saponins and dietary fibre that chelate zinc, forming complexes that cannot be absorbed in the gastrointestinal tract (5,25,28,48,49). The high prevalence of zinc deficiency among the study children may be caused by the high rate of subclinical infection and low bioavailability of absorbable zinc in the popular foodstuffs consumed. Some authors have reported similar findings in other countries (23-26,34,35,40-44).

Appropriate intervention strategies and policies are needed to enhance the intake of dietary absorbable zinc among pre-school-age children in the NCD. Efforts should be directed to reducing the frequency of infection among children, which may include improving sanitation and hygiene practices within the community. Other strategies may include supplementation, fortification, dietary diversity (food-based strategies) and nutrition education (5,6,11,50). These strategies are usually complementary and not mutually exclusive. In the short term, parents should be advised to give a variety of foodstuffs with high absorbable Zn – foodstuffs such as fresh fruits, meat, poultry, eggs and dairy products.

Multivitamins that contain appropriate amounts of Zn and other micronutrients may be included as part of the expanded program

on immunization (EPI), which is an established program in PNG.

Although this was a hospital-based study, the prevalence of zinc deficiency among the children with and without elevated serum CRP strongly suggests the need for continuous monitoring of the zinc status of vulnerable groups (pre-school-age children, pregnant women and lactating mothers) in NCD.

Conclusion

The prevalence of serum zinc deficiency among all the study children aged 12 to 59 months was 26%, and 42% had elevated serum CRP level. Serum zinc deficiency was present among 31% and 20% of the children in the 12 to 24 months and over 24 months age groups respectively. Our results also indicated a prevalence of serum zinc deficiency in 28% of male and 25% of female children.

The high prevalence of zinc deficiency among the pre-school-age children may be caused by the high rate of subclinical infection and low bioavailability of absorbable zinc in the popular foodstuffs that they are consuming. There is a need for community-based intervention strategies to improve the zinc status of young children. This should include effective public health control measures to reduce subclinical infections, zinc supplementation and fortification of some popular foodstuffs, intensive nutrition education, and information and parental awareness campaigns, emphasizing the significance of adequate intake of foodstuffs with absorbable zinc for the health and development of children.

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OBITUARY

Dr Alphonse Benjamin Rongap Sr

MOBUMO KIROMAT AND JOHN D. VINCE

On behalf of the Paediatric Society of Papua New Guinea

The late Dr Alphonse Rongap Sr was tragically shot and killed on 25th June 2016 on a back road in Lae, Morobe Province, Papua New Guinea (PNG), where he lived and worked for a large part of his life.

Dr Rongap was born at Angoram, East Sepik Province. He spent his childhood and attended primary school in Angoram. He entered the University of PNG in 1975 and graduated from the Faculty of Medicine in 1980 in a class of 24 young doctors. His classmates included Prof. Nakapi Tefuarani, Prof. Francis Hombhanje, Prof. Clement Malau and Dr Billy Selve. Following his training as a Resident Medical Officer and having decided on a career in child health, Dr Rongap enrolled in the Diploma of Child Health, graduating in 1984. He progressed to graduate as Master of Medicine in Child Health in 1987.

Dr Rongap was a kind, gentle and selfless paediatrician who maintained strong personal and family values. After graduation in 1987 his first posting as a specialist paediatrician was to Goroka, where he was also involved in research at the Papua New Guinea Institute of Medical Research. However, it was at Angau Memorial Hospital that he spent most of his career, working there for 25 years. Alphonse was hardworking and practical, and spoke up for the less fortunate people in the community. He made valuable contributions to the training of many young paediatricians and resident medical officers, and to health care in Morobe Province.

Within the paediatric and child health community Alphonse (Figure 1) was highly regarded and respected. His smile was infectious. A person of few words, his contributions to discussions were always well considered, wise and relevant. He influenced the Paediatric Society to focus more on newborns when, in a Symposium in 1998, he



Figure 1. Alphonse Rongap, Senior Paediatrician and Life Member of the Medical Society of Papua New Guinea.

presented a paper entitled 'The plight of the little people' in which he highlighted the lack of resources put into neonatal care in most hospitals in the country.

His daughter Dr Violet Rongap said of him: "What he gained during his training and whilst serving respective hospitals in the country were for the betterment of the children. Through this, he had a lot of friends. He was so simple and humble."

Dr Alphonse Rongap Sr has left behind his children, Dr Alphonse Rongap Jr and Dr Violet Rongap, and his wife and fellow Paediatrician, Dr Theresia Rongap. They will cherish his memory as a loving father and husband. The paediatric community is grateful to have had the opportunity of knowing Alphonse and working with him, and his memory will be honoured not only in the Paediatric Society of Papua New Guinea but also in the Medical Society of Papua New Guinea, of which he was a Life Member, and by all those who knew him and worked with him.

MEDLARS BIBLIOGRAPHY

PUBLICATIONS OF RELEVANCE TO PAPUA NEW GUINEA AND MELANESIA

Bibliographic Citation List generated from MEDLARS

- 1 **Adekunle AI, Pinkevych M, McGready R, Luxemburger C, White LJ, Nosten F, Cromer D, Davenport MP.**
Modeling the dynamics of *Plasmodium vivax* infection and hypnozoite reactivation in vivo.
PLoS Negl Trop Dis 2015 Mar 17;9(3):e0003595. doi: 10.1371/journal.pntd.0003595. eCollection 2015.
The dynamics of *Plasmodium vivax* infection is characterized by reactivation of hypnozoites at varying time intervals. The relative contribution of new *P. vivax* infection and reactivation of dormant liver stage hypnozoites to initiation of blood stage infection is unclear. In this study, we investigate the contribution of new inoculations of *P. vivax* sporozoites to primary infection versus reactivation of hypnozoites by modeling the dynamics of *P. vivax* infection in Thailand in patients receiving treatment for either blood stage infection alone (chloroquine), or the blood and liver stages of infection (chloroquine + primaquine). In addition, we also analysed rates of infection in a study in Papua New Guinea (PNG) where patients were treated with either artesunate, or artesunate + primaquine. Our results show that up to 96% of the *P. vivax* infection is due to hypnozoite reactivation in individuals living in endemic areas in Thailand. Similar analysis revealed that around 70% of infections in the PNG cohort were due to hypnozoite reactivation. We show how the age of the cohort, primaquine drug failure, and seasonality may affect estimates of the ratio of primary *P. vivax* infection to hypnozoite reactivation. Modeling of *P. vivax* primary infection and hypnozoite reactivation provides important insights into infection dynamics, and suggests that 90-96% of blood stage infections arise from hypnozoite reactivation. Major differences in infection kinetics between Thailand and PNG suggest the likelihood of drug failure in PNG.
- 2 **Agaku IT, Obadan EM, Odukoya OO, Olufajo O.**
Tobacco-free schools as a core component of youth tobacco prevention programs: a secondary analysis of data from 43 countries.
Eur J Public Health 2015 Apr;25(2):210-215. doi: 10.1093/eurpub/cku203. Epub 2014 Dec 8.
BACKGROUND: Preventing tobacco use is a key aspect of health promotion during adolescence. We assessed prevalence and impact of school-based tobacco prevention programs in 43 countries. METHODS: We performed a secondary analysis of national data of students aged 13-15 years (Global Youth Tobacco Surveys) from 43 countries during 2005-2011. National surveys of the corresponding school personnel (Global School Personnel Surveys) were performed in each country during the same year as the student surveys. Data on status of enforcement of national smoke-free school policies were obtained from the 2008 and 2009 WHO MPOWER reports. Logistic regression was used to measure ecologic-level associations between school-based tobacco prevention programs and tobacco-related knowledge and behaviour among students ($p < 0.05$). RESULTS: The proportion of students who were taught in class about the dangers of tobacco use during the school year ranged from 31.4% (Georgia) to 83.4% (Papua New Guinea). For every 10% increase (country level) in the proportion of teachers who reported having a tobacco prevention curriculum in their school, the odds of students reporting exposure to education in class about the dangers of tobacco increased by 6.0% (AOR = 1.06; 95% CI: 1.04-1.08). However, didactic education in class about the dangers of tobacco use was not independently associated with student current cigarette smoking behavior. Conversely, the likelihood of being a current smoker was significantly lower among students in countries with moderate/strongly enforced national smoke-free school policies compared with those in countries with poorly enforced/no national smoke-free school policies (AOR = 0.59; 95% CI: 0.45-0.76). CONCLUSIONS: Comprehensive tobacco prevention programs that include well-enforced smoke-free school policies may help reduce youth smoking.
- 3 **Ak G, Jaaback K, Yin H, Maley P, Scurry J.**
Malignant inflammatory myofibroblastic tumour of the uterus.
Pathology 2015 Jun;47(4):380-381. doi: 10.1097/PAT.0000000000000260.
- 4 **Aknin LB, Broesch T, Hamlin JK, Van de Vondervoort JW.**
Prosocial behavior leads to happiness in a small-scale rural society.
J Exp Psychol Gen 2015 Aug;144(4):788-795. doi: 10.1037/xge0000082. Epub 2015 Jun 1.
Humans are extraordinarily prosocial, and research conducted primarily in North America indicates that giving to others is emotionally rewarding. To examine whether the hedonic benefits of giving represent a universal feature of human behavior, we extended upon previous cross-cultural examinations by investigating whether inhabitants of a small-scale, rural, and isolated village in Vanuatu, where villagers have little influence from urban, Western culture, survive on subsistence farming without electricity, and have minimal formal education, report or display emotional rewards from engaging in prosocial (vs. personally beneficial) behavior. In Study 1, adults were randomly assigned to purchase candy for either themselves or others and then reported their positive affect. Consistent with previous research, adults purchasing goods for others reported greater positive emotion than adults receiving resources for themselves. In Study 2, 2- to 5-year-old children received candy and were subsequently asked to engage in costly giving (sharing their own candy with a puppet) and non-costly giving (sharing the experimenter's

candy with a puppet). Emotional expressions were video-recorded during the experiment and later coded for happiness. Consistent with previous research conducted in Canada, children displayed more happiness when giving treats away than when receiving treats themselves. Moreover, the emotional rewards of giving were largest when children engaged in costly (vs. non-costly) giving. Taken together, these findings indicate that the emotional rewards of giving are detectable in people living in diverse societies and support the possibility that the hedonic benefits of generosity are universal.

5 **Albert S, Aswani S, Fisher PL, Albert J.**

Keeping food on the table: human responses and changing coastal fisheries in Solomon Islands.

PLoS One 2015 Jul 9;10(7):e0130800. doi: 10.1371/journal.pone.0130800. eCollection 2015.

Globally the majority of commercial fisheries have experienced dramatic declines in stock and catch. Likewise, projections for many subsistence fisheries in the tropics indicate a dramatic decline is looming in the coming decades. In the Pacific Islands coastal fisheries provide basic subsistence needs for millions of people. A decline in fish catch would therefore have profound impacts on the health and livelihoods of these coastal communities. Given the decrease in local catch rates reported for many coastal communities in the Pacific, it is important to understand if fishers have responded to ecological change (either by expanding their fishing range and/or increasing their fishing effort), and if so, to evaluate the costs or benefits of these responses. We compare data from fish catches in 1995 and 2011 from a rural coastal community in Solomon Islands to examine the potentially changing coastal reef fishery at these time points. In particular we found changes in preferred fishing locations, fishing methodology and catch composition between these data sets. The results indicate that despite changes in catch rates (catch per unit effort) between data collected in 2011 and 16 years previously, the study community was able to increase gross catches through visiting fishing sites further away, diversifying fishing methods and targeting pelagic species through trolling. Such insight into local-scale responses to changing resources and/or fisheries development will help scientists and policy makers throughout the Pacific region in managing the region's fisheries in the future.

6 **Andrew EV, Pell C, Angwin A, Auwun A, Daniels J, Mueller I, Phuanukoonnon S, Pool R.**

Knowledge, attitudes, and practices concerning malaria in pregnancy: results from a qualitative study in Madang, Papua New Guinea.

PLoS One 2015 Apr 20;10(4):e0119077. doi: 10.1371/journal.pone.0119077. eCollection 2015.

BACKGROUND: Malaria is the leading cause of illness and death in Papua New Guinea (PNG). Infection during pregnancy with falciparum or vivax malaria, as occurs in PNG, has health implications for mother and child, causing complications such as maternal anemia, low birth weight and miscarriage. This article explores knowledge, attitudes and practices concerning malaria during pregnancy and its prevention in Madang, PNG, a high prevalence area. **METHODS:** As part of a qualitative study in Madang, exploring MiP, participatory techniques (free-listing and sorting) were conducted along with focus group discussions, in-depth interviews (with

pregnant women, health staff and other community members) and observations in the local community and health facilities. **RESULTS:** The main themes explored were attitudes towards and knowledge of MiP, its risks, and prevention. Although there was a general awareness of the term 'malaria', it was often conflated with general sickness or with pregnancy-related symptoms. Moreover, many preventive methods for MiP were related to practices of general healthy living. Indeed, varied messages from health staff about the risks of MiP were observed. In addition to ideas about the seriousness and risk of MiP, other factors influenced the uptake of interventions: availability and perceived comfort of sleeping under insecticide-treated mosquito nets were important determinants of usage, and women's heavy workload influenced chloroquine adherence. **CONCLUSION:** The non-specific symptoms of MiP and its resultant conflation with symptoms of pregnancy that are perceived as normal have implications for MiP prevention and control. However, in Madang, PNG, this was compounded by the inadequacy of health staff's message about MiP.

7 **Ariyaratnam R, Palmqvist CL, Hider P, Laing GL, Stupart D, Wilson L, Clarke DL, Hagander L, Watters DA, Gruen RL.**

Toward a standard approach to measurement and reporting of perioperative mortality rate as a global indicator for surgery.

Surgery 2015 Jul;158(1):17-26. doi: 10.1016/j.surg.2015.03.024. Epub 2015 May 6.

INTRODUCTION: The proportion of patients who die during or after surgery, otherwise known as the perioperative mortality rate (POMR), is a credible indicator of the safety and quality of operative care. Its accuracy and usefulness as a metric, however, particularly one that enables valid comparisons over time or between jurisdictions, has been limited by lack of a standardized approach to measurement and calculation, poor understanding of when in relation to surgery it is best measured, and whether risk-adjustment is needed. Our aim was to evaluate the value of POMR as a global surgery metric by addressing these issues using 4, large, mixed surgical datasets that represent high-, middle-, and low-income countries. **METHODS:** We obtained data from the New Zealand National Minimum Dataset, the Geelong Hospital patient management system in Australia, and purpose-built surgical databases in Pietermaritzburg, South Africa, and Port Moresby, Papua New Guinea. For each site, we calculated the POMR overall as well as for nonemergency and emergency admissions. We assessed the effect of admission episodes and procedures as the denominator and the difference between in-hospital POMR and POMR, including postdischarge deaths up to 30 days. To determine the need for risk-adjustment for age and admission urgency, we used univariate and multivariate logistic regression to assess the effect on relative POMR for each site. **RESULTS:** A total of 1,362,635 patient admissions involving 1,514,242 procedures were included. More than 60% of admissions in Pietermaritzburg and Port Moresby were emergencies, compared with less than 30% in New Zealand and Geelong. Also, Pietermaritzburg and Port Moresby had much younger patient populations ($p < .001$). A total of 8,655 deaths were recorded within 30 days, and 8-20% of in-hospital deaths occurred on the same day as the first operation. In-

- hospital POMR ranged approximately 9-fold, from 0.38 per 100 admissions in New Zealand to 3.44 per 100 admissions in Pietermaritzburg. In New Zealand, in-hospital 30-day POMR underestimated total 30-day POMR by approximately one third. The difference in POMR if procedures were used instead of admission episodes ranged from 7 to 70%, although this difference was less when central line and pacemaker insertions were excluded. Age older than 65 years and emergency admission had large, independent effects on POMR but relatively little effect in multivariate analysis on the relative odds of in-hospital death at each site. **CONCLUSION:** It is possible to collect POMR in countries at all levels of development. Although age and admission urgency are strong, independent associations with POMR, a substantial amount of its variance is site-specific and may reflect the safety of operative and anesthetic facilities and processes. Risk-adjustment is desirable but not essential for monitoring system performance. POMR varies depending on the choice of denominator, and in-hospital deaths appear to underestimate 30-day mortality by up to one third. Standardized approaches to reporting and analysis will strengthen the validity of POMR as the principal indicator of the safety of surgery and anesthesia care.
- 8 **Asante EA, Smidak M, Grimshaw A, Houghton R, Tomlinson A, Jeelani A, Jakubcova T, Hamdan S, Richard-Londt A, Linehan JM, Brandner S, Alpers M, Whitfield J, Mead S, Wadsworth JD, Collinge J.**
A naturally occurring variant of the human prion protein completely prevents prion disease.
Nature 2015 Jun 25;522(7557):478-481. doi: 10.1038/nature14510. Epub 2015 Jun 10.
Mammalian prions, transmissible agents causing lethal neurodegenerative diseases, are composed of assemblies of misfolded cellular prion protein (PrP). A novel PrP variant, G127V, was under positive evolutionary selection during the epidemic of kuru – an acquired prion disease epidemic of the Fore population in Papua New Guinea – and appeared to provide strong protection against disease in the heterozygous state. Here we have investigated the protective role of this variant and its interaction with the common, worldwide M129V PrP polymorphism. V127 was seen exclusively on a M129 PRNP allele. We demonstrate that transgenic mice expressing both variant and wild-type human PrP are completely resistant to both kuru and classical Creutzfeldt-Jakob disease (CJD) prions (which are closely similar) but can be infected with variant CJD prions, a human prion strain resulting from exposure to bovine spongiform encephalopathy prions to which the Fore were not exposed. Notably, mice expressing only PrP V127 were completely resistant to all prion strains, demonstrating a different molecular mechanism to M129V, which provides its relative protection against classical CJD and kuru in the heterozygous state. Indeed, this single amino acid substitution (G→V) at a residue invariant in vertebrate evolution is as protective as deletion of the protein. Further study in transgenic mice expressing different ratios of variant and wild-type PrP indicates that not only is PrP V127 completely refractory to prion conversion but acts as a potent dose-dependent inhibitor of wild-type prion propagation.
 - 9 **Asigau V, Lavu EK, McBride WJ, Biloh E, Naroi F, Koana E, Ferguson JK, Laman M.**
Prevalence of patients with acute febrile illnesses and positive dengue NS1 tests in a tertiary hospital in Papua New Guinea.
Am J Trop Med Hyg 2015 Jan;92(1):72-74. doi: 10.4269/ajtmh.14-0373. Epub 2014 Oct 20.
Because the prevalence of dengue fever in urban settings in Papua New Guinea is unknown, we investigated the presence of dengue using the NS1 antigen test in an outpatient-based prospective observational study at Port Moresby General Hospital. Of 140 patients with acute febrile illnesses, dengue fever was diagnosed in 14.9% (20 of 134; 95% confidence interval [95% CI] = 9.6-22.4). Malaria (2 of 137; 1.5%; 95% CI = 0.3-5.7), chikungunya (3 of 140; 2.1%; 95% CI = 0.6-6.6), and bacterial bloodstream infections (0 of 80; 0%; 95% CI = 0-5.7) were uncommon. Dengue fever should no longer be considered rare in Papua New Guinea.
 - 10 **Asugeni J, MacLaren D, Massey PD, Speare R.**
Mental health issues from rising sea level in a remote coastal region of the Solomon Islands: current and future.
Australas Psychiatry 2015 Dec;23(6 Suppl):22-25. doi: 10.1177/1039856215609767.
OBJECTIVE: There is little published research about mental health and climate change in the Pacific, including Solomon Islands. Solomon Islands has one of the highest rates of sea-level rise globally. The aim of this research was to document mental health issues related to sea-level rise for people in East Malaita, Solomon Islands. **METHOD:** A cross-sectional study was carried out in six low-lying villages in East Malaita, Solomon Islands. The researcher travelled to villages by dugout canoe. In addition to quantitative, closed-ended questions, open-ended questions with villagers explored individual and community responses to rising sea level. **RESULTS:** Of 60 people asked, 57 completed the questionnaire. Of these, 90% reported having seen a change in the weather patterns. Nearly all participants reported that sea-level rise is affecting them and their family and is causing fear and worry on a personal and community level. Four themes emerged from the qualitative analysis: experience of physical impacts of climate change; worry about the future; adaptation to climate change; government response needed. **CONCLUSION:** Given predictions of ongoing sea-level rise in the Pacific it is essential that more research is conducted to further understand the human impact of climate change for small island states which will inform local, provincial and national-level mental health responses.
 - 11 **Bangs MJ, Taai K, Howard TM, Cook S, Harbach RE.**
The mosquito *Anopheles (Cellia) oreios* sp. n., formerly species 6 of the Australasian *Anopheles farauti* complex, and a critical review of its biology and relation to disease.
Med Vet Entomol 2015 Mar;29(1):68-81. doi: 10.1111/mve.12092. Epub 2014 Dec 23.
Species 6 of the Australasian *Anopheles farauti* sibling species complex (Diptera: Culicidae) is described and formally named *Anopheles oreios* Bangs & Harbach, sp. n. Adult, pupal and fourth-instar larval specimens collected in the Baliem Valley, Papua Province, Indonesia, are characterized and compared with those of *Anopheles farauti*, *Anopheles hinesorum*, *Anopheles irenicus* and

Anopheles torresiensis (formerly informally denoted as species 1, 2, 7 and 3, respectively). The variable wings of adult females, the male genitalia, the pupa and the fourth-instar larva of *An. oreios* are illustrated and DNA sequence data are included for regions coding for sections of the mitochondrial COI and COII genes. The biology of *An. oreios* and its relation to malaria transmission are discussed in detail and contrasted with the biology and disease relations of some members of the *An. farauti* and *Anopheles punctulatus* sibling species complexes.

- 12 **Barnadas C, Timinao L, Javati S, Iga J, Malau E, Koepfli C, Robinson LJ, Senn N, Kiniboro B, Rare L, Reeder JC, Siba PM, Zimmerman PA, Karunajeewa H, Davis TME, Mueller I.**

Significant geographical differences in prevalence of mutations associated with *Plasmodium falciparum* and *Plasmodium vivax* drug resistance in two regions from Papua New Guinea.

Malar J 2015 Oct 9;14(1):399. doi: 10.1186/s12936-015-0879-9.

BACKGROUND: Drug resistance remains a major obstacle to malaria treatment and control. It can arise and spread rapidly, and vary substantially even at sub-national level. National malaria programmes require cost-effective and timely ways of characterizing drug resistance at multiple sites within their countries. **METHODS:** An improved multiplexed post-PCR ligase detection reaction-fluorescent microsphere assay (LDR-FMA) was used to simultaneously determine the presence of mutations in chloroquine resistance transporter (*crt*), multidrug resistance 1 (*mdr1*), dihydrofolate reductase (*dhfr*) and dihydropteroate synthase (*dhps*) genes in *Plasmodium falciparum* (*n* = 727) and *Plasmodium vivax* (*n* = 574) isolates collected in 2006 from cross-sectional community population surveys in two geographically distinct regions (Madang and East Sepik) of Papua New Guinea (PNG) where strong regional differences in *in vivo* aminoquinoline and antifolate therapeutic efficacy had previously been observed. Data were compared to those of a follow-up survey conducted in 2010. **RESULTS:** Despite some very low parasite densities, the assay successfully amplified all *P. falciparum* and *P. vivax* loci in 77 and 69% of samples, respectively. In 2006, prevalences of *pfdhfr* (59R-108 N) double mutation/wild type *pfdhps* haplotype, *pfcr* SVMNT haplotype (72S-76T double mutation), and 86Y *pfmdr1* mutation all exceeded 90%. For *P. vivax*, 65% carried at least two *pvdhfr* mutations, 97% the 647P *pvdhps* mutation and 54% the 976F *pvmadr1* mutation. Prevalence of mutant haplotypes was higher in Madang than East Sepik for *pfcr* SVMNT (97.4 vs 83.3%, *p* = 0.001), *pfdhfr* (59R-108 N) (100 vs 90.6%, *p* = 0.001), *pvdhfr* haplotypes (75.8 vs 47.6%, *p* = 0.001) and *pvmadr1* 976F (71.2 vs 26.2%, *p* < 0.001). Data from a subsequent Madang survey in 2010 showed that the prevalence of *pfdhps* mutations increased significantly from <5% to >30% (*p* < 0.001) as did the prevalence of *pvdhfr* mutant haplotypes (from 75.8 to 97.4%, *p* = 0.012). **CONCLUSIONS:** This LDR-FMA multiplex platform shows feasibility for low-cost, high-throughput, rapid characterization of a broad range of drug resistance markers in low parasitaemia infections. Significant geographical differences in mutation prevalence correlate with previous genotyping surveys and *in vivo* trials and may reflect variable drug pressure and differences in health-care access in these two PNG

populations.

- 13 **Beebe NW, Russell T, Burkot TR, Cooper RD.** *Anopheles punctulatus* group: evolution, distribution, and control.

Annu Rev Entomol 2015 Jan 7;60:335-350. doi: 10.1146/annurev-ento-010814-021206. Epub 2014 Oct 17.

The major malaria vectors of the Southwest Pacific belong to a group of closely related mosquitoes known as the *Anopheles punctulatus* group. The group comprises 13 co-occurring species that either are isomorphic or carry overlapping morphological features, and today several species remain informally named. The advent of species-diagnostic molecular tools in the 1990s permitted a new raft of studies into the newly differentiated mosquitoes of this group, and these have revealed five species as the region's primary malaria vectors: *An. farauti*, *An. hinesorum*, *An. farauti* 4, *An. koliensis*, and *An. punctulatus*. Species' distributions are now well established across Papua New Guinea, northern Australia, and the Solomon Archipelago, but little has been documented thus far in eastern Indonesia. As each species reveals significant differences in distribution and biology, the relative paucity of knowledge of their biology or ecology in relation to malaria transmission is brought into clearer focus. Only three of the species have undergone some form of spatial or population genetics analyses, and this has revealed striking differences in their genetic signatures throughout the region. This review compiles and dissects the key findings for this important mosquito group and points to where future research should focus to maximize the output of field studies in developing relevant knowledge on these malaria vectors.

- 14 **Beekman AM, Wossa SW, Kevo O, Ma P, Barrow RA.**

Discovery and synthesis of boletopsins 13 and 14, brominated fungal metabolites of terrestrial origin. *J Nat Prod* 2015 Aug 28;78(8):2133-2135. doi: 10.1021/acs.jnatprod.5b00202. Epub 2015 Jul 24.

Here we report the discovery and synthesis of complex polybrominated *p*-terphenyl ethers isolated from a mushroom (*Boletopsis* sp.) used as a traditional medicine by the Kiovi people in the highlands of Papua New Guinea. Boletopsins 13 and 14 represent the first report of polybrominated fungal metabolites to be produced by a terrestrial fungus. The synthetic method employs 2,4,4,6-tetrabromo-2,5-cyclohexadienone to achieve selective polybromination of the extended aromatic system in a selective and sequential manner.

- 15 **Beer B, Bender A.**

Causal inferences about others' behavior among the Wampar, Papua New Guinea – and why they are hard to elicit.

Front Psychol 2015 Mar 10;6:128. doi: 10.3389/fpsyg.2015.00128. eCollection 2015.

As social beings, people need to be able to interact intelligently with others in their social environment. Accordingly, people spend much time conversing with one another in order to understand the broad and fine aspects of the relations that link them. They are especially interested in the interactive behaviors that constitute social relations, such as mutual aid, gift giving and exchange, sharing, informal socializing, or deception. The evaluations of these

behaviors are embedded in social relationships and charged with values and emotions. We developed tasks to probe how people in an unfamiliar socio-cultural setting understand and account for the behavior of others conditional upon their category membership – by trying to elicit the basic categories, stereotypes, and models that inform the causal perceptions, inferences and reasoning people use in understanding others' interactive behaviours – and we tested these tasks among the Wampar in Papua New Guinea. The results show changes in the relevance of social categories among the Wampar but also, and perhaps more important, limitations in the translation and applicability of cognitive tasks.

- 16 **Benjamin JM, Moore BR, Salman S, Page-Sharp M, Tawat S, Yadi G, Lorry L, Siba PM, Batty KT, Robinson LJ, Mueller I, Davis TME.**

Population pharmacokinetics, tolerability, and safety of dihydroartemisinin-piperaquine and sulfadoxine-pyrimethamine-piperaquine in pregnant and nonpregnant Papua New Guinean women. *Antimicrob Agents Chemother* 2015 Jul;59(7):4260-4271. doi: 10.1128/AAC.00326-15. Epub 2015 May 11.

The tolerability, safety, and disposition of dihydroartemisinin (DHA) and piperaquine (PQ) were assessed in 32 pregnant (second/third trimester) and 33 nonpregnant Papua New Guinean women randomized to adult treatment courses of DHA-PQ (three daily doses) or sulfadoxine-pyrimethamine (SP)-PQ (three daily PQ doses, single dose of SP). All dose administrations were observed, and subjects fasted for 2 h postdose. Plasma PQ was assayed by using high-performance liquid chromatography, and DHA was assessed by using liquid chromatography-mass spectrometry. Compartmental pharmacokinetic models were developed using a population-based approach. Both regimens were well tolerated. There was an expected increase in the rate-corrected electrocardiographic QT interval which was independent of pregnancy and treatment. Two pregnant and two nonpregnant women had *Plasmodium falciparum* parasitemia which cleared within 48 h, and no other subject became slide positive for malaria during 42 days of follow-up. Of 30 pregnant women followed to delivery, 27 (90%) delivered healthy babies and 3 (10%) had stillbirths; these obstetric outcomes are consistent with those in the general population. The area under the plasma PQ concentration-time curve (AUC_{0-∞}) was lower in the pregnant patients (median [interquartile range], 23,721 µg · h/liter [21,481 to 27,951 µg · h/liter] versus 35,644 µg · h/liter [29,546 to 39,541 µg · h/liter]; p < 0.001) in association with a greater clearance relative to bioavailability (73.5 liters/h [69.4 to 78.4] versus 53.8 liters/h [49.7 to 58.2]; p < 0.001), but pregnancy did not influence the pharmacokinetics of DHA. The apparent pharmacokinetic differences between the present study and results from other studies of women with uncomplicated malaria that showed no effect of pregnancy on the AUC_{0-∞} of PQ and greater bioavailability may reflect differences in postdose fat intake, proportions of women with malaria, and/or racial differences in drug disposition.

- 17 **Bolnga JW, Morris M, Aipit J, Laman M.** Maternal and perinatal mortality in resource-limited settings. *Lancet Glob Health* 2015 Nov;3(11):e672. doi:

10.1016/S2214-109X(15)00155-2.

- 18 **Britton S, Cheng Q, Sutherland CJ, McCarthy JS.** A simple, high-throughput, colourimetric, field applicable loop-mediated isothermal amplification (HtLAMP) assay for malaria elimination. *Malar J* 2015 Aug 28;14:335. doi: 10.1186/s12936-015-0848-3.

BACKGROUND: To detect all malaria infections in elimination settings sensitive, high-throughput and field-deployable diagnostic tools are required. Loop-mediated isothermal amplification (LAMP) represents a possible field-applicable molecular diagnostic tool. However, current LAMP platforms are limited by their capacity for high throughput. **METHODS:** A high-throughput LAMP (HtLAMP) platform amplifying mitochondrial targets using a 96-well microtitre plate platform, processing 85 samples and 11 controls, using hydroxynaphtholblue as a colourimetric indicator was optimized for the detection of malaria parasites. Objective confirmation of visually detectable colour change results was made using a spectrophotometer. A dilution series of laboratory-cultured 3D7 *Plasmodium falciparum* parasites was used to determine the limit of detection of the HtLAMP assay, using *P. falciparum* (HtLAMP-Pf) and *Plasmodium* genus (HtLAMP-Pg) primers, on whole blood and filter paper, and using different DNA extraction protocols. The diagnostic accuracy of HtLAMP was validated using clinical samples from Papua New Guinea, Malaysia, Ghana and The Gambia and its field applicability was evaluated in Kota Marudu district hospital, Sabah, Malaysia. **RESULTS:** The HtLAMP assay proved to be a simple method generating a visually-detectable blue and purple colour change that could be objectively confirmed in a spectrophotometer at a wavelength of 600 nm. When compared with PCR, overall HtLAMP-Pg had a sensitivity of 98% (n = 260/266, 95% CI 95-99) and specificity 83% (n = 15/18, 95% CI 59-96). HtLAMP-Pf had a sensitivity of 97% (n = 124/128, 95% CI 92-99) and specificity of 96% (n = 151/157, 95% CI 92-99). A validation study in a regional hospital laboratory demonstrated ease of performance and interpretation of the HtLAMP assay. HtLAMP-Pf performed in this field setting had a sensitivity of 100% (n = 17/17, 95% CI 80-100) and specificity of 95% (n = 123/128, 95% CI 90-98) compared with multiplex PCR. HtLAMP-Pf also performed well on filter paper samples from asymptomatic Ghanaian children with a sensitivity of 88% (n = 23/25, 95% CI 69-97). **CONCLUSION:** This colourimetric HtLAMP assay holds much promise as a field-applicable molecular diagnostic tool for the purpose of malaria elimination.

- 19 **Burnett A, Yu M, Paudel P, Naduvilath T, Fricke TR, Hani Y, Garap J.**

Perceptions of eye health and eye health services among adults attending outreach eye care clinics in Papua New Guinea. *Ophthalmic Epidemiol* 2015 Dec;22(6):361-369. doi: 10.3109/09286586.2015.1057604.

PURPOSE: To determine how people attending outreach eye care clinics in Papua New Guinea (PNG) perceive eye health and eye health services. **METHODS:** An interview-based questionnaire was administered to a convenience sample of 614 adult participants across four provinces and perceptions of eye health and eye health services were recorded. Presenting and near visual acuity were measured

- and cause of visual impairment (VI) determined. RESULTS: In this sample, 113/614 participants (18.4%) presented with distance VI, 16 (2.6%) with distance blindness, and 221 (47.6%) with near VI. Older participants and those with near VI were more likely to indicate that it is hard to have an eye examination due to travel time, lack of transport and transport costs. Female participants and those from underserved areas were more likely to report shame and fear of jealousy from others when asked about their attitudes towards spectacles. Participants reporting that they were willing to pay higher amounts for testing and spectacles/treatment also reported higher education levels, higher household incomes and were more likely to be male. A quarter of participants (25.9%) indicated that they did not like having an eye examination because their reading and writing were poor. CONCLUSIONS: People attending outreach eye care clinics in PNG reported finding it difficult to attend eye health services due to transport difficulties and anticipated high costs. Negative attitudes towards spectacles were also prevalent, and negative perceptions appeared more frequently among older participants and those with less education.
- 20 **Byrne A, Hodge A, Jimenez-Soto E.** Accelerating maternal and child health gains in Papua New Guinea: modelled predictions from closing the equity gap using LIST. *Matern Child Health J* 2015 Nov;19(11):2429-2437. doi: 10.1007/s10995-015-1762-6.
- BACKGROUND: Many priority countries in the countdown to the Millennium Development Goals deadline are lagging in progress towards maternal and child health (MCH) targets. Papua New Guinea (PNG) is one such country beset by challenges of geographical inaccessibility, inequity and health system weakness. Several countries, however, have made progress through focused initiatives which align with the burden of disease and overcome specific inequities. This study identifies the potential impact on maternal and child mortality through increased coverage of prioritised interventions within the PNG health system. METHODS: The burden of disease and health system environment of PNG was documented to inform prioritised MCH interventions at community, outreach, and clinical levels. Potential reductions in maternal and child mortality through increased intervention coverage to close the geographical equity gap were estimated with the lives saved tool. RESULTS: A set of community-level interventions, with highest feasibility, would yield significant reductions in newborn and child mortality. Adding the outreach group delivers gains for maternal mortality, particularly through family planning. The clinical services group of interventions demands greater investment but are essential to reach MCH targets. Cumulatively, the increased coverage is estimated to reduce the rates of under-five mortality by 19%, neonatal mortality by 26%, maternal mortality ratio by 10% and maternal mortality by 33%. CONCLUSIONS: Modest investments in health systems focused on disadvantaged populations can accelerate progress in maternal and child survival even in fragile health systems like PNG. The critical approach may be to target interventions and implementation appropriately to the sensitive context of lagging countries.
- 21 **Cafaro J, Randle E, Wyche P, Higgins M, Fink J, Jones PD.** An assessment of current antenatal care practices and identification of modifiable risk factors for prematurity and low birth weight infants in pregnancy in Solomon Islands. *Rural Remote Health* 2015 Jul-Sep;15(3):3230. Epub 2015 Sep 10.
- 22 **Chan CW, Sakihama N, Tachibana S, Idris ZM, Lum JK, Tanabe K, Kaneko A.** *Plasmodium vivax* and *Plasmodium falciparum* at the crossroads of exchange among islands in Vanuatu: implications for malaria elimination strategies. *PLoS One* 2015 Mar 20;10(3):e0119475. doi: 10.1371/journal.pone.0119475. eCollection 2015.
- Understanding the transmission and movement of *Plasmodium* parasites is crucial for malaria elimination and prevention of resurgence. Located at the limit of malaria transmission in the Pacific, Vanuatu is an ideal candidate for elimination programs due to low endemicity and the isolated nature of its island setting. We analyzed the variation in the merozoite surface protein 1 (msp1) and the circumsporozoite protein (csp) of *P. falciparum* and *P. vivax* populations to examine the patterns of gene flow and population structures among seven sites on five islands in Vanuatu. Genetic diversity was in general higher in *P. vivax* than *P. falciparum* from the same site. In *P. vivax*, high genetic diversity was likely maintained by greater extent of gene flow among sites and among islands. Consistent with the different patterns of gene flow, the proportion of genetic variance found among islands was substantially higher in *P. falciparum* (28.81-31.23%) than in *P. vivax* (-0.53-3.99%). Our data suggest that the current island-by-island malaria elimination strategy in Vanuatu, while adequate for *P. falciparum* elimination, might need to be complemented with more centrally integrated measures to control *P. vivax* movement across islands.
- 23 **Chang CS, Liu HL, Moncada X, Seelenfreund A, Seelenfreund D, Chung KF.** A holistic picture of Austronesian migrations revealed by phylogeography of Pacific paper mulberry. *Proc Natl Acad Sci USA* 2015 Nov 3;112(44):13537-13542.
- The peopling of Remote Oceanic islands by Austronesian speakers is a fascinating and yet contentious part of human prehistory. Linguistic, archaeological, and genetic studies have shown the complex nature of the process in which different components that helped to shape Lapita culture in Near Oceania each have their own unique history. Important evidence points to Taiwan as an Austronesian ancestral homeland with a more distant origin in South China, whereas alternative models favor South China to North Vietnam or a Southeast Asian origin. We test these propositions by studying phylogeography of paper mulberry, a common East Asian tree species introduced and clonally propagated since prehistoric times across the Pacific for making barkcloth, a practical and symbolic component of Austronesian cultures. Using the hypervariable chloroplast *ndhF-rpl32* sequences of 604 samples collected from East Asia, Southeast Asia, and Oceanic islands (including 19 historical herbarium specimens from Near and Remote Oceania), 48 haplotypes are detected and haplotype cp-17 is predominant in both Near and Remote

Oceania. Because cp-17 has an unambiguous Taiwanese origin and cp-17-carrying Oceanic paper mulberries are clonally propagated, our data concur with expectations of Taiwan as the Austronesian homeland, providing circumstantial support for the "out of Taiwan" hypothesis. Our data also provide insights into the dispersal of paper mulberry from South China "into North Taiwan," the "out of South China-Indochina" expansion to New Guinea, and the geographic origins of post-European introductions of paper mulberry into Oceania.

- 24 **Cheng KC, Cao S, Raveh A, MacArthur R, Dranchak P, Chlipala G, Okoneski MT, Guha R, Eastman RT, Yuan J, Schultz PJ, Su XZ, Tamayo-Castillo G, Matainaho T, Clardy J, Sherman DH, Inglese J.**

Actinoramide A identified as a potent antimalarial from titration-based screening of marine natural product extracts. *J Nat Prod* 2015 Oct 23;78(10):2411-2422. doi: 10.1021/acs.jnatprod.5b00489. Epub 2015 Oct 14.

Methods to identify the bioactive diversity within natural product extracts (NPEs) continue to evolve. NPEs constitute complex mixtures of chemical substances varying in structure, composition, and abundance. NPEs can therefore be challenging to evaluate efficiently with high-throughput screening approaches designed to test pure substances. Here we facilitate the rapid identification and prioritization of antimalarial NPEs using a pharmacologically driven, quantitative high-throughput-screening (qHTS) paradigm. In qHTS each NPE is tested across a concentration range from which sigmoidal response, efficacy, and apparent EC50s can be used to rank order NPEs for subsequent organism reculture, extraction, and fractionation. Using an NPE library derived from diverse marine microorganisms we observed potent antimalarial activity from two *Streptomyces* sp. extracts identified from thousands tested using qHTS. Seven compounds were isolated from two phylogenetically related *Streptomyces* species: *Streptomyces ballenaensis* collected from Costa Rica and *Streptomyces bangulaensis* collected from Papua New Guinea. Among them we identified actinoramides A and B, belonging to the unusually elaborated nonproteinogenic amino-acid-containing tetrapeptide series of natural products. In addition, we characterized a series of new compounds, including an artifact, 25-epi-actinoramide A, and actinoramides D, E, and F, which are closely related biosynthetic congeners of the previously reported metabolites.

- 25 **Chi KH, Danavall D, Taleo F, Pillay A, Ye T, Nachamkin E, Kool JL, Fegan D, Asiedu K, Vestergaard LS, Ballard RC, Chen CY.**

Molecular differentiation of *Treponema pallidum* subspecies in skin ulceration clinically suspected as yaws in Vanuatu using real-time multiplex PCR and serological methods.

Am J Trop Med Hyg 2015 Jan;92(1):134-138. doi: 10.4269/ajtmh.14-0459. Epub 2014 Nov 17.

We developed a TaqMan-based real-time quadruplex polymerase chain reaction (PCR) to simultaneously detect *Treponema pallidum* subspecies *pallidum*, *T. pallidum* subsp. *pertenue*, and *T. pallidum* subsp. *endemicum*, the causative agents of venereal syphilis, yaws, and bejel, respectively. The PCR assay was applied to samples

from skin ulcerations of clinically presumptive yaws cases among children on Tanna Island, Vanuatu. Another real-time triplex PCR was used to screen for the point mutations in the 23S rRNA genes that have previously been associated with azithromycin resistance in *T. pallidum* subsp. *pallidum* strains. Seropositivity by the classical syphilis serological tests was 35.5% among children with skin ulcerations clinically suspected with yaws, whereas the presence of *T. pallidum* subsp. *pertenue* DNA was only found in lesions from 15.5% of children. No evidence of *T. pallidum* subsp. *pertenue* infection, by either PCR or serology, was found in ~59% of cases indicating alternative causes of yaws-like lesions in this endemic area.

- 26 **Chiu CY, Hodder AN, Lin CS, Hill DL, Li Wai Suen CS, Schofield L, Siba PM, Mueller I, Cowman AF, Hansen DS.**

Antibodies to the *Plasmodium falciparum* proteins MSPDBL1 and MSPDBL2 opsonize merozoites, inhibit parasite growth, and predict protection from clinical malaria.

J Infect Dis 2015 Aug 1;212(3):406-415. doi: 10.1093/infdis/jiv057. Epub 2015 Feb 2.

Increasing evidence suggests that antibodies against merozoite surface proteins (MSPs) play an important role in clinical immunity to malaria. Two unusual members of the MSP-3 family, merozoite surface protein Duffy binding-like (MSPDBL1 and MSPDBL2), have been shown to be extrinsically associated to MSP-1 on the parasite surface. In addition to a secreted polymorphic antigen associated with merozoite (SPAM) domain characteristic of MSP-3 family members, they also contain Duffy binding-like (DBL) domain and were found to bind to erythrocytes, suggesting that they play a role in parasite invasion. Antibody responses to these proteins were investigated in a treatment-reinfection study conducted in an endemic area of Papua New Guinea to determine their contribution to naturally acquired immunity. Antibodies to the SPAM domains of MSPDBL1 and MSPDBL2 as well as the DBL domain of MSPDBL1 were found to be associated with protection from *Plasmodium falciparum* clinical episodes. Moreover, affinity-purified anti-MSPDBL1 and MSPDBL2 were found to inhibit in vitro parasite growth and had strong merozoite opsonizing capacity, suggesting that protection targeting these antigens results from ≥2 distinct effector mechanisms. Together these results indicate that MSPDBL1 and MSPDBL2 are important targets of naturally acquired immunity and might constitute potential vaccine candidates.

- 27 **Chua CL, Robinson LJ, Baiwog F, Stanisic DI, Hamilton JA, Brown GV, Rogerson SJ, Boeuf P.**

High numbers of circulating pigmented polymorphonuclear neutrophils as a prognostic marker for decreased birth weight during malaria in pregnancy.

Int J Parasitol 2015 Feb;45(2-3):107-111.

During gestational malaria, *Plasmodium falciparum*-infected erythrocytes can sequester within the placenta, contributing to poor pregnancy outcomes, especially low birth weight. In children and non-pregnant adults, pigmented leukocytes may serve as markers of sequestered parasite burden and predict clinical outcomes. Here, we investigated circulating pigmented leukocyte numbers as predictors of clinical outcomes in pregnant women

presenting with malaria at enrolment. The number of circulating pigmented neutrophils at enrolment negatively correlated with birth weight ($\rho = -0.25$, $p = 0.04$), suggesting these cells may have a pathogenic role in, and could serve as prognostic markers for, malaria-associated low birth weight.

- 28 **Conn JE, Norris DE, Donnelly MJ, Beebe NW, Burkot TR, Coulbaly MB, Chery L, Eapen A, Keven JB, Kilama M, Kumar A, Lindsay SW, Moreno M, Quinones M, Reimer LJ, Russell TL, Smith DL, Thomas MB, Walker ED, Wilson ML, Yan G.**

Entomological monitoring and evaluation: diverse transmission settings of ICEMR projects will require local and regional malaria elimination strategies.

Am J Trop Med Hyg 2015 Sep;93(3 Suppl):28-41. doi: 10.4269/ajtmh.15-0009. Epub 2015 Aug 10.

The unprecedented global efforts for malaria elimination in the past decade have resulted in altered vectorial systems, vector behaviors, and bionomics. These changes combined with increasingly evident heterogeneities in malaria transmission require innovative vector control strategies in addition to the established practices of long-lasting insecticidal nets and indoor residual spraying. Integrated vector management will require focal and tailored vector control to achieve malaria elimination. This switch of emphasis from universal coverage to universal coverage plus additional interventions will be reliant on improved entomological monitoring and evaluation. In 2010, the National Institute of Allergy and Infectious Diseases (NIAID) established a network of malaria research centers termed ICEMRs (International Centers for Excellence in Malaria Research) expressly to develop this evidence base in diverse malaria endemic settings. In this article, we contrast the differing ecology and transmission settings across the ICEMR study locations. In South America, Africa, and Asia, vector biologists are already dealing with many of the issues of pushing to elimination such as highly focal transmission, proportionate increase in the importance of outdoor and crepuscular biting, vector species complexity, and 'sub patent' vector transmission.

- 29 **Czerwiński M.**

Blood groups - minuses and pluses. Do the blood group antigens protect us from infectious diseases? [Pol]

Postępy Hig Med Dosw (Online) 2015 Jun 25;69:703-722. doi: 10.5604/17322693.1158795.

Human blood can be divided into groups, which is a method of blood classification based on the presence or absence of inherited erythrocyte surface antigens that can elicit immune responses. According to the International Society of Blood Transfusion, there are 341 blood group antigens collected in 35 blood group systems. These antigens can be proteins, glycoproteins or glycosphingolipids, and function as transmembrane transporters, ion channels, adhesion molecules or receptors for other proteins. The majority of blood group antigens are present also on another types of cells. Due to their localization on the surface of cells, blood group antigens can act as receptors for various pathogens or their toxins, such as protozoa (malaria parasites), bacteria (*Helicobacter pylori*, *Vibrio cholerae* and *Shigella dysenteriae*) and viruses (Noroviruses, Parvoviruses, HIV). If the presence of group antigen (or its variant which arose due to mutation) is

beneficial for the host (eg, because pathogens are not able to bind to the cells), the blood group may become a selection trait, leading to its dissemination in the population exposed to that pathogen. There are thirteen blood group systems that can be related to pathogen resistance, and it seems that the particular influence was elicited by malaria parasites. It is generally thought that the high incidence of blood groups such as O in the Amazon region, Fy(a-b-) in Africa and Ge(-) in Papua New Guinea is the result of selective pressure from malaria parasites. This review summarizes the data about the relationship between blood groups and resistance to pathogens.

- 30 **Dare AJ, Bleicher J, Lee KC, Elobu AE, Kamara TB, Liko O, Luboga S, Danlop A, Kune G, Hagander L, Leather AJ, Yamey G.**

Generation of national political priority for surgery: a qualitative case study of three low-income and middle-income countries.

Lancet 2015 Apr 27;385 Suppl 2:S54. doi: 10.1016/S0140-6736(15)60849-2. Epub 2015 Apr 26.

BACKGROUND: Surgical conditions exert a major health burden in low-income and middle-income countries (LMICs), yet surgery remains a low priority on national health agendas. Little is known about the national factors that influence whether surgery is prioritised in LMICs. We investigated factors that could facilitate or prevent surgery from being a health priority in three LMICs. **METHODS:** We undertook three country case studies in Papua New Guinea, Uganda, and Sierra Leone, using a qualitative process-tracing method. In total 72 semi-structured interviews were conducted between March and June, 2014, in the three countries. Interviews were designed to query informants' attitudes, values, and beliefs about how and why different health issues, including surgical care, were prioritised within their country. Informants were providers, policy makers, civil society, funders, and other stakeholders involved with health agenda setting and surgical care. Interviews were analysed with Dedoose, a qualitative data analysis tool. Themes were organised into a conceptual framework adapted from Shiffman and Smith to assess the factors that affected whether surgery was prioritised. **FINDINGS:** In all three countries, effective political and surgical leadership, access to country-specific surgical disease indicators, and higher domestic health expenditures are facilitating factors that promote surgical care on national health agendas. Competing health and policy interests and poor framing of the need for surgery prevent the issue from receiving more attention. In Papua New Guinea, surgical care is a moderate-to-high health priority. Surgical care is embedded in the national health plan and there are influential leaders with surgical interests. Surgical care is a low-to-moderate health priority in Uganda. Ineffectively used policy windows and little national data on surgical disease have impeded efforts to increase priority for surgery. Surgical care remains a low health priority in Sierra Leone. Resource constraints and competing health priorities, such as infectious disease challenges, prevent surgery from receiving attention. **INTERPRETATION:** Priority for surgery on national health agendas varies across LMICs. Increasing dialogue between surgical providers and political leaders can increase the power of actors who advocate for surgical care. Greater emphasis on the importance of surgical care in achieving

- national health goals can strengthen internal and external framing of the issue. Growing political recognition of non-communicable diseases provides a favourable political context to increase attention for surgery. Lastly, increasing internally generated issue characteristics, such as improved tracking of national surgical indicators, could increase the priority given to surgery within LMICs.
- 31 **Deeming C, Gubhaju B.**
The mis-measurement of extreme global poverty: a case study in the Pacific Islands.
J Sociol (Melb) 2015 Sep;51(3):689-706.
Debate over the measurement of global poverty in low- and middle-income countries continues unabated. There is considerable controversy surrounding the 'dollar a day' measure used to monitor progress against the Millennium Development Goals. This article shines fresh light on the debate with new empirical analyses of poverty (including child poverty), inequality and deprivation levels in the Pacific island state of Vanuatu. The study focuses not only on economic and monetary metrics and measures, but also the measures of deprivation derived from sociology in relation to shelter, sanitation, water, information, nutrition, health and education. Until recently, there had been few, if any, attempts to study poverty and deprivation disparities among children in this part of the world. Different measures yield strikingly different estimates of poverty. The article, therefore, attempts to situate the study findings in the broader international context of poverty measurement and discusses their implications for future research and the post-2015 development agenda.
- 32 **Del Brutto OH, García HH.**
Taenia solium cysticercosis - the lessons of history.
J Neurol Sci 2015 Dec 15;359(1-2):392-395. doi: 10.1016/j.jns.2015.08.011. Epub 2015 Aug 7.
Human taeniasis as well as porcine and human cysticercosis – caused by the pork tapeworm *Taenia solium* – are ancient diseases. The fact that pigs were considered impure in ancient Greece and that the Koran prohibited the consumption of pork were likely related to the knowledge that cysticercosis may affect swine. Evidence suggests that human cysticercosis was also present in ancient Egypt and Rome. During the Renaissance, the causative agent was properly identified and human cases were recognized. Confirmation that both taeniasis and cysticercosis were caused by the same parasite was provided during the 19th Century by German pathologists. During the 20th Century, bouts of human cysticercosis in non-endemic regions left us valuable lessons on the mechanisms of disease acquisition and spread. These included a large series of neurocysticercosis cases in the United Kingdom that occurred after the return of troops stationed in India (which demonstrated that symptoms may occur years after infection), the epidemic of cysticercosis-related epilepsy in the Ekari people of West Papua occurring after the gift of pigs with cysticercosis received from Indonesia (demonstrating the fast establishment of endemic transmission and the impact of cysticercosis in epilepsy frequency), and the occurrence of neurocysticercosis among members of an Orthodox Jewish community of New York City, related to Latin American *Taenia* carriers working in their houses (highlighting the fact that cysticercosis transmission does not require the presence of infected pigs). These lessons of history have significantly contributed to our current knowledge on this disease.
- 33 **Diau J, Jimuru C, Asugeni J, Asugeni L, Puia M, Maomatekwa J, Harrington H, MacLaren D, Speare R, Massey PD.**
Measles outbreak investigation in a remote area of Solomon Islands, 2014.
Western Pac Surveill Response J 2015 Sep 8;6(3):17-21. doi: 10.5365/WPSAR.2015.6.2.001.
To describe a measles outbreak and health service response in a remote location in Malaita, Solomon Islands.
- 34 **Dick T.**
Alternative approaches to well-being and engagement in Vanuatu.
Australas Psychiatry 2015 Dec;23(6 Suppl):52-54. doi: 10.1177/1039856215608290.
OBJECTIVES: This article describes some innovative approaches to understanding, measuring and attributing value to traditional wisdom in Vanuatu. METHODS: The article uses decolonising methodologies to privilege indigenous perspectives. In particular, the study features the use of endogenous practices, such as sand drawing, as a vehicle for facilitating community engagement in the research. RESULTS: The results of the project reveal that, in the context of broad structural support for customary practices, communities leveraging traditional wisdom into commercial realms are able to generate livelihoods and maintain cultural heritage transmission. CONCLUSIONS: Local communities report increased pride and pleasure in the resurgence and innovation of cultural practices.
- 35 **Diefenbach-Elstob TR, Graves PM, Burgess GW, Pelowa DB, Warner JM.**
Seroepidemiology of melioidosis in children from a remote region of Papua New Guinea.
Int Health 2015 Sep;7(5):332-338. doi: 10.1093/inthealth/ihu088. Epub 2014 Dec 8.
BACKGROUND: The Balimo region in Papua New Guinea has previously been identified as melioidosis-endemic with a predilection for children. Where health resources are scarce, seroepidemiology can be used to assess exposure to *Burkholderia pseudomallei* and therefore risk of acquiring melioidosis. METHODS: Logistic regression was used to determine associations between indirect haemagglutination assay (IHA) seroreactivity with environmental and demographic/cultural factors to aid in determining risk factors associated with exposure to *B. pseudomallei* in children. RESULTS: Of the 968 participants, 92.9% (899/968) were children, representing the majority of the community school population in the immediate Balimo region. Of these, 24.6% (221/899) were seropositive. Bathing in the lagoon (OR = 2.679), drinking from the well or lagoon (OR = 1.474), and being a member of the Siboko (OR = 1.914) or Wagumisi (OR = 1.942) clans were significantly associated with seropositivity. In the multivariate analysis, drinking from a well or lagoon (OR = 1.713), and the Siboko (OR = 2.341) and Wabadala (OR = 2.022) clans were associated with seropositivity. CONCLUSIONS: This study in children supports observations that interactions with groundwater in this region are risk factors in acquiring melioidosis. Public health measures intended to limit this

exposure may help reduce the risk of acquiring melioidosis in this remote community. Associations with clan structure may provide more cultural specific insights; however, this requires further elucidation.

- 36 **Duke T, Kado JH, Auto J, Amini J, Gilbert K.** Closing the gaps in child health in the Pacific: an achievable goal in the next 20 years. *J Paediatr Child Health* 2015 Jan;51(1):54-60. doi: 10.1111/jpc.12804.

It is not inconceivable that by 2035 the substantial gaps in child health across the Pacific can close significantly. Currently, Australia and New Zealand have child mortality rates of 5 and 6 per 1000 live births, respectively, while Pacific island developing nations have under 5 mortality rates ranging from 13 to 16 (Vanuatu, Fiji and Tonga) to 47 and 58 per 1000 live births (Kiribati and Papua New Guinea, respectively). However, these Pacific child mortality rates are falling, by an average of 1.4% per year since 1990, and more rapidly (1.9% per year) since 2000. Based on progress elsewhere, there is a need to (i) define the specific things needed to close the gaps in child health; (ii) be far more ambitious and hopeful than ever before; and (iii) form a new regional compact based on solidarity and interdependence.

- 37 **Dunne EM, Tikkanen L, Balloch A, Gould K, Yoannes M, Phuanukoonnon S, Licciardi PV, Russell FM, Mulholland EK, Satzke C, Hinds J.** Characterization of 19A-like 19F pneumococcal isolates from Papua New Guinea and Fiji. *New Microbes New Infect* 2015 Jul 4;7:86-88. doi: 10.1016/j.nmni.2015.06.008. eCollection 2015.

Molecular identification of *Streptococcus pneumoniae* serotype 19F is routinely performed by PCR targeting the wzy gene of the capsular biosynthetic locus. However, 19F isolates with genetic similarity to 19A have been reported in the United States and Brazil. We screened 78 pneumococcal carriage isolates and found six 19F wzy variants that originated from children in Papua New Guinea and Fiji. Isolates were characterized using multilocus sequence typing and opsonophagocytic assays. The 19F wzy variants displayed similar susceptibility to anti-19F IgG antibodies compared to standard 19F isolates. Our findings indicate that these 19F variants may be more common than previously believed.

- 38 **File K, McLaws ML.** Ni-Vanuatu health-seeking practices for general health and childhood diarrheal illness: results from a qualitative methods study. *BMC Res Notes* 2015 May 8;8:189. doi: 10.1186/s13104-015-1151-7.

BACKGROUND: A local perspective on diarrheal illness has been shown to enhance control strategies for diarrheal disease in traditional rural settings. We aimed to assess caregivers' understandings of childhood general and diarrheal illness, in one rural community in Vanuatu, to help formulate control strategies for preventing diarrheal disease. **FINDINGS:** This was a descriptive study using qualitative analysis of responses to open-ended questions to provide a fuller understanding of illness. Thematic analysis with categories derived from medical anthropology was used to analyse responses and draw conclusions. Twenty-nine participants were interviewed; 22 were maternal responses, three were traditional practitioners, two

were rural health care workers, one was a spiritual healer and one had a caregiver role. Respondents categorised illness as biomedical or traditional. Explanations of illness were enmeshed in and derived from both the traditional and biomedical system as the illness experience in the child under their care unfolded. Diarrheal severity influenced treatment selection and respondents expressed a preference for biomedical assistance. Respondents articulated a preference for biomedicine as the primary help-seeking resort for small children. Exclusive reliance on either traditional or biomedical options was uncommon. Local herbal remedies were the preferred home treatment when illness was known or mild, while oral rehydration therapy was used when accessing biomedical practitioners. **CONCLUSIONS:** Belief about diarrheal illness was influenced by traditional medicine and biomedicine. New evidence points to a growing preference for biomedicine as the first choice for severe childhood diarrheal illness. Diarrheal illness could be countered by maternal hand hygiene education at the medical dispensary and rural aid post.

- 39 **Fujita M, Poudel KC, Green K, Wi T, Abeyewickreme I, Ghidinelli M, Kato M, Vun MC, Sopheap S, San KO, Bollen P, Rai KK, Dahal A, Bhandari D, Boas P, Yaipupu J, Sirinirund P, Saonum P, Duong BD, Nhan do T, Thu NT, Jimba M.**

HIV service delivery models towards 'Zero AIDS-related Deaths': a collaborative case study of 6 Asia and Pacific countries.

BMC Health Serv Res 2015 Apr 24;15:176. doi: 10.1186/s12913-015-0804-5.

BACKGROUND: In the Asia-Pacific region, limited systematic assessment has been conducted on HIV service delivery models. Applying an analytical framework of the continuum of prevention and care, this study aimed to assess HIV service deliveries in six Asia and Pacific countries from the perspective of service availability, linking approaches and performance monitoring for maximizing HIV case detection and retention. **METHODS:** Each country formed a review team that provided published and unpublished information from the national HIV program. Four types of continuum were examined: (i) service linkages between key population outreach and HIV diagnosis (vertical-community continuum); (ii) chronic care provision across HIV diagnosis and treatment (chronological continuum); (iii) linkages between HIV and other health services (horizontal continuum); and (iv) comprehensive care sites coordinating care provision (hub and heart of continuum). **RESULTS:** Regarding the vertical-community continuum, all districts had voluntary counselling and testing (VCT) in all countries except for Myanmar and Vietnam. In these two countries, limited VCT availability was a constraint for referring key populations reached. All countries monitored HIV testing coverage among key populations. Concerning the chronological continuum, the proportion of districts/townships having antiretroviral treatment (ART) was less than 70% except in Thailand, posing a barrier for accessing pre-ART/ART care. Mechanisms for providing chronic care and monitoring retention were less developed for VCT/pre-ART process compared to ART process in all countries. On the horizontal continuum, the availability of HIV testing for tuberculosis patients and pregnant women was limited and there were sub-

optimal linkages between tuberculosis, antenatal care and HIV services except for Cambodia and Thailand. These two countries indicated higher HIV testing coverage than other countries. Regarding hub and heart of continuum, all countries had comprehensive care sites with different degrees of community involvement. **CONCLUSIONS:** The analytical framework was useful to identify similarities and considerable variations in service availability and linking approaches across the countries. The study findings would help each country critically adapt and adopt global recommendations on HIV service decentralization, linkages and integration. Especially, the findings would inform cross-fertilization among the countries and national HIV program reviews to determine county-specific measures for maximizing HIV case detection and retention.

40 **Fung P, Montague R.**

A qualitative evaluation of leadership development workshops for mental health workers from four Pacific Island countries.

Australas Psychiatry 2015 Jun;23(3):218-221. doi: 10.1177/1039856215576417. Epub 2015 Mar 17.

OBJECTIVE: This paper provides a qualitative evaluation of a series of leadership development workshops held at the New South Wales Institute of Psychiatry (NSWIOP) for mental health workers from Papua New Guinea, Federated States of Micronesia, Republic of Marshall Islands, and Palau. **METHOD:** Fourteen mental health workers attended the week-long training focused on project management and partnership development skills. In-depth interviews were conducted with participants at the commencement and conclusion of the training, and questionnaires were completed. A focus group was conducted with the NSWIOP organisers. The data was analysed using qualitative techniques to identify emergent themes for both participants and NSWIOP project team. **FINDINGS:** All Pacific Island participants responded positively to the training. All reported greater confidence in taking on formal or informal leadership roles in the workplace, developing project planning skills and interpersonal skills such as networking and partnerships. The NSWIOP organisers identified strengths and weaknesses in the delivery of this training. **CONCLUSIONS:** The strong partnerships developed between NSWIOP and the Ministry of Health in all four countries contributed to the success of the training. Leadership Development Programs are an important aspect of building capacity in the mental health services of Pacific Island countries.

41 **Gaffney D, Summerhayes GR, Ford A, Scott JM, Denham T, Field J, Dickinson WR.**

Earliest pottery on New Guinea mainland reveals Austronesian influences in highland environments 3000 years ago.

PLoS One 2015 Sep 2;10(9):e0134497. doi: 10.1371/journal.pone.0134497. eCollection 2015.

Austronesian speaking peoples left Southeast Asia and entered the Western Pacific c.4000-3000 years ago, continuing on to colonise Remote Oceania for the first time, where they became the ancestral populations of Polynesians. Understanding the impact of these peoples on the mainland of New Guinea before they entered Remote Oceania has eluded archaeologists. New research from the archaeological site of Wañelek in the New Guinea

highlands has broken this silence. Petrographic and geochemical data from pottery and new radiocarbon dating demonstrates that Austronesian influences penetrated into the highland interior by 3000 years ago. One potsherd was manufactured along the northeast coast of New Guinea, whereas others were manufactured from inland materials. These findings represent the oldest securely dated pottery from an archaeological context on the island of New Guinea. Additionally, the pottery comes from the interior, suggesting the movements of people and technological practices, as well as objects at this time. The antiquity of the Wañelek pottery is coincident with the expansion of Lapita pottery in the Western Pacific. Such occupation also occurs at the same time that changes have been identified in subsistence strategies in the archaeological record at Kuk Swamp suggesting a possible link between the two.

42 **Gangaiah D, Webb KM, Humphreys TL, Fortney KR, Toh E, Tai A, Katz SS, Pillay A, Chen CY, Roberts SA, Munson RS Jr, Spinola SM.**

Haemophilus ducreyi cutaneous ulcer strains are nearly identical to class I genital ulcer strains.

PLoS Negl Trop Dis 2015 Jul 6;9(7):e0003918. doi: 10.1371/journal.pntd.0003918. eCollection 2015.

BACKGROUND: Although cutaneous ulcers (CU) in the tropics are frequently attributed to *Treponema pallidum* subspecies *pertenue*, the causative agent of yaws, *Haemophilus ducreyi* has emerged as a major cause of CU in yaws-endemic regions of the South Pacific islands and Africa. *H. ducreyi* is generally susceptible to macrolides, but CU strains persist after mass drug administration of azithromycin for yaws or trachoma. *H. ducreyi* also causes genital ulcers (GU) and was thought to be exclusively transmitted by microabrasions that occur during sex. In human volunteers, the GU strain 35000HP does not infect intact skin; wounds are required to initiate infection. These data led to several questions: Are CU strains a new variant of *H. ducreyi* or did they evolve from GU strains? Do CU strains contain additional genes that could allow them to infect intact skin? Are CU strains susceptible to azithromycin? **METHODOLOGY/PRINCIPAL FINDINGS:** To address these questions, we performed whole-genome sequencing and antibiotic susceptibility testing of 5 CU strains obtained from Samoa and Vanuatu and 9 archived class I and class II GU strains. Except for single nucleotide polymorphisms, the CU strains were genetically almost identical to the class I strain 35000HP and had no additional genetic content. Phylogenetic analysis showed that class I and class II strains formed two separate clusters and CU strains evolved from class I strains. Class I strains diverged from class II strains ~1.95 million years ago (mya) and CU strains diverged from the class I strain 35000HP ~0.18 mya. CU and GU strains evolved under similar selection pressures. Like 35000HP, the CU strains were highly susceptible to antibiotics, including azithromycin. **CONCLUSIONS/SIGNIFICANCE:** These data suggest that CU strains are derivatives of class I strains that were not recognized until recently. These findings require confirmation by analysis of CU strains from other regions.

43 **Gare J, Kelly-Hanku A, Ryan CE, David M, Kaima P, Imara U, Lote N, Crowe SM, Hears AC.**

Factors influencing antiretroviral adherence and

virological outcomes in people living with HIV in the highlands of Papua New Guinea.

PLoS One 2015 Aug 5;10(8):e0134918. doi: 10.1371/journal.pone.0134918. eCollection 2015.

Adherence to antiretroviral therapy (ART) is paramount for virological suppression and positive treatment outcomes. ART has been rapidly scaled up in Papua New Guinea (PNG) in recent years; however, clinical monitoring of HIV+ individuals on ART is limited. A cross-sectional study was conducted at two major sexual health clinics in high HIV prevalence provinces in the Highlands Region of PNG to assess ART adherence, factors affecting adherence and the relationship between ART adherence and virological outcomes. Ninety-five HIV+ individuals were recruited and administered a questionnaire to gather demographic and ART adherence information whilst clinical data and pill counts were extracted from patient charts and blood was collected for viral load testing. Bivariate analysis was performed to identify independent predictors of ART adherence. Fourteen percent (n = 12) of participants showed evidence of virological failure. Although the majority of participants self-reported excellent ART adherence in the last seven days (78.9%, 75/91), pill count measurements indicated only 40% (34/84) with >95% adherence in the last month. Taking other medications while on ART (p = 0.01) and taking ART for ≥1 year (p = 0.037) were positively associated with adherence by self-report and pill count, respectively. Participants who had never heard of drug resistance were more likely to show virological failure (p = 0.033). Misconception on routes of HIV transmission still persists in the studied population. These findings indicate that non-adherence to ART is high in this region of PNG and continued education and strategies to improve adherence are required to ensure the efficacy of ART and prevent HIV drug resistance.

44 Gauci PJ, McAllister J, Mitchell IR, Boyle DB, Bulach DM, Weir RP, Melville LF, Gubala AJ.

Genomic characterisation of three Mapputta group viruses, a serogroup of Australian and Papua New Guinean bunyaviruses associated with human disease.

PLoS One 2015 Jan 14;10(1):e0116561. doi: 10.1371/journal.pone.0116561. eCollection 2015.

The Mapputta serogroup tentatively contains the mosquito-associated viruses Mapputta, Maprik, Trubanaman and Gan Gan. Interestingly, this serogroup has previously been associated with an acute epidemic polyarthritis-like illness in humans; however, there has been no ensuing genetic characterisation. Here we report the complete genome sequences of Mapputta and Maprik viruses, and a new Mapputta group candidate, Buffalo Creek virus, previously isolated from mosquitoes and detected by serology in a hospitalised patient. Phylogenetic analyses indicate that the group is one of the earliest diverged groups within the genus Orthobunyavirus of the family Bunyaviridae. Analyses show that these three viruses are related to the recently sequenced Australian bunyaviruses from mosquitoes, Salt Ash and Murrumbidgee. A notable feature of the Mapputta group viruses is the absence of the NSs (non-structural) ORF commonly found on the S segment of other orthobunyaviruses. Viruses of the Mapputta group have been isolated from geographically diverse regions ranging from tropical Papua New Guinea to the semi-arid climate

of south-eastern Australia. The relevance of this group to human health in the region merits further investigation.

45 Goucke CR, Jackson T, Morriss W, Royle J.

Essential pain management: an educational program for health care workers.

World J Surg 2015 Apr;39(4):865-870. doi: 10.1007/s00268-014-2635-7.

BACKGROUND: Education for health care workers on pain-related topics is not always readily available, and this is especially so in low and middle income countries (LMICs). The Essential Pain Management program (EPM) has been developed to offer a simple interactive educational opportunity for health care workers in LMICs. **METHODS:** Following a needs analysis in Papua New Guinea, an 8 h educational program with the aims of improving pain knowledge and providing a simple pain management framework was developed. An evaluation of the program using the Kirkpatrick model is being used. The program has a 'teach the teachers' component to encourage sustainability. **RESULTS:** The program has been run in 30 countries, delivered to 1,600 participants, and 340 instructors have been trained. Feedback has been positive, pre post testing in 27 sites showed a mean pre score of 65.89% rising to 75.23% (n = 581 respondents). A subanalysis demonstrates doctors and nurses improving by similar degrees. When local instructors have delivered the program after attending the trainer's session the participant test results were comparable to the results seen when the overseas instructors taught the course. **DISCUSSION:** The widespread adoption of the EPM program suggests there is a need for pain education in LMICs. The teach the teachers component of the program and the comparable results from their teaching should contribute to sustainability. Further support and mentoring using electronic systems such as Facebook, text messaging, and a website may also contribute to sustainability.

46 Grace RF, Tang DW, Namel E.

An audit of the haemodynamic and emergence characteristics of single-shot 'ketofol'.

Anaesth Intensive Care 2015 Jul;43(4):503-505.

'Ketofol', the single-syringe combination of ketamine and propofol (50 mg of ketamine and 90 mg of propofol in a 10 ml syringe) is becoming increasingly popular for short procedures, progressively replacing the more traditional use of ketamine and diazepam in some settings. This audit examined the haemodynamic, emergence and other characteristics of ketofol administration in 42, otherwise fit, women undergoing bilateral post-partum tubal ligation at Vila Central Hospital in Vanuatu. The combination of ketamine and propofol had no clinically important adverse haemodynamic effects. Wake-up from ketofol was favourable, with low rates of nausea and minimal emergence delirium. However, 43% of patients required airway support. For short procedures such as post-partum tubal ligation in fit patients, ketofol appears to have minimal adverse haemodynamic effects and favourable emergence characteristics.

47 Graham SM, Grzemska M, Brands A, Nguyen H, Amini J, Triasih R, Talukder K, Ahmed S, Amanullah F, Kumar B, Tufail P, Detjen A, Marais B, Hennig C, Islam T.

Regional initiatives to address the challenges of tuberculosis in children: perspectives from the Asia-Pacific region.

Int J Infect Dis 2015 Mar;32:166-169. doi: 10.1016/j.ijid.2014.12.013.

Increasing attention is being given to the challenges of management and prevention of tuberculosis in children and adolescents. There have been a number of recent important milestones achieved at the global level to address this previously neglected disease. There is now a need to increase activities and build partnerships at the regional and national levels in order to address the wide policy-practice gaps for implementation, and to take the key steps outlined in the Roadmap for Child Tuberculosis published in 2013. In this article, we provide the rationale and suggest strategies illustrated with examples to improve diagnosis, management, outcomes and prevention for children with tuberculosis in the Asia-Pacific region, with an emphasis on the need for greatly improved recording and reporting. Effective collaboration with community engagement between the child health sector, the National Tuberculosis Control Programmes, community-based services and the communities themselves is essential.

- 48 **Greenhill AR, Phuanukoonnon S, Michael A, Yoannes M, Orami T, Smith H, Murphy D, Blyth C, Reeder J, Siba P, Pomat W, Lehmann D.**

Streptococcus pneumoniae and *Haemophilus influenzae* in paediatric meningitis patients at Goroka General Hospital, Papua New Guinea: serotype distribution and antimicrobial susceptibility in the pre-vaccine era.

BMC Infect Dis 2015 Oct 27;15(1):485. doi: 10.1186/s12879-015-1197-0.

BACKGROUND: Bacterial meningitis remains an important infection globally, with the greatest burden in children in low-income settings, including Papua New Guinea (PNG). We present serotype, antimicrobial susceptibility and outcome data from paediatric meningitis patients prior to introduction of *Haemophilus influenzae* type b (Hib) and pneumococcal conjugate vaccines (PCVs) in PNG, providing a baseline for evaluation of immunisation programs. **METHODS:** Cerebrospinal fluid (CSF) was collected from children admitted to Goroka General Hospital with suspected meningitis between 1996 and 2005. Culture and sensitivity was conducted, and pneumococci and *H. influenzae* were serotyped. Laboratory findings were linked to clinical outcomes. **RESULTS:** We enrolled 1884 children. A recognised pathogen was identified in 375 children (19.9%). *Streptococcus pneumoniae* (n=180) and Hib (n=153) accounted for 88.8% of pathogens isolated. 24 different pneumococcal serogroups were identified; non-PCV types 2, 24 and 46 accounted for 31.6% of pneumococcal meningitis. 10- and 13-valent PCVs would cover 44.1% and 45.4% of pneumococcal meningitis respectively. Pneumococcal isolates were commonly resistant to penicillin (21.5%) and 23% of Hib isolates were simultaneously resistant to ampicillin, co-trimoxazole and chloramphenicol. The case fatality rate in patients with a recognised bacterial pathogen was 13.4% compared to 8.5% in culture-negative patients. **CONCLUSIONS:** If implemented in routine expanded programme of immunisation (EPI) with high coverage, current PCVs could prevent almost half of pneumococcal meningitis cases. Given the

diversity of circulating serotypes in PNG serotype replacement is of concern. Ongoing surveillance is imperative to monitor the impact of vaccines. In the longer term vaccines providing broader protection against pneumococcal meningitis will be needed.

- 49 **Greenhill AR, Tsuji H, Ogata K, Natsuhara K, Morita A, Soli K, Larkins JA, Tadokoro K, Odani S, Baba J, Naito Y, Tomitsuka E, Nomoto K, Siba PM, Horwood PF, Umezaki M.**

Characterization of the gut microbiota of Papua New Guineans using reverse transcription quantitative PCR.

PLoS One 2015 Feb 6;10(2):e0117427. doi: 10.1371/journal.pone.0117427. eCollection 2015.

There has been considerable interest in composition of gut microbiota in recent years, leading to a better understanding of the role the gut microbiota plays in health and disease. Most studies have been limited in their geographical and socioeconomic diversity to high-income settings, and have been conducted using small sample sizes. To date, few analyses have been conducted in low-income settings, where a better understanding of the gut microbiome could lead to the greatest return in terms of health benefits. Here, we have used quantitative real-time polymerase chain reaction targeting dominant and sub-dominant groups of microorganisms associated with human gut microbiome in 115 people living a subsistence lifestyle in rural areas of Papua New Guinea. Quantification of *Clostridium coccoides* group, *C. leptum* subgroup, *C. perfringens*, *Bacteroides fragilis* group, *Bifidobacterium*, *Atopobium* cluster, *Prevotella*, Enterobacteriaceae, *Enterococcus*, *Staphylococcus*, and *Lactobacillus* spp. was conducted. Principal coordinates analysis (PCoA) revealed two dimensions with *Prevotella*, clostridia, *Atopobium*, Enterobacteriaceae, *Enterococcus* and *Staphylococcus* grouping in one dimension, and *B. fragilis*, *Bifidobacterium* and *Lactobacillus* grouping in the second dimension. Highland people had higher numbers of most groups of bacteria detected, and this is likely a key factor for the differences revealed by PCoA between highland and lowland study participants. Age and sex were not major determinants in microbial population composition. The study demonstrates a gut microbial composition with some similarities to those observed in other low-income settings where traditional diets are consumed, which have previously been suggested to favor energy extraction from a carbohydrate rich diet.

- 50 **Greenhill SJ.** TransNewGuinea.org: an online database of New Guinea languages.

PLoS One 2015 Oct 27;10(10):e0141563.

The island of New Guinea has the world's highest linguistic diversity, with more than 900 languages divided into at least 23 distinct language families. This diversity includes the world's third largest language family: Trans-New Guinea. However, the region is one of the world's least well studied, and primary data is scattered across a wide range of publications and more often than not hidden in unpublished "gray" literature. The lack of primary research data on the New Guinea languages has been a major impediment to our understanding of these languages, and the history of the peoples in New Guinea. TransNewGuinea.org aims to collect

data about these languages and place them online in a consistent format. This database will enable future research into the New Guinea languages with both traditional comparative linguistic methods and novel cutting-edge computational techniques. The long-term aim is to shed light into the prehistory of the peoples of New Guinea, and to understand why there is such major diversity in their languages.

- 51 **Gutiérrez JM, Burnouf T, Harrison RA, Calvete JJ, Brown N, Jensen SD, Warrell DA, Williams DJ; Global Snakebite Initiative.**

A call for incorporating social research in the global struggle against snakebite.

PLoS Negl Trop Dis 2015 Sep 17;9(9):e0003960. doi: 10.1371/journal.pntd.0003960. eCollection 2015.

- 52 **Harrington H, Bradbury R, Taeka J, Asugeni J, Asugeni V, Igeni T, Gwala J, Newton L, Fa CE, anuabae, Kilivisi FL, Esau D, Flores A, Ribeyro E, Liku D, Muse A, Asugeni L, Talana J, Shield J, MacLaren DJ, Massey PD, Muller R, Speare R.** Prevalence of soil-transmitted helminths in remote villages in East Kwaio, Solomon Islands.

Western Pac Surveill Response J 2015 Aug 10;6(3):51-58. doi: 10.5365/WPSAR.2015.6.1.016.

OBJECTIVE: Although soil-transmitted helminths (STH) are endemic in Solomon Islands, there are few recent reports on their prevalence. This study aimed to determine the prevalence of STH in residents of remote communities in Solomon Islands. **METHODS:** A cross-sectional convenience-sampled survey of residents of four adjacent villages in Malaita, Solomon Islands was performed in Atoifi and Na'au in April 2011 and in Abitona and Sifilo in April 2012. All residents older than one year were invited to participate, which involved providing a single sample of faeces examined using a modified Kato-Katz technique and completing a questionnaire that asked demographic and STH-related behaviour questions. **RESULTS:** The overall participation rate was 52.8%, with 402 participants comprising 49.8% males. Hookworm was the predominant STH with only a single case of trichuriasis found in Atoifi. The total prevalence of hookworm was 22.6% (95% confidence interval: 18.6-27.1); the prevalence of hookworm in Abitona, Na'au and Sifilo was 20.0%, 29.9% and 27.4%, respectively, whereas in Atoifi it was 2.3% ($p < 0.001$). Intensity was low in all villages. Although health behaviours differed significantly between Atoifi and the other three villages, the type of toilet used was the only significant association with hookworm. **DISCUSSION:** Residents of Atoifi have a relative freedom from STH compared to the other three villages. Rather than a region-wide morbidity control approach, a 'one village at a time' approach aiming to eliminate STH and dealing with each village as a separate autonomous unit empowered to manage its own challenges may be a preferred option.

- 53 **Haslam NR.**

Post-mortem as preventative medicine in Papua New Guinea: a case in point.

Rural Remote Health 2015 Oct-Dec;15(4):2861. Epub 2015 Oct 31.

CONTEXT: Sorcery-related killing and violence has increased in Papua New Guinea (PNG) in recent years. The international community has condemned the violence and a number of non-

government organisations have called for action; however, effective and appropriate interventions at a community level remain elusive. It has been suggested within some communities and in the literature that post-mortems may help to reduce fears of sorcery and associated violence by providing an alternative biomedical explanation of death. Evidence to support this proposal, however, is limited. **ISSUE:** In 2012 the author was working in Ok Tedi Hospital, Tabubil, a remote mining town in the Star Mountains of PNG. The area is notable for a recent rise in sorcery-related violence and murders since 2009. In March 2012 a family from a nearby village requested a post-mortem following a relative's sudden death. They clearly stated that violence and killings against suspected perpetrators of sorcery had occurred due to a similar sudden death only a year before. As such they were concerned that the nature of their relative's death would rouse suspicions of sorcery and result in violence. The family hoped that a medical explanation of their relative's death would prevent rumours of sorcery developing and reduce the risk of violence against suspected perpetrators of sorcery. **LESSONS LEARNED:** The post-mortem, led by a consultant surgeon and performed in Ok Tedi Hospital, Tabubil, concluded that death was due to complications from an acute myocardial infarction. As requested these results were presented at the funeral to a congregation of approximately 80 people. Following the funeral presentation the author received feedback that fears of sorcery had been alleviated and during a 2-week follow-up period no related violence against suspected perpetrators of sorcery was observed. This case is a unique and intriguing example of biomedical and sociocultural integration in the Highlands of PNG. The presence of Ok Tedi Mine, which has provided wealth, education, transport and medical resources to the area for over 30 years, no doubt can partly explain the family's actions. For the family, however, a recent increase in sorcery-related violence would appear to be the primary reason for requesting a post-mortem. Whether these actions reduced suspicions of sorcery and the risk of subsequent violence as the family had anticipated is unclear. However, given a recent rise in post-mortem requests from regions of PNG with some of the highest rates of sorcery-related killings it seems prudent to further investigate the role of post-mortems in the prevention of sorcery-related violence and killings.

- 54 **Hemer SR.**

Breaking silences and upholding confidences: responding to HIV in the Lihir Islands, Papua New Guinea.

Med Anthropol 2015;34(2):124-138. doi: 10.1080/01459740.2014.944263. Epub 2014 Sep 16.

Various forms of silence are understood to characterize the response to HIV/AIDS in the Lihir Islands in Papua New Guinea. While some efforts have been made to prevent HIV and educate residents, these seem not to have been in proportion to its classification as a high-risk setting for transmission, given social factors associated with the Lihir gold mine. Confidentiality is both practiced yet critiqued in Lihir as another form of silencing that detracts from efforts to emphasize the serious nature of HIV, promote its prevention, and care for those who live with it. 'Breaking the silence' has come to be seen as key to preventing HIV in Lihir, yet while

certain silences are acknowledged, others have escaped scrutiny.

- 55 **Herbst K, Juvekar S, Bhattacharjee T, Bangha M, Patharia N, Tei T, Gilbert B, Sankoh O.** The INDEPTH Data Repository: an international resource for longitudinal population and health data from health and demographic surveillance systems. *J Empir Res Hum Res Ethics* 2015 Jul;10(3):324-333. doi: 10.1177/1556264615594600.

The International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH) is a global network of research centers that conduct longitudinal health and demographic evaluation of populations in low- and middle-income countries (LMICs) currently in 52 health and demographic surveillance system (HDSS) field sites situated in sub-Saharan Africa (14 countries), Asia (India, Bangladesh, Thailand, Vietnam, and Indonesia), and Oceania (Papua New Guinea). Through this network of HDSS field sites, INDEPTH is capable of producing reliable longitudinal data about the lives of people in the research communities as well as how development policies and programs affect those lives. The aim of the INDEPTH Data Repository is to enable INDEPTH member centers and associated researchers to contribute and share fully documented, high-quality datasets with the scientific community and health policy makers.

- 56 **Hetzel MW, Morris H, Tarongka N, Barnadas C, Pulford J, Makita L, Siba PM, Mueller I.** Prevalence of malaria across Papua New Guinea after initial roll-out of insecticide-treated mosquito nets. *Trop Med Int Health* 2015 Dec;20(12):1745-1755. doi: 10.1111/tmi.12616. Epub 2015 Oct 20.

OBJECTIVES: To assess the population prevalence of malaria in villages across Papua New Guinea (PNG) following the first roll-out of free long-lasting insecticidal nets (LLIN). **METHODS:** Between October 2008 and August 2009, a household survey was conducted in 49 random villages in districts covered by the LLIN distribution campaign. The survey extended to 19 villages in sentinel sites that had not yet been covered by the campaign. In each village, 30 households were randomly sampled, household heads were interviewed and capillary blood samples were collected from all consenting household members for microscopic diagnosis of malaria. **RESULTS:** Malaria prevalence ranged from 0% to 49.7% with a weighted average of 12.1% (95% CI 9.5-15.3) in the national sample. More people were infected with *Plasmodium falciparum* (7.0%; 95% CI 5.4-9.1) than with *P. vivax* (3.8%; 95% CI 2.4-5.7) or *P. malariae* (0.3%; 95% CI 0.1-0.6). Parasitaemia was strongly age-dependent with a *P. falciparum* peak at age 5-9 years and a *P. vivax* peak at age 1-4 years, yet with differences between geographical regions. Individual LLIN use and high community coverage were associated with reduced odds of infection (OR = 0.64 and 0.07, respectively; both $p < 0.001$). Splenomegaly in children and anaemia were common morbidities attributable to malaria. **CONCLUSIONS:** Malaria prevalence across PNG is again at levels comparable to the 1970s. The strong association of LLIN use with reduced parasitaemia supports efforts to achieve and maintain high country-wide coverage. *P. vivax* infections will require special targeted approaches across PNG.

- 57 **Hofmann N, Mwingira F, Shekalaghe S, Robinson LJ, Mueller I, Felger I.**

Ultra-sensitive detection of *Plasmodium falciparum* by amplification of multi-copy subtelomeric targets. *PLoS Med* 2015 Mar 3;12(3):e1001788. doi: 10.1371/journal.pmed.1001788. eCollection 2015.

BACKGROUND: Planning and evaluating malaria control strategies relies on accurate definition of parasite prevalence in the population. A large proportion of asymptomatic parasite infections can only be identified by surveillance with molecular methods, yet these infections also contribute to onward transmission to mosquitoes. The sensitivity of molecular detection by PCR is limited by the abundance of the target sequence in a DNA sample; thus, detection becomes imperfect at low densities. We aimed to increase PCR diagnostic sensitivity by targeting multi-copy genomic sequences for reliable detection of low-density infections, and investigated the impact of these PCR assays on community prevalence data. **METHODS AND FINDINGS:** Two quantitative PCR (qPCR) assays were developed for ultra-sensitive detection of *Plasmodium falciparum*, targeting the high-copy telomere-associated repetitive element 2 (TARE-2, ~250 copies/genome) and the var gene acidic terminal sequence (varATS, 59 copies/genome). Our assays reached a limit of detection of 0.03 to 0.15 parasites/ μ l blood and were 10 \times more sensitive than standard 18S rRNA qPCR. In a population cross-sectional study in Tanzania, 295/498 samples tested positive using ultra-sensitive assays. Light microscopy missed 169 infections (57%). 18S rRNA qPCR failed to identify 48 infections (16%), of which 40% carried gametocytes detected by pfs25 quantitative reverse-transcription PCR. To judge the suitability of the TARE-2 and varATS assays for high-throughput screens, their performance was tested on sample pools. Both ultra-sensitive assays correctly detected all pools containing one low-density *P. falciparum*-positive sample, which went undetected by 18S rRNA qPCR, among nine negatives. TARE-2 and varATS qPCRs improve estimates of prevalence rates, yet other infections might still remain undetected when absent in the limited blood volume sampled. **CONCLUSIONS:** Measured malaria prevalence in communities is largely determined by the sensitivity of the diagnostic tool used. Even when applying standard molecular diagnostics, prevalence in our study population was underestimated by 8% compared to the new assays. Our findings highlight the need for highly sensitive tools such as TARE-2 and varATS qPCR in community surveillance and for monitoring interventions to better describe malaria epidemiology and inform malaria elimination efforts.

- 58 **Ibell C, Sheridan SA, Hill PS, Tasserei J, Maleb MF, Rory JJ.**

The individual, the government and the global community: sharing responsibility for health post-2015 in Vanuatu, a small island developing state. *Int J Equity Health* 2015 Oct 24;14:102. doi: 10.1186/s12939-015-0244-1.

INTRODUCTION: The end of 2015 will see the creation of the Sustainable Development Goals – the new global framework for development. The process of creating universally relevant goals has involved community consultation throughout the world. Within this process it is vital that Pacific Island countries are included as they face particular development challenges due to their size and

geographical location. As small island developing states, many Pacific Island countries struggle to overcome high rates of poverty and poor health outcomes. In order to include Pacific voices in the new health related Sustainable Development Goals, Vanuatu was selected as a representative of the Pacific for this qualitative study. This paper presents the perspectives of communities throughout Vanuatu on their essential health needs and how best to meet them. **METHODS:** This paper examines the perspectives of 102 individuals from throughout Vanuatu. Ten focus group discussions and 2 individual interviews were conducted within communities in September 2013. Discussions focused on community perceptions of health, essential health needs, and responsibility in achieving health needs. Discussions were audio recorded and transcribed. The transcripts were then analysed using a theoretical thematic approach in order to identify central themes and subthemes. **RESULTS:** Individuals in this study demonstrated a comprehensive understanding of health, defining health in a holistic manner. Participants identified clear environmental and societal factors that impact upon health, and emphasized failures within the current health system as important barriers to attaining good health. Participants described the challenges faced in taking responsibility for one's health, and pointed to both the government and the international community as key players in meeting the essential health needs of communities. **CONCLUSIONS:** As a small island developing state, Vanuatu faces accentuated development challenges - particularly as globalisation and climate change progress. The individuals and communities in this study demonstrate a clear understanding of their needs, and show a strong desire for change. They point to both the government and the international community to assist in meeting health needs, and stress that respect for traditional governance and community involvement in decision-making are vital in this process. In order to ensure that the new health goals effectively meet local needs in Vanuatu such factors must be incorporated into policy and implementation decision-making.

59 Irani V, Ramsland PA, Guy AJ, Siba PM, Mueller I, Richards JS, Beeson JG.

Acquisition of functional antibodies that block the binding of erythrocyte-binding antigen 175 and protection against *Plasmodium falciparum* malaria in children.

Clin Infect Dis 2015 Oct 15;61(8):1244-1252. doi: 10.1093/cid/civ525. Epub 2015 Jul 1.

BACKGROUND: The targets and mechanisms of human immunity to malaria are poorly understood, which poses a major barrier to malaria vaccine development. Antibodies play a key role in human immunity and may act by inhibiting receptor-binding functions of key merozoite invasion ligands. Antibodies to the major invasion ligand and vaccine candidate, erythrocyte-binding antigen 175 (EBA-175), have been linked with protection, but how these antibodies function has not been established. **METHODS:** We developed 2 new assays that quantify the ability of antibodies to inhibit binding of EBA-175 to its erythrocyte receptor, glycophorin A, using either native or recombinant EBA-175. Binding-inhibitory antibodies were evaluated in a longitudinal cohort study of Papua New Guinean children and related to risk of malaria, age, infection

status, and markers of parasite exposure. **RESULTS:** Binding-inhibition assays (BIAs) were reproducible, and the 2 assays had a high level of agreement. Inhibitory antibodies were common among children, acquired in association with markers of increasing parasite exposure, and high in those children with active infection. Inhibitory antibodies correlated with total immunoglobulin G levels to the EBA-175 binding domain (region II). Importantly, binding-inhibitory antibodies were significantly associated with protection from symptomatic malaria when measured using either BIA. **CONCLUSIONS:** Findings suggest that naturally acquired binding-inhibitory antibodies are an important functional mechanism that contributes to protection against malaria and further supports the potential of EBA-175 as a vaccine candidate. Identifying vaccines and approaches that induce potent binding-inhibitory antibodies may be a valuable strategy in the development of highly efficacious malaria vaccines.

60 Isba R, Zani B, Gathu M, Sinclair D.

Artemisinin-naphthoquine for treating uncomplicated *Plasmodium falciparum* malaria.

Cochrane Database Syst Rev 2015 Feb 23;2:CD011547. doi: 10.1002/14651858.CD011547.

BACKGROUND: The World Health Organization (WHO) recommends artemisinin-based combination therapy (ACT) for treating people with *Plasmodium falciparum* malaria. Five combinations are currently recommended, all administered over three days. Artemisinin-naphthoquine is a new combination developed in China, which is being marketed as a one-day treatment. Although shorter treatment courses may improve adherence, the WHO recommends at least three days of the short-acting artemisinin component to eliminate 90% *P. falciparum* parasites in the bloodstream, before leaving the longer-acting partner drug to clear the remaining parasites. **OBJECTIVES:** To evaluate the efficacy and safety of the artemisinin-naphthoquine combination for treating adults and children with uncomplicated *P. falciparum* malaria. **SEARCH METHODS:** We searched the Cochrane Infectious Diseases Group Specialized Register; Cochrane Central Register of Controlled Trials (CENTRAL) published in The Cochrane Library; MEDLINE; EMBASE; and LILACS up to January 2015. We also searched the metaRegister of Controlled Trials (mRCT) using 'malaria' and 'arte* OR dihydroarte*' as search terms. **SELECTION CRITERIA:** Randomized controlled trials comparing artemisinin-naphthoquine combinations with established WHO-recommended ACTs for the treatment of adults and children with uncomplicated malaria due to *P. falciparum*. **DATA COLLECTION AND ANALYSIS:** Two review authors independently assessed trials for eligibility and risk of bias, and extracted data. We analysed primary outcomes in line with the WHO 'Protocol for assessing and monitoring antimalarial drug efficacy' and compared drugs using risk ratios (RR) and 95% confidence intervals (CI). Secondary outcomes were effects on gametocytes, haemoglobin, and adverse events. We assessed the quality of evidence using the GRADE approach. **MAIN RESULTS:** Four trials, enrolling 740 adults and children, met the inclusion criteria. Artemisinin-naphthoquine was administered as a single dose (two trials), as two doses given eight hours apart (one trial), and once daily for three days (one trial), and compared to three-day regimens of established ACTs. Three

additional small pharmaceutical company trials have been carried out. We have requested the data but have not received a response from the company. *Artemisinin-naphthoquine versus artemether-lumefantrine* In three small trials from Benin, Côte d'Ivoire, and Papua New Guinea, both combinations had a very low incidence of treatment failure at Day 28, and there were no differences demonstrated in PCR-unadjusted, or PCR-adjusted treatment failure (three trials, 487 participants, low quality evidence). Only the single study from Papua New Guinea followed participants up to Day 42, and the number of treatment failures remained very low with both combinations (one trial, 186 participants, very low quality evidence). *Artemisinin-naphthoquine versus dihydroartemisinin-piperaquine* In a single small trial from Indonesia, treatment failure at Day 28 and Day 42 was very low in both groups with no differences demonstrated (one trial, 144 participants, very low quality evidence). **AUTHORS' CONCLUSIONS:** The results of these few trials of artemisinin-naphthoquine are promising, but further trials from multiple settings are required to reliably demonstrate the relative efficacy and safety compared to established ACTs. Future trials should be adequately powered to demonstrate non-inferiority, and regimens incorporating three days of the artemisinin component are probably preferable to the one-day regimens.

61 Isozumi R, Fukui M, Kaneko A, Chan CW, Kawamoto F, Kimura M.

Improved detection of malaria cases in island settings of Vanuatu and Kenya by PCR that targets the *Plasmodium* mitochondrial cytochrome c oxidase III (cox3) gene.

Parasitol Int 2015 Jun;64(3):304-308. doi: 10.1016/j.parint.2014.09.006. Epub 2014 Sep 22.

Detection of sub-microscopic parasitemia is crucial for all malaria elimination programs. PCR-based methods have proven to be sensitive, but two rounds of amplification (nested PCR) are often needed to detect the presence of *Plasmodium* DNA. To simplify the detection process, we designed a nested PCR method whereby only the primary PCR is required for the detection of the four major human *Plasmodium* species. Primers designed for the detection of the fifth species, *Plasmodium knowlesi*, were not included in this study due to the absence of appropriate field samples. Compared to the standard 18S rDNA PCR method, our cytochrome c oxidase III (cox3) method detected 10-50% more cases while maintaining high sensitivities (1.00) for all four *Plasmodium* species in our samples from Vanuatu (n = 77) and Kenya (n = 76). Improvement in detection efficiency was more substantial for samples with sub-microscopic parasitemia (54%) than those with observable parasitemia (10-16%). Our method will contribute to improved malaria surveillance in low endemicity settings.

62 Jayathunge PH, McBride WJ, MacLaren D, Browne K.

Men in Papua New Guinea accurately report their circumcision status.

PLoS One 2015 Apr 13;10(4):e0123429. doi: 10.1371/journal.pone.0123429. eCollection 2015.

BACKGROUND: Male circumcision (MC) is a well-established component of HIV prevention in countries with high HIV prevalence and heterosexually driven epidemics. Delivery and

monitoring of MC programs are reliant on good quality MC data. Such data are often generated through self-reported MC status surveys. This study examined self-reported MC status in comparison with genital photographs from men in Papua New Guinea (PNG). **METHODS:** This retrospective non-interventional study collated self-reported MC status data from the 'acceptability and feasibility of MC' study at 4 sites in PNG during 2010-2011. Participants reported their MC status based on an 8-category photographic classification covering the range of foreskin cutting practices in PNG. Genital photographs of 222 participants from this study were independently classified by 2 investigators. The 8-category photographic classification was simplified into a 3 category classification of 'no cut', 'straight cut' and 'round cut' before comparing for agreement between self-reporting and investigator assessment using Cohen's Kappa measure. **RESULTS:** Using the 3-category classification, there was 90.6% (201/222) agreement between self-assessment and investigator classification (κ value 0.805). Of the discordant 9.4% (21/222), 3.6% (8/222) self-classified as having a cut foreskin (5 straight cut; 3 round cut) while investigators classified as having no cut; 4.1% (9/222) self-classified as having no cut while investigators classified them as having had a cut (6 straight cut; 3 round cut) and 1.8% (4/222) self-classified as having a round cut while investigators classified as having a straight cut. Given the great variety of foreskin cutting practices and appearances, feasible explanations are suggested for two-thirds (13/21) of these discordant results. **CONCLUSIONS:** This study demonstrates a high level of agreement between self-reporting and investigator assessment of MC status in PNG and suggests self-reporting of MC status to be highly reliable among men in PNG.

63 Jennison C, Arnott A, Tessier N, Tavul L, Koepfli C, Felger I, Siba PM, Reeder JC, Bahlo M, Mueller I, Barry AE.

Plasmodium vivax populations are more genetically diverse and less structured than sympatric *Plasmodium falciparum* populations.

PLoS Negl Trop Dis 2015 Apr 15;9(4):e0003634. doi: 10.1371/journal.pntd.0003634. eCollection 2015.

INTRODUCTION: The human malaria parasite, *Plasmodium vivax*, is proving more difficult to control and eliminate than *Plasmodium falciparum* in areas of co-transmission. Comparisons of the genetic structure of sympatric parasite populations may provide insight into the mechanisms underlying the resilience of *P. vivax* and can help guide malaria control programs. **METHODOLOGY/PRINCIPAL FINDINGS:** *P. vivax* isolates representing the parasite populations of four areas on the north coast of Papua New Guinea (PNG) were genotyped using microsatellite markers and compared with previously published microsatellite data from sympatric *P. falciparum* isolates. The genetic diversity of *P. vivax* ($H_e = 0.83-0.85$) was higher than that of *P. falciparum* ($H_e = 0.64-0.77$) in all four populations. Moderate levels of genetic differentiation were found between *P. falciparum* populations, even over relatively short distances (less than 50 km), with 21-28% private alleles and clear geospatial genetic clustering. Conversely, very low population differentiation was found between *P. vivax* catchments, with less than 5% private alleles and no genetic clustering observed. In addition, the

effective population size of *P. vivax* (30353; 13043-69142) was larger than that of *P. falciparum* (18871; 8109-42986). **CONCLUSIONS/SIGNIFICANCE:** Despite comparably high prevalence, *P. vivax* had higher diversity and a panmictic population structure compared to sympatric *P. falciparum* populations, which were fragmented into subpopulations. The results suggest that in comparison to *P. falciparum*, *P. vivax* has had a long-term large effective population size, consistent with more intense and stable transmission, and limited impact of past control and elimination efforts. This underlines suggestions that more intensive and sustained interventions will be needed to control and eventually eliminate *P. vivax*. This research clearly demonstrates how population genetic analyses can reveal deeper insight into transmission patterns than traditional surveillance methods.

- 64 **Johnson SL, Baker AL, Chain PS, Currie BJ, Daligault HE, Davenport KW, Davis CB, Inglis TJ, Kaestli M, Koren S, Mayo M, Merritt AJ, Price EP, Sarovich DS, Warner J, Rosovitz MJ.**

Whole-genome sequences of 80 environmental and clinical isolates of *Burkholderia pseudomallei*. *Genome Announc* 2015 Feb 12;3(1). pii: e01282-14. doi: 10.1128/genomeA.01282-14.

Here, we present the draft genome sequences of 80 isolates of *Burkholderia pseudomallei*. The isolates represent clinical cases of melioidosis and environmental isolates from regions in Australia and Papua New Guinea where *B. pseudomallei* is endemic. The genomes provide further context for the diversity of the pathogen.

- 65 **Jollant F, Macdonald C.**

Endogamy and suicide: an observation-based hypothesis.

Med Hypotheses 2015 Nov;85(5):542-547. doi: 10.1016/j.mehy.2015.07.010. Epub 2015 Jul 17.

Suicide is a complex and multifactorial behavior, which is likely the result of distinct pathways in different individuals or groups. Endogamy has been associated with numerous diseases, including behavioral disorders. Here, we discuss the hypothesis of endogamy as one mechanism facilitating high rates of suicide in some small and isolated groups of people across the world. To support our hypothesis, we describe four geographically and culturally distinct populations (the Aguarunas of Peru, the Vaqueiros of Spain, the Baruyas of New Guinea, and the Palawans of the Philippines), which present the following characteristics: (1) a high level of isolation and endogamy; (2) very high rates of suicide restricted to one group with (3) adjacent groups of similar origin and culture displaying low rates of suicide. Within these four distinct populations, endogamy could act in one isolated group as the amplifier of both selected genetic risk alleles and microcultural values (e.g. suicide as an acceptable solution), beyond cultural and genetic traits shared by the whole population (and therefore found in all groups). Genetic and microcultural risk factors are transmitted through close kinship and imitation/modeling, and could interact to increase the frequency of vulnerable individuals leading, in turn, to heightened rates of suicide. Culture could sometimes additionally act by generating stressful conditions for some individuals (eg, lower social status and maltreatment). In contrast to endogamy, suicide motives (notably interpersonal conflicts) and

mental disorders appear to be universal risk factors. More investigation of this endogamy hypothesis is necessary, which could represent a singular case of gene-culture co-transmission and shed light on particular conditions of suicide genesis.

- 66 **Jones HA, Charlton KE.**

A cross-sectional analysis of the cost and affordability of achieving recommended intakes of non-starchy fruits and vegetables in the capital of Vanuatu.

BMC Public Health 2015 Mar 28;15:301. doi: 10.1186/s12889-015-1644-2.

BACKGROUND: The low-income Pacific Island nation of Vanuatu is experiencing a double burden of diet-related disease whereby micronutrient deficiencies and underweight occur at the same time as obesity related non-communicable diseases. Increasing intakes of nutrient dense, energy dilute foods such as fruits and vegetables will be important to address this issue. However, reduced access to agricultural land in urban areas provides limited opportunities for traditional subsistence fruit and vegetable production. Set in Port Vila, Vanuatu's capital and main urban centre, this study aimed to determine the cost and affordability of meeting international recommendations to consume at least 400 g of non-starchy fruits and vegetables (NSFV) per person per day, and assess the adequacy of households' NSFV expenditure. **METHODS:** NSFV prices from the 2010 Vanuatu Consumer Price Index (n=56) were used to determine the minimum monthly cost of purchasing 400 g of local NSFV per person, after accounting for wastage. The 2010 Vanuatu Household Income and Expenditure Survey (n=578 households) was analysed to determine the proportion of households' total and food budget required to purchase 400 g of local NSFV for all household members. Household NSFV costs were also compared against actual household expenditure on these items. Consumption of own-produce and gifts received were included within estimates of food expenditure. **RESULTS:** The minimum cost of purchasing the recommended amount of local NSFV was 1,486.24 vatu (\$16.60 US) per person per month. This level of expenditure would require an average of 9.6% (SD 6.4%) of households' total budget and 26.3% (SD 25.8%) of their food budget. The poorest households would need to allocate 40.9% (SD 34.3%) of their total food budget to NSFV to purchase recommended amounts of these foods. Twenty-one percent of households recorded sufficient NSFV expenditure while 23.4% recorded less than 10% of the expenditure required to meet the NSFV recommendations. **CONCLUSIONS:** Achieving recommended intakes of local NSFV in Port Vila is largely unaffordable, and expenditure on these foods was inadequate for most households in Port Vila in 2010. Addressing fruit and vegetable affordability will be an important consideration in prevention of non-communicable diseases in the Pacific region.

- 67 **Karl S, Laman M, Moore BR, Benjamin J, Koleala T, Ibam C, Kasian B, Siba PM, Waltmann A, Mueller I, Woodward RC, St Pierre TG, Davis TME.**

Gametocyte clearance kinetics determined by quantitative magnetic fractionation in Melanesian children with uncomplicated malaria treated with artemisinin combination therapy.

Antimicrob Agents Chemother 2015 Aug;59(8):4489-

4496. doi: 10.1128/AAC.00136-15. Epub 2015 May 18.

Quantitative magnetic fractionation and a published mathematical model were used to characterize between-treatment differences in gametocyte density and prevalence in 70 Papua New Guinean children with uncomplicated *Plasmodium falciparum* and/or *Plasmodium vivax* malaria randomized to one of two artemisinin combination therapies (artemether-lumefantrine or artemisinin-naphthoquine) in an intervention trial. There was an initial rise in peripheral *P. falciparum* gametocyte density with both treatments, but it was more pronounced in the artemisinin-naphthoquine group. Model-derived estimates of the median pretreatment sequestered gametocyte population were 21/μl for artemether-lumefantrine and 61/μl for artemisinin-naphthoquine ($p < 0.001$). The median time for *P. falciparum* gametocyte density to fall to $< 2.5/\mu\text{l}$ (below which transmission becomes unlikely) was 16 days in the artemether-lumefantrine group and 20 days in artemisinin-naphthoquine group ($p < 0.001$). Gametocyte prevalence modeling suggested that artemisinin-naphthoquine-treated children became gametocytemic faster (median, 2.2 days) than artemether-lumefantrine-treated children (median, 5.3 days; $p < 0.001$) and had a longer median *P. falciparum* gametocyte carriage time per individual (20 versus 13 days; $p < 0.001$). Clearance of *P. vivax* gametocytes was rapid (within 3 days) in both groups; however, consistent with the reappearance of asexual forms in the main trial, nearly 40% of children in the artemether-lumefantrine group developed *P. vivax* gametocytemia between days 28 and 42 compared with 3% of children in the artemisinin-naphthoquine group. These data suggest that artemisinin is less active than artemether against sequestered gametocytes. Greater initial gametocyte release after artemisinin-naphthoquine increases the period of potential *P. falciparum* transmission by 4 days relative to artemether-lumefantrine, but the longer elimination half-life of naphthoquine than of lumefantrine suppresses *P. vivax* recurrence and consequent gametocytemia.

- 68 **Karl S, Jones MK, Gutiérrez L, Moore B, Kattenberg E, Lacerda M.** Challenges for diagnosis of malaria and neglected tropical diseases in elimination settings. *Biomed Res Int* 2015;2015:270756. doi: 10.1155/2015/270756. Epub 2015 Nov 5.

- 69 **Karl S, Li Wai Suen CS, Unger HW, Ome-Kaius M, Mola G, White L, Wangnapi RA, Rogerson SJ, Mueller I.** Preterm or not – an evaluation of estimates of gestational age in a cohort of women from rural Papua New Guinea. *PLoS One* 2015 May 6;10(5):e0124286. doi: 10.1371/journal.pone.0124286. eCollection 2015.

BACKGROUND: Knowledge of accurate gestational age is required for comprehensive pregnancy care and is an essential component of research evaluating causes of preterm birth. In industrialised countries gestational age is determined with the help of fetal biometry in early pregnancy. Lack of ultrasound and late presentation to antenatal clinic limits this practice in low-resource settings. Instead, clinical estimators of gestational age are used, but their accuracy remains a matter of debate. **METHODS:** In a cohort of 688 singleton

pregnancies from rural Papua New Guinea, delivery gestational age was calculated from Ballard score, last menstrual period, symphysis-pubis fundal height at first visit and quickening as well as mid- and late pregnancy fetal biometry. Published models using sequential fundal height measurements and corrected last menstrual period to estimate gestational age were also tested. Novel linear models that combined clinical measurements for gestational age estimation were developed. Predictions were compared with the reference early pregnancy ultrasound (< 25 gestational weeks) using correlation, regression and Bland-Altman analyses and ranked for their capability to predict preterm birth using the harmonic mean of recall and precision (F-measure). **RESULTS:** Average bias between reference ultrasound and clinical methods ranged from 0-11 days (95% confidence levels: 14-42 days). Preterm birth was best predicted by mid-pregnancy ultrasound (F-measure: 0.72), and neuromuscular Ballard score provided the least reliable preterm birth prediction (F-measure: 0.17). The best clinical methods to predict gestational age and preterm birth were last menstrual period and fundal height (F-measures 0.35). A linear model combining both measures improved prediction of preterm birth (F-measure: 0.58). **CONCLUSIONS:** Estimation of gestational age without ultrasound is prone to significant error. In the absence of ultrasound facilities, last menstrual period and fundal height are among the more reliable clinical measures. This study underlines the importance of strengthening ultrasound facilities and developing novel ways to estimate gestational age.

- 70 **Karunajeewa H, Waltmann A, Wini L, Mueller I.** Missing malaria? Potential obstacles to diagnosis and hypnozoite eradication. *Med J Aust* 2015 Apr 20;202(7):360.

- 71 **Kelly-Hanku A, Kawage T, Vallely A, Mek A, Mathers B.** Sex, violence and HIV on the inside: cultures of violence, denial, gender inequality and homophobia negatively influence the health outcomes of those in closed settings. *Cult Health Sex* 2015;17(8):990-1003. doi: 10.1080/13691058.2015.1020877. Epub 2015 Apr 8.

To map the context of HIV in closed settings in Papua New Guinea (PNG), semi-structured interviews were undertaken with 56 prisoners and detainees and 60 key stakeholders. The nature of HIV-related risk differs for detained women and men, and reflects important gender-based issues present in PNG society more broadly. Women in detention are vulnerable to sexual violence and exploitation and at greatest risk of HIV while detained in police holding cells, where they are typically supervised by male officers, in contrast to prisons, where they have little contact with male staff. HIV risk for men in prison is associated with consensual and non-consensual sex; this risk is perpetuated by a pervasive culture of denial and institutionalised homophobia. The illegal nature of sodomy and male-to-male sex provides Correctional Services the legal grounds by which to refuse access to condoms for prisoners. Addressing HIV risk among detained men and women in PNG requires the reform of legislation, police and prison practices and an understanding of broader structural problems of gender-based violence and stigma and

discrimination.

72 **Kent LM, Reiersen P, Morton DP.**

'Live More': Study protocol for a community-based lifestyle education program addressing non-communicable diseases in low-literacy areas of the South Pacific.

BMC Public Health 2015 Dec 9;15(1):1221. doi: 10.1186/s12889-015-2560-1.

BACKGROUND: Non-communicable diseases (NCDs) have reached epidemic proportions in Pacific Island countries. Unhealthy lifestyle is one of the major risk factors and lifestyle interventions have been shown to be efficacious for primary, secondary and early tertiary prevention. However, there is a paucity of evidence regarding effective community-based lifestyle interventions in the Pacific Islands. The Complete Health Improvement Program for high-income countries was contextualised for rural communities with relatively low literacy rates in low-income countries using the REFLECT delivery approach. This study will assess the effect of this 'Live More' program to reduce participants' NCD risk factors and improve lifestyle behaviours associated with health and wellbeing, in low-literacy communities in countries of the South Pacific. **METHODS/DESIGN:** This study is a 6-month cluster-randomised controlled trial of 288 adults (equal proportions of men and women aged 18 years and over) with waist circumference of ≥ 92 cm for men and ≥ 80 cm for women in four rural villages in each of Fiji, Vanuatu and Solomon Islands. Participants will permanently reside in their village and be able to prepare their own meals. Two villages will be randomised to the 'Live More' intervention ($n=24$) or to control receiving only country-specific Ministry of Health literature ($n=24$). Intervention participants will meet three times a week in the first month, then once a week for the next two months and once a month for the last three months. Themes covered include: NCDs and their causes; and the benefits of positive lifestyle choices, positive psychology, stress management, forgiveness and self-worth, and how these influence long-term health habits. Outcome assessments at baseline, 30-days, 3-months and 6-months include body mass index, waist circumference, blood lipids, blood pressure and blood glucose. Secondary outcomes include changes in medication and substance use, diet, physical activity, emotional health and supportive relationships, collected by lifestyle questionnaire at the same time points. **DISCUSSION:** This is the first lifestyle intervention using the Reflect approach to target NCDs. The findings from the study will be used to guide broader delivery of a lifestyle intervention to improve health and wellbeing across the South Pacific.

73 **Kessaram T, McKenzie J, Girin N, Roth A, Vivili P, Williams G, Hoy D.**

Tobacco smoking in islands of the Pacific Region, 2001-2013.

Prev Chronic Dis 2015 Dec 3;12:E212. doi: 10.5888/pcd12.150155.

We provide an overview of tobacco smoking patterns in Pacific island countries and territories to facilitate monitoring progress toward the goal of a Tobacco-Free Pacific by 2025. We examined data from 4 surveys conducted in the region between 2001 and 2013, including the STEPwise approach to surveillance for adults (25-64 years); the Global School-Based Student Health Survey and the Global

Youth Tobacco Survey (students 13-15 years); and the Youth Risk Behavior Surveillance System (grade 9-12 students) in United States affiliated Pacific Islands (USAPIs). Adult smoking prevalence ranged from less than 5% of women in Vanuatu to almost 75% of men in Kiribati. Smoking prevalence among students (13-15 years) ranged between 5.6% and 52.1%. There were declines in smoking among youths in many USAPIs. To achieve the tobacco-free goal and reduce disease burden, accelerated action is needed to align national legislation with international agreements and build capacity for tobacco control at all levels.

74 **Kessaram T, McKenzie J, Girin N, Merilles OE Jr, Pullar J, Roth A, White P, Hoy D.**

Overweight, obesity, physical activity and sugar-sweetened beverage consumption in adolescents of Pacific islands: results from the Global School-Based Student Health Survey and the Youth Risk Behavior Surveillance System.

BMC Obes 2015 Sep 16;2:34. doi: 10.1186/s40608-015-0062-4. eCollection 2015.

BACKGROUND: Overweight, obesity and their consequences are challenges to sustainable social and economic development in Pacific island countries and territories (PICTs). Complementing previous analyses for adults, the purpose of this paper is to synthesise available data on overweight, obesity and their risk factors in adolescents in the region. The resulting Pacific perspective for the younger generation will inform both the national and regional public health response to the crisis of noncommunicable diseases. **METHODS:** We examined the prevalence of overweight, obesity, physical activity and carbonated sugar-sweetened beverage (SSB) consumption, by using published results of two cross-sectional surveys: the Global School-Based Student Health Survey (GSHS) and the Youth Risk Behavior Surveillance System (YRBSS). GSHS was conducted in ten PICTs between 2010 and 2013 and provided results for 13-15 year olds. YRBSS surveys, conducted repeatedly in five PICTs between 1999 and 2013, provided results for grade 9-12 students (approximately 14-18 years) and enabled examination of trends. **RESULTS:** Obesity prevalence ranged from 0% in female students in Vanuatu to 40% in males in Niue (GSHS). Among grade 9-12 students (YRBSS), obesity was highest in American Samoa (40% of males; 37% of females). Approximately 60% of students in the Cook Islands, Niue and Tonga (GSHS) and American Samoa (YRBSS), were overweight. In both surveys, less than half of students reported engaging in sixty minutes of physical activity on at least 5 days of the past week. Daily consumption of carbonated SSBs in the past month was reported by over 42% of students in six PICTs (GSHS), and in the past week by more than 18% of students in three PICTs (YRBSS). In PICTs conducting YRBSS, obesity prevalence remained high or increased within the period 1999-2013. **CONCLUSION:** There is a need for urgent action on overweight, obesity and their risk factors in Pacific youth. The multiple social, economic and physical determinants of this public health crisis must be addressed. This requires all sectors within government and society in PICTs to implement and evaluate policies that will protect and promote the health of their populations across the life course.

- 75 **Kevany S, Gildea A, Garae C, Moa S, Lautusi A.** Global health diplomacy, national integration, and regional development through the monitoring and evaluation of HIV/AIDS programs in Papua New Guinea, Vanuatu, and Samoa. *Int J Health Policy Manag* 2015 Apr 27;4(6):337-341. doi: 10.15171/ijhpm.2015.89.
- The South Pacific countries of Vanuatu, Samoa, and Papua New Guinea have ascended rapidly up the development spectrum in recent years, refining an independent and post-colonial economic and political identity that enhances their recognition on the world stage. All three countries have overcome economic, political and public health challenges in order to stake their claim to sovereignty. In this regard, the contributions of national and international programs for the diagnosis, treatment and prevention of HIV/AIDS, with specific reference to their monitoring and evaluation (M&E) aspects, have contributed not just to public health, but also to broader political and diplomatic goals such as 'nation-building'. This perspective describes the specific contributions of global health programs to the pursuit of national integration, development, and regional international relations, in Vanuatu, Samoa and Papua New Guinea, respectively, based on in-country M&E activities on behalf of the Global Fund to Fight AIDS, Tuberculosis (TB) and Malaria and the Australian Department of Foreign Affairs and Trade (DFAT) during 2014 and 2015. Key findings include: (1) that global health programs contribute to non-health goals; (2) that HIV/AIDS programs promote international relations, decentralized development, and internal unity; (3) that arguments in favour of the maintenance and augmentation of global health funding may be enhanced on this basis; and (4) that 'smart' global health approaches have been successful in South Pacific countries.
- 76 **Kinaston RL, Anson D, Petchey P, Walter R, Robb K, Buckley H.** Lapita diet and subsistence strategies on Watom Island, Papua New Guinea: new stable isotope evidence from humans and animals. *Am J Phys Anthropol* 2015 May;157(1):30-41. doi: 10.1002/ajpa.22685. Epub 2015 Jan 12.
- Stable isotope ratios ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) were analyzed from the bone collagen of individuals ($n = 8$) from a Lapita burial ground (ca. 2800-2350 BP) on Watom Island, located off northeast New Britain in the Bismarck Archipelago. The aim of this study was to assess the diet and subsistence strategies of humans that lived during the later Lapita period in Near Oceania. To aid in the interpretation of the human diet we analyzed the stable isotope ratios of faunal material from the site ($n = 27$). We also aim to assess methods of animal husbandry at the site over time from an analysis of the stable isotope ratios ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of pig bones ($n = 22$) from different temporal periods (Lapita, post-Lapita, and late prehistoric). The protein diet of the humans consisted of marine organisms from the inshore environment and some deep-water species, most likely marine turtle, in addition to higher trophic level terrestrial foods, likely pig and native animals (eg, fruit bat, cuscus and bandicoot). Although the sample sizes were small, females ($n = 4$) displayed more variable $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values compared with males ($n = 4$), which may be associated with the movement of adult females to the island. The stable isotope analysis of the pig bones indicated that there were few differences between the diets of the pigs from the Lapita and post-Lapita layers, suggesting that the method of pig husbandry was similar between these two periods and was likely relatively free-range.
- 77 **Kirby B, Mola G, Case C, Robson SJ.** The use of 'mother and baby gifts' (MBGs) to increase uptake of supervised births in the Milne Bay Province of Papua New Guinea. *Aust NZ J Obstet Gynaecol* 2015 Jun;55(3):291-293. doi: 10.1111/ajo.12325. Epub 2015 Jun 5.
- Improving access to supervised birth reduces mortality in developing countries. In the Milne Bay Province of Papua New Guinea, many women do not deliver at local health centres (HCs) because they feel 'shy' at presenting in an impoverished state and not having baby's clothes, and the state of facilities associated with HCs was poor. To overcome this, women were offered 'mother and baby gifts' (MBGs) at the time of delivery. We found subsequent increases in the rate of supervised birth in all HCs surveyed.
- 78 **Kitau R, Datta SS, Patel MK, Hennessey K, Wannemuehler K, Sui G, Lagani W.** Hepatitis B surface antigen seroprevalence among children in Papua New Guinea, 2012-2013. *Am J Trop Med Hyg* 2015 Mar;92(3):501-506. doi: 10.4269/ajtmh.14-0537. Epub 2015 Jan 12.
- Approximately 8% of the population in Papua New Guinea (PNG) has chronic hepatitis B virus (HBV) infection. To decrease the burden of chronic HBV infection, a national 3-dose infant hepatitis B vaccination program was implemented starting in 1989, with a birth dose (BD) added to the schedule in 1992. To assess the impact of the hepatitis B vaccination program, we conducted a serosurvey among children born after vaccine introduction. During 2012-2013, a cross-sectional stratified four-stage cluster survey was conducted to estimate hepatitis B surface antigen (HBsAg) prevalence among children 4-6 years of age. We collected demographic data, vaccination history, and tested children for HBsAg. Of 2,133 participants, 2,130 children had vaccination data by either card or recall: 28% received a BD; 81% received ≥ 3 vaccine doses. Of 2,109 children providing a blood sample, 60 (2.3%) tested positive for HBsAg. This is the largest, most geographically diverse survey of hepatitis B vaccination and HBsAg seroprevalence done in PNG. Progress has been made in PNG toward the Western Pacific Regional goal to reduce the prevalence of chronic HBV infection to <1% by 2017 among 5-year-old children. Vaccination efforts should be strengthened, including increasing BD coverage and completing the 3-dose series.
- 79 **Koch M, Kehop DA, Kinminja B, Sabak M, Wavimbukie G, Barrows KM, Matainaho TK, Barrows LR, Rai PP.** An ethnobotanical survey of medicinal plants used in the East Sepik Province of Papua New Guinea. *J Ethnobiol Ethnomed* 2015 Nov 14;11:79. doi: 10.1186/s13002-015-0065-8.
- BACKGROUND: Rapid modernization in the East Sepik (ES) Province of Papua New Guinea (PNG) is resulting in a decrease in individuals knowledgeable in medicinal plant use. Here we report a synthesis and comparison of traditional medicinal plant use from four ethnically distinct

- locations in the ES Province and furthermore compare them to two other previous reports of traditional plant use from different provinces of PNG. **METHODS:** This manuscript is based on an annotated combination of four Traditional Medicines (TM) survey reports generated by University of Papua New Guinea (UPNG) trainees. The surveys utilized a questionnaire titled "Information sheet on traditional herbal preparations and medicinal plants of PNG", administered in the context of the TM survey project which is supported by WHO, US NIH and PNG governmental health care initiatives and funding. Regional and transregional comparison of medicinal plant utilization was facilitated by using existing plant databases: the UPNG TM Database and the PNG Plant Database (PNG Plants) using Bayesian statistical analysis. **RESULTS:** Medicinal plant use between four distinct dialect study areas in the ES Province of PNG showed that only a small fraction of plants had shared use in each area, however usually utilizing different plant parts, being prepared differently and to treat different medical conditions. Several instances of previously unreported medicinal plants could be located. Medicinally under- and over-utilized plants were found both in the regional reports and in a transregional analysis, thus showing that these medicinal utilization frequencies differ between provinces. **CONCLUSIONS:** Documentation of consistent plant use argues for efficacy and is particularly important since established and effective herbal medicinal interventions are sorely needed in the rural areas of PNG, and unfortunately clinical validation for the same is often lacking. Despite the existence of a large corpus of medical annotation of plants for PNG, previously unknown medical uses of plants can be uncovered. Furthermore, comparisons of medicinal plant utilization is possible if databases are reformatted for consistencies that allow comparisons. A concerted effort in building easily comparable databases could dramatically facilitate ethnopharmacological analysis of the existing plant diversity.
- 80 **Koepfli C, Robinson LJ, Rarau P, Salib M, Sambale N, Wampfler R, Betuela I, Nuiatragool W, Barry AE, Siba P, Felger I, Mueller I.** Blood-stage parasitaemia and age determine *Plasmodium falciparum* and *P. vivax* gametocytaemia in Papua New Guinea. *PLoS One* 2015 May 21;10(5):e0126747. doi: 10.1371/journal.pone.0126747. eCollection 2015.
- A better understanding of human-to-mosquito transmission is crucial to control malaria. In order to assess factors associated with gametocyte carriage, 2083 samples were collected in a cross-sectional survey in Papua New Guinea. *Plasmodium* species were detected by light microscopy and qPCR and gametocytes by detection of pfs25 and pvs25 mRNA transcripts by reverse-transcriptase PCR (qRT-PCR). The parasite prevalence by PCR was 18.5% for *Plasmodium falciparum* and 13.0% for *P. vivax*. 52.5% of all infections were submicroscopic. Gametocytes were detected in 60% of *P. falciparum*-positive and 51% of *P. vivax*-positive samples. Each 10-fold increase in parasite density led to a 1.8-fold and 3.3-fold increase in the odds of carrying *P. falciparum* and *P. vivax* gametocytes. Thus the proportion of gametocyte positive and gametocyte densities was highest in young children carrying high asexual parasite densities and in symptomatic individuals. Dilution series of gametocytes allowed absolute quantification of gametocyte densities by qRT-PCR and showed that pvs25 expression is 10-20 fold lower than pfs25 expression. Between 2006 and 2010 parasite prevalence in the study site has decreased by half. 90% of the remaining infections were asymptomatic and likely constitute an important reservoir of transmission. However, mean gametocyte densities were low (approx. 1-2 gametocyte/ μ L) and it remains to be determined to what extent low-density gametocyte positive individuals are infective to mosquitos.
- 81 **Koleala T, Karl S, Laman M, Moore BR, Benjamin J, Barnadas C, Robinson LJ, Kattenberg JH, Javati S, Wong RP, Rosanas-Urgell A, Betuela I, Siba PM, Mueller I, Davis TME.** Temporal changes in *Plasmodium falciparum* anti-malarial drug sensitivity in vitro and resistance-associated genetic mutations in isolates from Papua New Guinea. *Malar J* 2015 Jan 28;14:37. doi: 10.1186/s12936-015-0560-3.
- BACKGROUND:** In northern Papua New Guinea (PNG), most *Plasmodium falciparum* isolates proved resistant to chloroquine (CQ) in vitro between 2005 and 2007, and there was near-fixation of *pfprt* K76T, *pfdhfr* C59R/S108N and *pfmdr1* N86Y. To determine whether the subsequent introduction of artemisinin combination therapy (ACT) and reduced CQ-sulphadoxine-pyrimethamine pressure had attenuated parasite drug susceptibility and resistance-associated mutations, these parameters were re-assessed between 2011 and 2013. **METHODS:** A validated fluorescence-based assay was used to assess growth inhibition of 52 *P. falciparum* isolates from children in a clinical trial in Madang Province. Responses to CQ, lumefantrine, piperazine, naphthoquine, pyronaridine, artesunate, dihydroartemisinin and artemether were assessed. Molecular resistance markers were detected using a multiplex PCR ligase detection reaction fluorescent microsphere assay. **RESULTS:** CQ resistance (in vitro concentration required for 50% parasite growth inhibition (IC_{50}) >100 nM) was present in 19% of isolates. All piperazine and naphthoquine IC_{50} s were <100 nM and those for lumefantrine, pyronaridine and the artemisinin derivatives were in low nM ranges. Factor analysis of IC_{50} s showed three groupings (lumefantrine; CQ, piperazine, naphthoquine; pyronaridine, dihydroartemisinin, artemether, artesunate). Most isolates (96%) were monoclonal *pfprt* K76T (SVMNT) mutants and most (86%) contained *pfmdr1* N86Y (YYSND). No wild-type *pfdhfr* was found but most isolates contained wild-type (SAKAA) *pfdhps*. Compared with 2005-2007, the geometric mean (95% CI) CQ IC_{50} was lower (87 (71-107) vs 167 (141-197) nM) and there had been no change in the prevalence of *pfprt* K76T or *pfmdr1* mutations. There were fewer isolates of the *pfdhps* (SAKAA) wild-type (60 vs 100%) and *pfdhfr* mutations persisted. **CONCLUSIONS:** Reflecting less drug pressure, in vitro CQ sensitivity appears to be improving in Madang Province despite continued near-fixation of *pfprt* K76T and *pfmdr1* mutations. Temporal changes in IC_{50} s for other anti-malarial drugs were inconsistent but susceptibility was preserved. Retention or increases in *pfdhfr* and *pfdhps* mutations reflect continued use of sulphadoxine-pyrimethamine in the study area including through paediatric intermittent preventive

treatment. The susceptibility of local isolates to lumefantrine may be unrelated to those of other ACT partner drugs.

82 **Konečná M, Urlacher SS.**

Effect of chewing betel nut (*Areca catechu*) on salivary cortisol measurement.

Am J Phys Anthropol 2015 Sep;158(1):151-154. doi: 10.1002/ajpa.22766. Epub 2015 Jun 8.

OBJECTIVES: Cultural practices may compromise the accuracy of salivary hormone measurements and must be considered when designing human biology research protocols. This study aims to evaluate the acute effect of one common human practice – chewing betel nut – on the measurement of salivary cortisol levels under field conditions. **MATERIALS AND METHODS:** Data were collected from 17 adult habitual betel nut users (males=11; females=6; mean age=32.8 years) from a small rural community in Papua New Guinea. Saliva was collected in time series from each participant before and at 0, 15, 30, 45, 60, and 75 min after chewing betel nut. Samples were analyzed by radioimmunoassay and cortisol levels were compared across time using linear mixed effects modeling. **RESULTS:** Measured mean cortisol concentration fell nearly 40% immediately following betel nut use and remained significantly below baseline levels for the following 45 min (all $p < 0.05$). Cortisol concentrations measured at 60 min and 75 min were indistinguishable from baseline levels (all $p > 0.16$). **DISCUSSION:** Chewing betel nut is associated with a transient but significant reduction in measured levels of salivary cortisol. Future research must take this into account in populations where betel nut use is prevalent.

83 **Laman M, Aipit S, Bona C, Siba PM, Robinson LJ, Manning L, Davis TME.**

Ultrasonographic assessment of splenic volume at presentation and after anti-malarial therapy in children with malarial anaemia.

Malar J 2015 May 28;14:219. doi: 10.1186/s12936-015-0741-0.

BACKGROUND: Splenic enlargement is a component of the host response to malaria and may also influence the genesis and progression of malarial anaemia. Few cross-sectional and no longitudinal studies have assessed the relationship between splenic volume measured ultrasonographically and haemoglobin concentrations in children with malaria. **METHODS:** Fifteen Papua New Guinean children with severe malarial anaemia (SMA; haemoglobin < 50 g/L) and ten with moderate malarial anaemia (MMA; 51-99 g/L) were recruited. The SMA patients were given intramuscular artemether followed by oral artemisinin combination therapy (ACT), and were transfused one unit of packed cells 0.3-4.0 days post-admission. The MMA patients were treated with ACT. Splenic enlargement (Hackett's grade, subcostal distance and ultrasonographically determined volume) and haemoglobin concentrations were measured on days 0, 1, 2, 3, 7, 14, 28, and 42. **RESULTS:** Associations between Hackett's grade, subcostal distance and splenic volume were modest ($rs \leq 0.62$, $p < 0.001$). Baseline splenic volume was not associated with age or haemoglobin ($p \geq 0.90$). Mean splenic volume had fallen by approximately 50% at day 14 in children with MMA ($p \leq 0.011$ vs days 0, 1 and 2), but there was no change in the SMA group ($p \geq 0.30$). There was no change in

haemoglobin in the MMA group during follow-up but a rise in the SMA group to day 7 ($p \leq 0.05$ vs days 0, 1, 2, and 3) which paralleled the packed cell volume transfused. **CONCLUSIONS:** Clinical assessment of splenomegaly is imprecise compared with ultrasonography. Serial splenic volumes and haemoglobin concentrations suggest that the spleen does not influence post-treatment haemoglobin, including after transfusion.

84 **Laman M, Benjamin JM, Moore BR, Salib M, Tawat S, Davis WA, Siba PM, Robinson LJ, Davis TME.**

Artemether-lumefantrine versus artemisinin-naphthoquinone in Papua New Guinean children with uncomplicated malaria: a six months post-treatment follow-up study.

Malar J 2015 Mar 21;14:121. doi: 10.1186/s12936-015-0624-4.

BACKGROUND: In a recent trial of artemisinin-naphthoquinone (artemisinin-NQ) and artemether-lumefantrine (AM-LM) therapy in young children from Papua New Guinea (PNG), there were no treatment failures in artemisinin-NQ-treated children with *Plasmodium falciparum* or *Plasmodium vivax* compared with 2.2% and 30.0%, respectively, in AM-LM-treated children during 42 days of follow-up. To determine whether, consistent with the long elimination half-life of NQ, this difference in efficacy would be more durable, clinical episodes of malaria were assessed in a subset of trial patients followed for six months post-treatment. **METHODS:** For children completing trial procedures and who were assessable at six months, all within-trial and subsequent clinical malaria episodes were ascertained, the latter by clinic attendances and/or review of hand-held health records. Presentations with non-malarial illness were also recorded. Differences between allocated treatments for pre-specified endpoints were determined using Kaplan-Meier survival analysis. **RESULTS:** Of 247 children who were followed to Day 42, 176 (71.3%) were included in the present sub-study, 87 allocated to AM-LM and 89 to artemisinin-NQ. Twenty children in the AM-LM group (32.8%) had a first episode of clinical malaria within six months compared with 10 (16.4%) in the artemisinin-NQ group ($p = 0.033$, log rank test). The median (interquartile range) time to first episode of clinical malaria was 64 (50-146) vs 116 (77-130) days, respectively ($p = 0.20$). There were no between-group differences in the incidence of first presentation with non-malarial illness ($p = 0.31$). **CONCLUSIONS:** The greater effectiveness of artemisinin-NQ over conventional AM-LM extends to at least six months post-treatment for clinical malaria but not non-malarial illness.

85 **Lamprell G, Greenfield D, Braithwaite J.**

The paradoxes of gender mainstreaming in developing countries: the case of health care in Papua New Guinea.

Glob Public Health 2015 Jan;10(1):41-54. Epub 2014 Oct 9.

Gender mainstreaming developed as the global strategy for gender equality nearly two decades ago. Since then it has faced criticism for its technocratic application, and its role in the de-politicisation and neutralisation of the women's movement in gender policy-making. In the health sector, this incongruity is exacerbated by a traditional bio-medical approach to women's issues. In this paper, we ask whether

gender mainstreaming can be made to work in the health sectors of developing countries where these challenges, as well as women's poor health status, are further complicated by a raft of local traditional, cultural, political and socioeconomic barriers. To answer these questions, we present a case study of Papua New Guinea (PNG), one of the world's most disadvantaged and politically challenging countries. We review data on women's health in PNG and analyse PNG's aspirational and actual performance on gender mainstreaming, looking at: international commitments; political will and capacity; national policies and programmes; and the women's movement along with civil society's participation. We find numerous paradoxes between the aims of gender mainstreaming and the necessary conditions for its success.

86 Lees J, McCool J, Woodward A.

Eye health outreach services in the Pacific Islands region: an updated profile.
NZ Med J 2015 Aug 21;128(1420):25-33.

BACKGROUND: Anecdotal reports indicate a decreasing number of patients presenting for assessment, and in particular a reduction in the number of patients requiring cataract surgery in Pacific Island Countries (PICs). Furthermore, research and routine surveillance are uncommon. **AIM:** To analyse and describe the records of eye health outreach clinics from a single provider in seven Pacific Islands. **METHOD:** Routine data collected at the Fred Hollows Foundation eye health outreach clinics in Fiji, Kiribati, Papua New Guinea (PNG), Samoa, the Solomon Islands, Tonga and Vanuatu between 2009 and 2013 were analysed. **RESULTS:** Over the study period the number of patients treated per clinic fell in Fiji, Samoa and the Solomon Islands. Data from PNG show a higher mean number of patients per clinic and the number of patients presenting at PNG outreach clinics appears to be increasing. Cataract was the main eye health condition for between 40% and 70% of visits overall, but this range varied between 14% (PNG) and 94% (Fiji). In all countries, males were more likely to receive cataract surgery than females. Refractive error was the most common presenting complaint at PNG outreach clinics; diabetic retinopathy was most common in Tonga. Cases of trachoma or trichiasis were identified in all countries, excepting Kiribati, Samoa and Tonga. **CONCLUSION:** Data from outreach eye health clinics show marked differences between PICs in the most common presenting conditions. In three countries, it appears there has recently been a reduction in the overall number of patients presenting for treatment. Cautious interpretation of the data is required due to concern about data completeness and quality.

87 Leodoro BM, Beasley SW, Maoate K.

Establishing pediatric surgical services in emerging countries: what the first world can learn from Vanuatu.

J Pediatr Surg 2015 May;50(5):829-832. doi: 10.1016/j.jpedsurg.2015.02.003. Epub 2015 Feb 8.

INTRODUCTION: Conventional surgical aid to emerging countries often does little to build capacity or infrastructure. An evolving model in the South Pacific has been designed to promote local expertise by training local surgeons to a high standard and helping establish sustainable pediatric surgical services in those regions. This review

identifies the key elements required to improve and expand local specialist pediatric surgical capacity in Vanuatu. It highlights some of the challenges that face external agencies in helping to create sufficient local infrastructure to achieve these goals and describes how the impediments can be overcome. **METHODOLOGY:** We conducted a review of the program that provides a sustainable pediatric surgical service to the small and poor Pacific nation of Vanuatu through the involvement and support of the Pacific Island Project administered by the Royal Australasian College of Surgeons. **RESULTS:** A needs assessment must be done from the recipient's perspective and can be achieved by collaboration between an external agency and existing local surgeons. The key to a sustainable service is identifying and training high quality young indigenous doctors early and providing mentorship and support, including after their return. A sustainable and viable service requires an adequately resourced position for the new surgeons(s) within a framework of a long term strategic plan for the specialty and adequate infrastructure in place on their return. Development of rapport with government and influencing strategic health priorities is a prerequisite of a new national specialty service. **CONCLUSIONS:** (1) Establishing long term viable pediatric surgical capability can only be achieved through the local health system with local leadership and ownership. (2) Internal capability includes governance, alignment with Ministry of Health priorities and policies, and effective clinical leadership. (3) Selection of person(s) to be trained is best done early, and he/she must be supported throughout training and afterwards. (4) Long term dependence on a single person makes the service vulnerable. (5) Ultimately, a service configuration that ensures children have timely access to quality specialist advice and which reflects the needs of the population is the main determinant of clinical outcomes.

88 Leoni S, Buonfrate D, Angheben A, Gobbi F, Bisoffi Z.

The hyper-reactive malarial splenomegaly: a systematic review of the literature.

Malar J 2015 Apr 29;14:185. doi: 10.1186/s12936-015-0694-3.

BACKGROUND: The hyper-reactive malarial splenomegaly syndrome (HMS) is a leading cause of massive splenomegaly in malaria-endemic countries. HMS is caused by a chronic antigenic stimulation derived from the malaria parasite. Classic Fakunle's major criteria for case definition are: persistent gross splenomegaly, elevated anti-malarial antibodies, IgM titre >2 SD above the local mean value and favourable response to long-term malaria prophylaxis. The syndrome is fatal if left untreated. The aim of this study is to systematically review the literature about HMS, particularly focussing on case definition, epidemiology and management. **METHODS:** The search strategy was based on the following database sources: Pubmed, EmBase, Scopus. Search was done in March, 2014 and limited to English, Spanish, Italian, French, and Portuguese. **RESULTS:** Papers detected were 149, of which 89 were included. Splenomegaly was variably defined and the criterion of increased IgM was not always respected. The highest prevalence was reported in Papua New Guinea (up to 80%). In different African countries, 31 to 76% of all splenomegalies were caused by

- HMS. Fatality rate reached 36% in three years. The most frequent anti-malarial treatments administered were weekly chloroquine or daily proguanil from a minimum of one month to lifelong. In non-endemic countries, a few authors opted for a single, short anti-malarial treatment. All treated patients with no further exposure improved. Cases not completely fulfilling Fakunle's criteria and therefore untreated, subsequently evolved into HMS. It seems thus appropriate to treat incomplete or 'early' HMS, too. CONCLUSIONS: For patients not re-exposed to endemic areas, a short course of treatment is sufficient, showing that eradicating the infection is sufficient to cure HMS. Longer (probably lifelong) courses, or intermittent treatments, are required for those who remain exposed. Splenectomy, associated with high mortality, should be strictly limited to cases not responding to medical treatment.
- 89 **Ley S, Carter R, Millan K, Phuanukoonnon S, Pandey S, Coulter C, Siba P, Beck HP.** Non-tuberculous mycobacteria: baseline data from three sites in Papua New Guinea, 2010-2012. *Western Pac Surveill Response J* 2015 Nov 24;6(4):24-29. doi: 10.5365/WPSAR.2015.6.2.004. OBJECTIVE: To determine the proportion of non-tuberculous mycobacteria (NTM) in samples of pulmonary tuberculosis (TB) cases from Papua New Guinea who were diagnosed using acid-fast microscopy. METHODS: As part of a case detection study for TB, conducted in three provincial hospitals in Papua New Guinea, sputum samples of suspected tuberculous cases aged 15 years or older were collected from November 2010 to July 2012. Mycobacterial species isolated from sputum and grown in culture were examined to distinguish between NTM and the *Mycobacterium tuberculosis* complex (MTBC). RESULTS: NTM were detected in 4% (9/225) of sputum samples grown in culture. Five (2.2%) of them were identified as NTM only and four (1.8%) were identified as mixed cultures containing both MTBC and NTM. Four different NTM species were identified: *M. fortuitum*, *M. intracellulare*, *M. terrae* and *M. avium*. DISCUSSION: This is the first report from Papua New Guinea identifying NTM in three different locations. As NTM cannot be distinguished from *M. tuberculosis* through smear microscopy, the presence of NTM can lead to a false-positive diagnosis of tuberculosis. The prevalence of NTM should be determined and a diagnostic algorithm developed to confirm acid-fast bacilli in a smear as *M. tuberculosis*.
- 90 **Ligabue-Braun R, Carlini CR.** Poisonous birds: a timely review. *Toxicon* 2015 Jun 1;99:102-108. doi: 10.1016/j.toxicon.2015.03.020. Epub 2015 Mar 31. Until very recently, toxicity was not considered a trait observed in birds, but works published in the last two decades started to shed light on this subject. Poisonous birds are rare (or little studied), and comprise pitohui and ifrita birds from Papua New Guinea, the European quail, the spoor-winged goose, the hoopees, the North American ruffed grouse, the bronzewings, and the red warbler. A hundred more species are considered unpalatable or malodorous to humans and other animals. The present review intends to present the current understanding of bird toxicity, possibly pointing to an ignored research field. Whenever possible, biochemical characteristics of these poisons and their effects on humans and other animals are discussed, along with historical aspects of poison discovery and evolutionary hypotheses regarding their function.
- 91 **Logue K, Small ST, Chan ER, Reimer L, Siba PM, Zimmerman PA, Serre D.** Whole-genome sequencing reveals absence of recent gene flow and separate demographic histories for *Anopheles punctulatus* mosquitoes in Papua New Guinea. *Mol Ecol* 2015 Mar;24(6):1263-1274. doi: 10.1111/mec.13107. Epub 2015 Mar 6. *Anopheles* mosquitoes are the vectors of several human diseases including malaria. In many malaria endemic areas, several species of *Anopheles* coexist, sometimes in the form of related sibling species that are morphologically indistinguishable. Determining the size and organization of *Anopheles* populations, and possible ongoing gene flow among them is important for malaria control and, in particular, for monitoring the spread of insecticide resistance alleles. However, these parameters have been difficult to evaluate in most *Anopheles* species due to the paucity of genetic data available. Here, we assess the extent of contemporary gene flow and historical variations in population size by sequencing and de novo assembling the genomes of wild-caught mosquitoes from four species of the *Anopheles punctulatus* group of Papua New Guinea. Our analysis of more than 50 Mb of orthologous DNA sequences revealed no evidence of contemporary gene flow among these mosquitoes. In addition, investigation of the demography of two of the *An. punctulatus* species revealed distinct population histories. Overall, our analyses suggest that, despite their similarities in morphology, behaviour and ecology, contemporary sympatric populations of *An. punctulatus* are evolving independently.
- 92 **Longbottom K.** Neonatal intensive care in the Solomon Islands. *J Paediatr Child Health* 2015 Sep;51(9):932. doi: 10.1111/jpc.12759.
- 93 **Lufele E, Aipit J, Siba P, Robinson LJ, Laman M.** A decline of *Haemophilus influenzae* type b meningitis in Papua New Guinean children despite low vaccination coverage. *J Trop Pediatr* 2015 Aug;61(4):313-314. doi: 10.1093/tropej/fmv040. Epub 2015 Jun 30.
- 94 **Lukic A, Uphill J, Brown CA, Beck J, Poulter M, Campbell T, Adamson G, Hummerich H, Whitfield J, Ponto C, Zerr I, Lloyd SE, Collinge J, Mead S.** Rare structural genetic variation in human prion diseases. *Neurobiol Aging* 2015 May;36(5):2004.e1-8. doi: 10.1016/j.neurobiolaging.2015.01.011. Epub 2015 Jan 22. Prion diseases are a diverse group of neurodegenerative conditions, caused by the templated misfolding of prion protein. Aside from the strong genetic risk conferred by multiple variants of the prion protein gene (*PRNP*), several other variants have been suggested to confer risk in the most common type, sporadic Creutzfeldt-Jakob disease (sCJD) or in the acquired prion diseases. Large and rare copy number variants (CNVs) are known to confer risk in several related disorders including Alzheimer's disease (at *APP*), schizophrenia, epilepsy, mental retardation, and autism. Here,

we report the first genome-wide analysis for CNV-associated risk using data derived from a recent international collaborative association study in sCJD ($n = 1147$ after quality control) and publicly available controls ($n = 5427$). We also investigated UK patients with variant Creutzfeldt-Jakob disease ($n = 114$) and elderly women from the Eastern Highlands of Papua New Guinea who proved highly resistant to the epidemic prion disease kuru, who were compared with healthy young Fore population controls ($n = 395$). There were no statistically significant alterations in the burden of CNVs >100 , >500 , or >1000 kb duplications, or deletions in any disease group or geographic region. After correction for multiple testing, no statistically significant associations were found. A UK blood service control sample showed a duplication CNV that overlapped *PRNP*, but these were not found in prion disease. Heterozygous deletions of a 3' region of the *PARK2* gene were found in 3 sCJD patients and no controls ($p = 0.001$, uncorrected). A cell-based prion infection assay did not provide supportive evidence for a role for *PARK2* in prion disease susceptibility. These data are consistent with a modest impact of CNVs on risk of late-onset neurologic conditions and suggest that, unlike *APP*, *PRNP* duplication is not a causal high-risk mutation.

95 **MacLaren D, Asugeni J, Redman-MacLaren M; Atoifi Health Research Group.**

Strengthening research capacity in the Pacific: an example from the Atoifi Health Research Group, Solomon Islands.

Australas Psychiatry 2015 Dec;23(6 Suppl):42-44. doi: 10.1177/1039856215609768.

OBJECTIVE: To provide an example of one model of research capacity building for mental health from a remote setting in Solomon Islands. **METHODS:** The Atoifi Health Research Group is building health research capacity with a health service on the remote east coast of Malaita, Solomon Islands. The group uses a 'learn-by-doing' approach embedded in health service and community-level health projects. The group is eclectic in nature and deliberately engages a variety of partners to discover culturally informed methods of collecting, analysing and disseminating research findings. **RESULTS:** Key successes of the Atoifi Health Research Group are: that it was initiated by Solomon Islanders with self-expressed desire to learn about research; the learn-by-doing model; inclusion of community people to inform questions and socio-cultural appropriateness; and commitment to ongoing support by international researchers. **CONCLUSIONS:** Given different social, cultural, economic, geographic, spiritual and service contexts across the Pacific, locally appropriate approaches need to be considered. Such approaches challenge the orthodox approach of centralized investment to replicate specialist driven approaches of funder nations. Increasing expertise at all levels through participatory capacity building models that define and address local problems may be more sustainable and responsive to local mental health contexts.

96 **MacLaren D, Redman-MacLaren M, Timothy-Harrington R, Asugeni R, Muse E, Jimuru E, Moutoa K, Speare R.**

Strengthening capacity for local evidence to inform local responses to HIV in a remote Solomon Islands health service.

Western Pac Surveill Response J 2015 May 6;6(2):58-65. doi: 10.5365/WPSAR.2015.6.1.015.

BACKGROUND: Documenting specific knowledge and attitudes about HIV in the culturally diverse nation of Solomon Islands is essential to inform locally targeted public health responses. As part of a large capacity-strengthening project at Atoifi Adventist Hospital in East Kwaio, Solomon Islands, researchers, using a 'learn-by-doing' process, worked with participants in public health research methods. **METHODS:** Overall, 43 people attended research capacity building workshops in 2011; eight joined the HIV study group. A cross-sectional survey including semi-structured interviews on HIV was conducted by the group. In February 2014, a hospital administrator was interviewed about how the 2011 study informed local HIV responses. **RESULTS:** Of the 53 survey participants, 64% self-assessed as having little or no HIV knowledge, but 90% knew HIV could be transmitted between men and women during sex. Less than 50% knew HIV could be transmitted between two men having sex, 45% thought HIV could be transmitted by mosquitoes and 55% agreed condoms help protect from HIV. Most participants reported negative attitudes towards people with HIV. Three years later the health administrator reported ad hoc responses to HIV because of low HIV prevalence, increasing noncommunicable diseases, staff turnover and resource shortages. **DISCUSSION:** This HIV study was used to strengthen research skills in local health professionals and community members in Solomon Islands. It showed that community members require accurate information about HIV transmission and that entrenched stigma is an issue. Although results provided local evidence for local response, ongoing health system challenges and little local HIV transmission meant HIV services remain rudimentary.

97 **MacLaren DJ, McBride WJ, Kelly GC, Muller R, Tommbe R, Kaldor JM, Valley AJ.**

HIV prevalence is strongly associated with geographical variations in male circumcision and foreskin cutting in Papua New Guinea: an ecological study.

Sex Transm Infect 2015 Nov;91(7):502-505. doi: 10.1136/sextrans-2014-051970. Epub 2015 Jun 30.

OBJECTIVE: To examine the correlation between HIV prevalence and male circumcision and other foreskin cutting practices across the four regions of Papua New Guinea (PNG). **DESIGN:** An ecological substudy using unique data from an interdisciplinary research programme to evaluate the acceptability, sociocultural context and public health impact of male circumcision for HIV prevention in PNG. **METHODS:** Published data describing (a) self-reported circumcision status by region from the 'Acceptability and Feasibility of Male Circumcision for HIV prevention in PNG' study and (b) HIV prevalence by region from PNG National Department of Health were used to correlate male circumcision and other foreskin cutting practices and HIV prevalence. Maps were constructed to visually represent variations across the four regions of PNG. **RESULTS:** Regions of PNG with the highest HIV prevalence had the lowest prevalence of male circumcision and other forms of foreskin cutting and vice versa. Male circumcision and dorsal longitudinal cuts were strongly associated with HIV prevalence and able to explain 99% of the

observed geographical variability in HIV prevalence in PNG ($p < 0.01$). **CONCLUSIONS:** The regional prevalence of HIV infection in PNG appears to be closely correlated with the regional distribution of male circumcision and dorsal longitudinal foreskin cuts. Further research is warranted to investigate causality of this correlation as well as the potential of dorsal longitudinal cuts to confer protection against HIV acquisition in heterosexual men.

98 Makaen J, Omena M.

Maintenance of a reliable laboratory service for tuberculosis intervention in Papua New Guinea. *Lab Med* 2015 Spring;46(2):e35-37. doi: 10.1309/LMBUJNUG639EELTY.

The reemergence of tuberculosis, including multidrug-resistant strains, in Papua New Guinea highlights the never ending nature of the antituberculosis (anti-TB) campaign in that country and warrants the need for constant vigilance against the condition. Through surveillance, early detection, and management, the spread and incidence of TB can be kept in check. To maintain successful TB control programs, the government and partners committed to this campaign need to overhaul essential aspects of laboratory services. Clinical laboratories play a critical role in diagnostics; their functions cannot be substituted nor relegated. It is time to end neglect of these services in Papua New Guinea and to arm the laboratories in that country with full financial and logistical support so that they can lead the campaign against TB.

99 Marks M, Mitjà O, Vestergaard LS, Pillay A, Knauf S, Chen CY, Bassat Q, Martin DL, Fegan D, Taleo F, Kool J, Lukehart S, Emerson PM, Solomon AW, Ye T, Ballard RC, Mabey DC, Asiedu KB.

Challenges and key research questions for yaws eradication. *Lancet Infect Dis* 2015 Oct;15(10):1220-1225. doi: 10.1016/S1473-3099(15)00136-X. Epub 2015 Sep 8.

Yaws is endemic in west Africa, southeast Asia, and the Pacific region. To eradicate yaws by 2020, WHO has launched a campaign of mass treatment with azithromycin. Progress has been made towards achievement of this ambitious goal, including the validation of point-of-care and molecular diagnostic tests and piloting of the strategy in several countries, including Ghana, Vanuatu, and Papua New Guinea. Gaps in knowledge need to be addressed to allow refinement of the eradication strategy. Studies exploring determinants of the spatial distribution of yaws are needed to help with the completion of baseline mapping. The finding that *Haemophilus ducreyi* causes lesions similar to yaws is particularly important and further work is needed to assess the effect of azithromycin on these lesions. The integration of diagnostic tests into different stages of the eradication campaign needs investigation. Finally, studies must be done to inform the optimum mass-treatment strategy for sustainable interruption of transmission.

100 Marks M, Mitjà O, Solomon AW, Asiedu KB, Mabey DC.

Yaws. *Br Med Bull* 2015 Mar;113(1):91-100. doi: 10.1093/bmb/ldu037. Epub 2014 Dec 18.

INTRODUCTION: Yaws, caused by *Treponema pallidum* ssp. *pertenue*, is endemic in parts of

West Africa, Southeast Asia and the Pacific. The WHO has launched a campaign, based on mass treatment with azithromycin, to eradicate yaws by 2020. **SOURCES OF DATA:** We reviewed published data, surveillance data and data presented at yaws eradication meetings. **AREAS OF AGREEMENT:** Azithromycin is now the preferred agent for treating yaws. Point-of-care tests have demonstrated their value in yaws. **AREAS OF CONTROVERSY:** There is limited data from 76 countries which previously reported yaws. Different doses of azithromycin are used in community mass treatment for yaws and trachoma. **GROWING POINTS:** Yaws eradication appears an achievable goal. The programme will require considerable support from partners across health and development sectors. **AREAS TIMELY FOR DEVELOPING RESEARCH:** Studies to complete baseline mapping, integrate diagnostic tests into surveillance and assess the impact of community mass treatment with azithromycin are ongoing.

101 Marks M, Katz S, Chi KH, Vahi V, Sun Y, Mabey DC, Solomon AW, Chen CY, Pillay A.

Failure of PCR to detect *Treponema pallidum* ssp. *pertenue* DNA in blood in latent yaws. *PLoS Negl Trop Dis* 2015 Jun 30;9(6):e0003905. doi: 10.1371/journal.pntd.0003905. eCollection 2015.

Yaws, caused by *Treponema pallidum* ssp. *pertenue*, is a neglected tropical disease closely related to venereal syphilis and is targeted for eradication by 2020. Latent yaws represents a diagnostic challenge, and current tools cannot adequately distinguish between individuals with true latent infection and individuals who are serofast following successful treatment. PCR on blood has previously been shown to detect *T. pallidum* DNA in patients with syphilis, suggesting that this approach may be of value in yaws. We performed real-time PCR for *Treponema pallidum* ssp. *pertenue* on blood samples from 140 children with positive *T. pallidum* particle agglutination (TPPA) and rapid plasma reagin (RPR) tests and 7 controls (negative serology), all collected as part of a prospective study of yaws in the Solomon Islands. All samples were also tested by a nested PCR for *T. pallidum*. 12 patients had clinical evidence of active yaws whilst 128 were considered to have latent yaws. 43 children had high titre rapid plasma reagins (RPRs) of $\geq 1:32$. PCR testing with both assays gave negative results in all cases. It is possible that the failure to detect *T. pallidum* ssp. *pertenue* in blood reflects lower loads of organism in latent yaws compared to those in latent infection with *T. pallidum* ssp. *pallidum*, and/or a lower propensity for haematogenous dissemination in yaws than in syphilis. As the goal of the yaws control programme is eradication, a tool that can differentiate true latent infection from individuals who are serofast would be of value; however, PCR of blood is not that tool.

102 Marks M, Vahi V, Sokana O, Puiahi E, Pavluck A, Zhang Z, Dalipanda T, Bottomley C, Mabey DC, Solomon AW.

Mapping the epidemiology of yaws in the Solomon Islands: a cluster randomized survey. *Am J Trop Med Hyg* 2015 Jan;92(1):129-133. doi: 10.4269/ajtmh.14-0438. Epub 2014 Nov 24.

Yaws, a non-venereal treponemal disease, is targeted for eradication by 2020 but accurate epidemiological data to guide control programs remain sparse. The Solomon Islands reports the

second highest number of cases of yaws worldwide. We conducted a cluster randomized survey of yaws in two provinces of the Solomon Islands. One thousand four hundred and ninety-seven (1,497) children 5-14 years of age were examined. Clinical signs of active yaws were found in 79 children (5.5%), whereas 140 children (9.4%) had evidence of healed yaws lesions. Four hundred and seventy (470) (31.4%) children had a positive *Treponema pallidum* particle agglutination assay (TPPA). Two hundred and eighty-five (285) children (19%) had a positive TPPA and rapid plasma reagin assay. Risk of yaws increased with age and was more common in males. The prevalence of yaws at village level was the major risk factor for infection. Our findings suggest the village, not the household, should be the unit of treatment in the World Health Organization (WHO) yaws eradication strategy.

103 Marks M, Taotao-Wini B, Satorara L, Engelman D, Nasi T, Mabey DC, Steer AC.

Long term control of scabies fifteen years after an intensive treatment programme.

PLoS Negl Trop Dis 2015 Dec 1;9(12):e0004246. doi: 10.1371/journal.pntd.0004246. eCollection 2015.

INTRODUCTION: Scabies is a major public health problem in the Pacific and is associated with an increased risk of bacterial skin infections, glomerulonephritis and rheumatic fever. Mass drug administration with ivermectin is a promising strategy for the control of scabies. Mass treatment with ivermectin followed by active case finding was conducted in five communities in the Solomon Islands between 1997 and 2000 and resulted in a significant reduction in the prevalence of both scabies and bacterial skin infections. **METHODS:** We conducted a prospective follow-up study of the communities where the original scabies control programme had been undertaken. All residents underwent a standardised examination for the detection of scabies and impetigo. **RESULTS:** Three hundred and thirty eight residents were examined, representing 69% of the total population of the five communities. Only 1 case of scabies was found, in an adult who had recently returned from the mainland. The prevalence of active impetigo was 8.8% overall and 12.4% in children aged 12 years or less. **DISCUSSION:** We found an extremely low prevalence of scabies 15 years after the cessation of a scabies control programme. The prevalence of impetigo had also declined further since the end of the control programme. Our results suggest that a combination of mass treatment with ivermectin and intensive active case finding may result in long term control of scabies. Larger scale studies and integration with other neglected tropical disease control programmes should be priorities for scabies control efforts.

104 Marks M, Vahi V, Sokana O, Chi KH, Puiahi E, Kilua G, Pillay A, Dalipanda T, Bottomley C, Solomon AW, Mabey DC.

Impact of community mass treatment with azithromycin for trachoma elimination on the prevalence of yaws.

PLoS Negl Trop Dis 2015 Aug 4;9(8):e0003988. doi: 10.1371/journal.pntd.0003988. eCollection 2015.

BACKGROUND: Community mass treatment with 30 mg/kg azithromycin is central to the new WHO strategy for eradicating yaws. Both yaws and

trachoma – which is earmarked for elimination by 2020 using a strategy that includes mass treatment with 20 mg/kg azithromycin – are endemic in the Pacific, raising the possibility of an integrated approach to disease control. Community mass treatment with azithromycin for trachoma elimination was conducted in the Solomon Islands in 2014. **METHODS:** We conducted a study to assess the impact of mass treatment with 20 mg/kg azithromycin on yaws. We examined children aged 5-14 years and took blood and lesion samples for yaws diagnosis. **RESULTS:** We recruited 897 children, 6 months after mass treatment. There were no cases of active yaws. Serological evidence of current infection was found in 3.6% (95% CI = 2.5-5.0%). This differed significantly between individuals who had and had not received azithromycin (2.8% vs 6.5%, $p = 0.015$); the prevalence of positive serology in 5-14 year-olds had been 21.7% (95% CI = 14.6%-30.9%) 6 months prior to mass treatment. Not receiving azithromycin was associated with an odds of 3.9 for infection ($p = 0.001$). National figures showed a 57% reduction in reported cases of yaws following mass treatment. **DISCUSSION:** Following a single round of treatment we did not identify any cases of active yaws in a previously endemic population. We found a significant reduction in latent infection. Our data support expansion of the WHO eradication strategy and suggest an integrated approach to the control of yaws and trachoma in the Pacific may be viable.

105 Marks M, Kako H, Butcher R, Lauri B, Puiahi E, Pitakaka R, Sokana O, Kilua G, Roth A, Solomon AW, Mabey DC.

Prevalence of sexually transmitted infections in female clinic attendees in Honiara, Solomon Islands. *BMJ Open* 2015 Apr 28;5(4):e007276. doi: 10.1136/bmjopen-2014-007276.

OBJECTIVES: This study sought to determine the prevalence of common bacterial sexually transmitted infections, including *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, in women attending clinics in the Solomon Islands. **METHODS:** We conducted a sexual health survey among women attending three nurse-led community outpatient clinics in August 2014, to establish the prevalence of bacterial sexually transmitted infections in female clinic attendees in Honiara, Solomon Islands. Vaginal swab samples were tested for infection with *C. trachomatis* and *N. gonorrhoeae* using a commercial strand displacement amplification assay. Serum samples were tested for syphilis. **RESULTS:** We enrolled 296 women, aged 16-49, attending three clinics. Knowledge of safe sexual practices was high but reported condom usage was low. The prevalence of infection with *C. trachomatis* was 20%. The prevalence of infection with *N. gonorrhoeae* and syphilis were 5.1% and 4.1%, respectively. **CONCLUSIONS:** Bacterial sexually transmitted infections are a major health problem in the Solomon Islands. Interventions are urgently needed.

106 Martin J, Tau G, Cherian MN, Vergel de Dios J, Mills D, Fitzpatrick J, Adu-Krow W, Cheng D.

Survey of the capacity for essential surgery and anaesthesia services in Papua New Guinea.

BMJ Open 2015 Dec 16;5(12):e009841. doi: 10.1136/bmjopen-2015-009841.

OBJECTIVE: To assess capacity to provide essential surgical services including emergency, obstetric and anaesthesia care in Papua New

Guinea (PNG) in order to support planning for relevant post-2015 Sustainable Development Goals for PNG. DESIGN: Cross-sectional survey. SETTING: Hospitals and health facilities in PNG. PARTICIPANTS: 21 facilities including 3 national/provincial hospitals, 11 district/rural hospitals, and 7 health centres. OUTCOME MEASURES: The WHO Situational Analysis Tool to Assess Emergency and Essential Surgical Care (WHO-SAT) was used to measure each participating facility's capacity to deliver essential surgery and anaesthesia services, including 108 items related to relevant infrastructure, human resources, interventions and equipment. RESULTS: While major surgical procedures were provided at each hospital, fewer than 30% had uninterrupted access to oxygen, and 57% had uninterrupted access to resuscitation bag and mask. Most hospitals reported capacity to provide general anaesthesia, though few hospitals reported having at least one certified surgeon, obstetrician and anaesthesiologist. Access to anaesthetic machines, pulse oximetry and blood bank was severely limited. Many non-hospital health centres provide basic surgical procedures, but almost none had uninterrupted access to electricity, running water, oxygen and basic supplies for resuscitation, airway management and obstetric services. CONCLUSIONS: Capacity for essential surgery and anaesthesia services is severely limited in PNG due to shortfalls in physical infrastructure, human resources, and basic equipment and supplies. Achieving post-2015 Sustainable Development Goals, including universal healthcare, will require significant investment in surgery and anaesthesia capacity in PNG.

- 107 **Martínez I, Stegen JC, Maldonado-Gómez MX, Eren AM, Siba PM, Greenhill AR, Walter J.** The gut microbiota of rural Papua New Guineans: composition, diversity patterns, and ecological processes.

Cell Rep 2015 Apr 28;11(4):527-538. doi: 10.1016/j.celrep.2015.03.049. Epub 2015 Apr 16.

Although recent research revealed an impact of westernization on diversity and composition of the human gut microbiota, the exact consequences on metacommunity characteristics are insufficiently understood, and the underlying ecological mechanisms have not been elucidated. Here, we have compared the fecal microbiota of adults from two non-industrialized regions in Papua New Guinea (PNG) with that of United States (US) residents. Papua New Guineans harbor communities with greater bacterial diversity, lower inter-individual variation, vastly different abundance profiles, and bacterial lineages undetectable in US residents. A quantification of the ecological processes that govern community assembly identified bacterial dispersal as the dominant process that shapes the microbiome in PNG but not in the US. These findings suggest that the microbiome alterations detected in industrialized societies might arise from modern lifestyle factors limiting bacterial dispersal, which has implications for human health and the development of strategies aimed to redress the impact of westernization.

- 108 **Mason D, Marks M.**

Bakua: tinea imbricata in the Solomon Islands. *Am J Trop Med Hyg* 2015 May;92(5):883. doi: 10.4269/ajtmh.14-0770.

- 109 **Massey PD, Asugeni R, Wakageni J, Kekeubata E, Maena'aadi J, Laete'esafi J, Waneagea J, Asugeni V, MacLaren D, Speare R.**

Steps on a journey to TB control in Solomon Islands: a cross-sectional, mixed methods pre-post evaluation of a local language DVD.

BMC Int Health Hum Rights 2015 Feb 3;15:1. doi: 10.1186/s12914-015-0041-3.

BACKGROUND: In Solomon Islands many people with tuberculosis (TB) have challenges in accessing services because of socio-cultural, geographic and health service reasons, resulting in delays in TB treatment and low detection rates. The purpose of this project was to (i) develop a local language audio-visual resource (DVD) about TB, (ii) share this resource with people in remote villages and (iii) evaluate the process and outcomes. METHODS: The project involved the development and evaluation of a DVD in local Kwaio language. The DVD included five short videos based on the Australian Respiratory Council TB Education Flipchart. The DVD also included short videos of: traditional music/chanting (ai'ima); drama that presented an allegory of TB; and a short documentary on the redevelopment of the local TB Ward. A mixed-methods approach evaluated changes in TB knowledge and investigated the impact of the DVD. RESULTS: The DVD was recorded and produced in March-June 2013 and screened in 41 villages and hamlets. The pre-post DVD survey was completed by 64% (255/400) of people who viewed the DVD in the villages. Pre-DVD survey responses showed a moderate to high knowledge about TB signs, symptoms and treatment but 76/255 (30%) stated TB was caused by sorcery and 85/255 (33%) incorrectly stated that TB medication should be stopped when a patient feels better. The post-DVD survey showed a significant increase in people in coastal villages reporting (i) a 3-week cough would trigger a medical assessment and (ii) TB is mainly spread through the air. Statements that TB is not caused by sorcery increased post-DVD in both coastal and mountain villages; however, belief in sorcery in mountain villages remained high at 20/70 (29%). CONCLUSIONS: The local DVD resource was developed within local cultural understandings and oral traditions of Kwaio people. Using modern but accessible DVD technology generated a lot of interest about the disease and the stories. The project evaluation indicates that current delays in seeking treatment may be more due to socio-cultural and health service factors than awareness of the disease. Therefore the development of TB services, including TB education, which are culturally sensitive, remains important.

- 110 **Maukera R, Blignault I.**

A decade of peace: mental health issues and service developments in the Solomon Islands since 2003.

Australas Psychiatry 2015 Dec;23(6):658-661. doi: 10.1177/1039856215592317. Epub 2015 Jul 2.

OBJECTIVE: To describe the impact on mental health and psychosocial wellbeing of the armed conflict that occurred in the Solomon Islands from 1998 to 2003 and the subsequent political unrest and natural disasters, and the developments in mental health services since 2003. METHOD: A literature and document review was conducted, supplemented by the written reflections of senior staff in the Solomon Islands Mental Health Service. RESULTS: Conflict

and natural disaster have had a significant impact on the mental health and functioning of individuals, families and communities. National health system reform has been accompanied by the reorientation of the mental health services from custodial care to care in the community and greater emphasis on mental health promotion and prevention. The dedication of the small group of Solomon Islands mental health professionals, supported by local health service managers and external donors, has been a major strength. However, they face significant challenges. CONCLUSIONS: Continued investment in mental health, including the treatment and prevention of mental and substance use disorders, is essential for mental health and development outcomes. All development stakeholders, including civil society, government, academic and research institutions, and development partners, have a role to play.

- 111 **Mehlotra RK, Hall NB, Bruse SE, John B, Blood Zikursh MJ, Stein CM, Siba PM, Zimmerman PA.** CCR2, CCR5, and CXCL12 variation and HIV/AIDS in Papua New Guinea.

Infect Genet Evol 2015 Dec;36:165-173. doi: 10.1016/j.meegid.2015.09.014. Epub 2015 Sep 28.

Polymorphisms in chemokine receptors, serving as HIV co-receptors, and their ligands are among the well-known host genetic factors associated with susceptibility to HIV infection and/or disease progression. Papua New Guinea (PNG) has one of the highest adult HIV prevalences in the Asia-Pacific region. However, information regarding the distribution of polymorphisms in chemokine receptor (CCR5, CCR2) and chemokine (CXCL12) genes in PNG is very limited. In this study, we genotyped a total of nine CCR2-CCR5 polymorphisms, including CCR2 190G >A, CCR5 -2459G >A and Δ32, and CXCL12 801G >A in PNG (n = 258), North America (n = 184), and five countries in West Africa (n = 178). Using this data, we determined previously characterized CCR5 haplotypes. In addition, based on the previously reported associations of CCR2 190, CCR5 -2459, CCR5 open reading frame, and CXCL12 801 genotypes with HIV acquisition and/or disease progression, we calculated composite full risk scores, considering both protective as well as susceptibility effects of the CXCL12 801 AA genotype. We observed a very high frequency of the CCR5 -2459A allele (0.98) in the PNG population, which together with the absence of Δ32 resulted in a very high frequency of the HHE haplotype (0.92). These frequencies were significantly higher than in any other population (all p-values <0.001). Regardless of whether we considered the CXCL12 801 AA genotype protective or susceptible, the risk scores were significantly higher in the PNG population compared with any other population (all p-values <0.001). The results of this study provide new insights regarding CCR5 variation in the PNG population, and suggest that the collective variation in CCR2, CCR5, and CXCL12 may increase the risk of HIV/AIDS in a large majority of Papua New Guineans.

- 112 **Mitjà O, Marks M, Konan DJ, Ayelo G, Gonzalez-Beiras C, Boua B, Houinei W, Kobara Y, Tabah EN, Nsiire A, Obvala D, Taleo F, Djupuri R, Zaixing Z, Utzinger J, Vestergaard LS, Bassat Q, Asiedu K.** Global epidemiology of yaws: a systematic review. *Lancet Glob Health* 2015 Jun;3(6):e324-331. doi: 10.1016/S2214-109X(15)00011-X.

BACKGROUND: To achieve yaws eradication, the use of the new WHO strategy of initial mass treatment with azithromycin and surveillance twice a year needs to be extended everywhere the disease occurs. However, the geographic scope of the disease is unknown. We aimed to synthesise published and unpublished work to update the reported number of people with yaws at national and subnational levels and to estimate at-risk populations. **METHODS:** We searched PubMed and WHO databases to identify published data for prevalence of active and latent yaws from Jan 1, 1990, to Dec 31, 2014. We also searched for ongoing or recently completed unpublished studies from the WHO yaws surveillance network. We estimated yaws prevalence (and 95% CIs). We collected yaws incidence data from official national surveillance programmes at the first administrative level from Jan 1, 2010, to Dec 31, 2013, and we used total population data at the second administrative level to estimate the size of at-risk populations. **FINDINGS:** We identified 103 records, of which 23 published articles describing 27 studies and four unpublished studies met the inclusion criteria. Prevalence of active disease ranged from 0.31% to 14.54% in yaws-endemic areas, and prevalence of latent yaws ranged from 2.45% to 31.05%. During 2010-13, 256,343 yaws cases were reported to WHO from 13 endemic countries, all of which are low-income and middle-income countries. 215,308 (84%) of 256,343 cases reported to WHO were from three countries – Papua New Guinea, Solomon Islands, and Ghana. We estimated that, in 2012, over 89 million people were living in yaws-endemic districts. **INTERPRETATION:** Papua New Guinea, Solomon Islands, and Ghana should be the focus of initial efforts at implementing the WHO yaws eradication strategy. Community-based mapping and active surveillance must accompany the implementation of yaws eradication activities.

- 113 **Mitjà O, Houinei W, Moses P, Kapa A, Paru R, Hays R, Lukehart S, Godornes C, Bieb SV, Grice T, Siba P, Mabey D, Sanz S, Alonso PL, Asiedu K, Bassat Q.**

Mass treatment with single-dose azithromycin for yaws.

N Engl J Med 2015 Feb 19;372(8):703-710. doi: 10.1056/NEJMoa1408586.

BACKGROUND: Mass treatment with azithromycin is a central component of the new World Health Organization (WHO) strategy to eradicate yaws. Empirical data on the effectiveness of the strategy are required as a prerequisite for worldwide implementation of the plan. **METHODS:** We performed repeated clinical surveys for active yaws, serologic surveys for latent yaws, and molecular analyses to determine the cause of skin ulcers and identify macrolide-resistant mutations before and 6 and 12 months after mass treatment with azithromycin on a Papua New Guinea island on which yaws was endemic. Primary outcome indicators were the prevalence of serologically confirmed active infectious yaws in the entire population and the prevalence of latent yaws with high-titer seroreactivity in a subgroup of children 1 to 15 years of age. **RESULTS:** At baseline, 13,302 of 16,092 residents (82.7%) received one oral dose of azithromycin. The prevalence of active infectious yaws was reduced from 2.4% before mass treatment to 0.3% at 12 months (difference, 2.1 percentage

points; $p < 0.001$). The prevalence of high-titer latent yaws among children was reduced from 18.3% to 6.5% (difference, 11.8 percentage points; $p < 0.001$) with a near-absence of high-titer seroreactivity in children 1 to 5 years of age. Adverse events identified within 1 week after administration of the medication occurred in approximately 17% of the participants, included nausea, diarrhoea, and vomiting, and were mild in severity. No evidence of emergence of resistance to macrolides against *Treponema pallidum* subspecies *pertenue* was seen. **CONCLUSIONS:** The prevalence of active and latent yaws infection fell rapidly and substantially 12 months after high-coverage mass treatment with azithromycin, with the reduction perhaps aided by subsequent activities to identify and treat new cases of yaws. Our results support the WHO strategy for the eradication of yaws.

- 114 **Moore BR, Salman S, Benjamin J, Page-Sharp M, Yadi G, Batty KT, Siba PM, Mueller I, Davis TME.** Pharmacokinetics of piperazine transfer into the breast milk of Melanesian mothers. *Antimicrob Agents Chemother* 2015 Jul;59(7):4272-4278. doi: 10.1128/AAC.00327-15. Epub 2015 May 11.

Transfer of piperazine (PQ) into breast milk was examined in 27 Papua New Guinean women given a 3-day course of dihydroartemisinin-PQ or sulfadoxine-pyrimethamine-PQ during the second/third trimester. Breast milk was sampled on days 1, 2, 3 to 5, 7 to 11, and 14 to 17 postdelivery, a median of 70 days postdose (range, 6 to 145 days). A blood sample was taken at delivery, and additional serial samples were available from 9 women who delivered within 42 days of dosing. Milk and plasma PQ were assayed by high-performance liquid chromatography. A population-based approach was used to model the \log_e (plasma) and milk concentration-time data. A sigmoid Emax model best described PQ breast milk transfer. The population average milk:plasma PQ ratio was 0.58, with a peak of 2.5 at delivery. The model-derived maximum milk intake (148 ml/kg of body weight/day) was similar to the accepted value of 150 ml/kg/day. The median estimated absolute and relative cumulative infant PQ doses were 22 μg and 0.07%, respectively, corresponding to absolute and relative daily doses of 0.41 $\mu\text{g}/\text{kg}$ and 0.004%. Model-based simulations for PQ treatment regimens given at birth, 1 week postdelivery, and 6 weeks postdelivery showed that the highest median estimated relative total infant dose (0.36%; median absolute total dose of 101 $\mu\text{g}/\text{kg}$) was seen after maternal PQ treatment 6 weeks postpartum. The maximum simulated relative total and daily doses from any scenario were 4.3% and 2.5%, respectively, which were lower than the recommended 10% upper limit. Piperazine is transferred into breast milk after maternal treatment doses, but PQ exposure for suckling infants appears safe.

- 115 **Morita A, Natsuhara K, Tomitsuka E, Odani S, Baba J, Tadokoro K, Igai K, Greenhill AR, Horwood PF, Soli KW, Phuanukoonnon S, Siba PM, Umezaki M.** Development, validation, and use of a semi-quantitative food frequency questionnaire for assessing protein intake in Papua New Guinean Highlanders. *Am J Hum Biol* 2015 May-Jun;27(3):349-357. doi:

10.1002/ajhb.22647. Epub 2014 Nov 3.

OBJECTIVES: The aim of this article was to develop a semi-quantitative food frequency questionnaire (FFQ) and evaluate its validity to estimate habitual protein intake, and investigate current dietary protein intakes of Papua New Guinea (PNG) Highlanders. **METHODS:** A 32-item FFQ was developed and tested among 135 healthy male and female volunteers. The FFQ-estimated daily total and animal protein intakes were compared with biomarkers and 3-day Weighed Food Records (WFR) by correlation analyses, Bland-Altman plot analyses and joint classification analyses. **RESULTS:** The FFQ-estimated total protein intake significantly correlated with urinary nitrogen in the first morning void after adjusting urinary creatinine concentration ($r = 0.28$, $p < 0.01$) and the FFQ-estimated animal protein intake significantly correlated with the hair $\delta^{15}\text{N}$ (Spearman's $r = 0.34$, $p < 0.001$). The limits of agreement were ± 2.39 Z-score residuals for total protein intake and ± 2.19 Z-score for animal protein intake, and intra-individual differences increased as protein intake increased. The classification into the same and adjacent quartiles was 66.0% for total protein intake and 73.6% for animal protein intake. Median daily total and animal protein intake estimates from the FFQ and the 3-day WFR showed a good agreement with differences of 0.2 and 4.9 g, respectively. None of the studied communities in the PNG Highlands met the biologically required protein intake, although the community closer to an urban center showed higher protein intake than the more remote communities. **CONCLUSIONS:** The newly developed 32-item FFQ for PNG Highlanders is applicable for evaluation of protein intake at the individual level.

- 116 **Morita K, Nabeshima T, Buerano CC.**

Japanese encephalitis.

Rev Sci Tech 2015 Aug;34(2):441-452.

Japanese encephalitis (JE) is an inflammation of the central nervous system in humans and animals, specifically horses and cattle. The disease, which can sometimes be fatal, is caused by the flavivirus Japanese encephalitis virus (JEV), of which there are five genotypes (genotypes 1, 2, 3, 4 and 5). The transmission cycle of the virus involves pigs and wild birds as virus amplifiers and mosquitoes as vectors for transferring the virus between amplifying hosts and dead-end hosts, ie, humans, horses and cattle. In horses and cattle the disease is usually asymptomatic, but when clinical signs do occur they include fever, decreased appetite, frothing at the mouth, rigidity of the legs and recumbency, and neurological signs, such as convulsive fits, circling, marked depression and disordered consciousness. In pigs, it can cause abortion and stillbirths. At present, the virus is detected in a wide area covering eastern and southern Asia, Indonesia, northern Australia, Papua New Guinea and Pakistan. JEV RNA has also been detected in Italy, first in dead birds in 1997 and 2000 and then in mosquitoes in 2010. Genotype shift, ie, a change of genotype from genotype 3 to genotype 1, has occurred in some countries, namely Japan, South Korea, Chinese Taiwan and Vietnam. Laboratory methods are available for confirming the causative agent of the disease. There are control measures to prevent or minimise infection and, among them, vaccination is one of the most important and one which should be adopted in endemic and epidemic areas.

117 **Muga F.**

Rich country, poor people: the challenges of providing psychiatric services in the public and the private sectors in Papua New Guinea.

Australas Psychiatry 2015 Dec;23(6 Suppl):29-31. doi: 10.1177/1039856215608293.

OBJECTIVE: To describe some of the challenges in the provision of psychiatric services in Papua New Guinea. **CONCLUSION:** Many of the challenges faced when providing mental health care are not clinical in nature, but rather a combination of social, cultural, economic and infrastructural factors that hinder the adequate provision of, and access to, psychiatric services in Papua New Guinea.

118 **Munro J, McIntyre L.**

(Not) getting political: indigenous women and preventing mother-to-child transmission of HIV in West Papua.

Cult Health Sex 2015 Feb;18(2):156-170. doi: 10.1080/13691058.2015.1070436. Epub 2015 Aug 25.

This paper builds on critiques that call for a more nuanced and contextualized understanding of conditions that affect HIV prevention by looking at West Papuan women's experiences of prevention of mother-to-child transmission services. Drawing on qualitative, ethnographic research with indigenous women and health workers, the paper demonstrates that women experience poor-quality HIV education and counselling, and that indigenous practices and concerns are largely not addressed by HIV services. We attribute this to a combination of national anti-indigenous and anti-separatist political concerns with donor-led interventions that result in limited localisation and reduced effectiveness of HIV prevention measures. In West Papua, services are needed that enhance cooperation and shared commitment, and that acknowledge and work to overcome existing inequalities, ethnic tensions and discrimination in the health system. Beyond Indonesia, donor-led HIV programmes and interventions need to balance avoidance of politically sensitive issues with complicity in perpetuating health inequalities. Translating global health interventions and donor priorities into locally compelling HIV prevention activities involves more than navigating local cultural and religious beliefs. Programme development and implementation strategies that entail confronting structural questions as well as social hierarchies, cleavages and silences are needed to render more effective services: strategies that are inherently political.

119 **Naito YI, Morita A, Natsuhara K, Tadokoro K, Baba J, Odani S, Tomitsuka E, Igai K, Tsutaya T, Yoneda M, Greenhill AR, Horwood PF, Soli KW, Phuanukoonnon S, Siba PM, Umezaki M.**

Association of protein intakes and variation of diet-scalp hair nitrogen isotopic discrimination factor in Papua New Guinea highlanders.

Am J Phys Anthropol 2015 Nov;158(3):359-370. doi: 10.1002/ajpa.22798. Epub 2015 Jul 14.

OBJECTIVES: We present a new nitrogen isotopic discrimination factor between diets and scalp hairs ($\Delta^{15}\text{N}_{\text{Hair-Diet}}$: $\delta^{15}\text{N}_{\text{Hair}} - \delta^{15}\text{N}_{\text{Diet}}$) for indigenous residents in three communities in the Papua New Guinea highlands who consumed various amounts and qualities of protein. The $\Delta^{15}\text{N}$ is important for precise evaluation of the dietary habits of human populations, in both contemporary

and traditional lifestyles. Several hypotheses have been proposed regarding factors that affect $\Delta^{15}\text{N}$ values, based largely on observations from animal feeding experiments. However, variations and factors controlling $\Delta^{15}\text{N}$ in humans are not well understood, mainly due to the difficulty of controlling the diets of participants. **MATERIALS AND METHODS:** These residents were studied because they have maintained relatively traditional dietary habits, which allow quantitative recording of diets. $\Delta^{15}\text{N}$ was estimated by comparing hair $\delta^{15}\text{N}$ values to mean dietary $\delta^{15}\text{N}$ values calculated from the recorded intake of each food item and their $\delta^{15}\text{N}$ values. **RESULTS:** The results showed that: i) there was a significant difference in $\Delta^{15}\text{N}$ among study locations ($3.9 \pm 0.9\text{‰}$ for most urbanized, $5.2 \pm 1.0\text{‰}$ for medium and $5.0 \pm 0.9\text{‰}$ for least urbanized communities; range = $1.2\text{--}7.3\text{‰}$ for all participants); and ii) estimated $\Delta^{15}\text{N}$ values were negatively correlated with several indicators of animal protein intake (% nitrogen in diet: range = $0.9\text{--}7.6\%$). **DISCUSSION:** We hypothesize that a combination of several factors, which presumably included urea recycling and amino acid and protein recycling and/or de novo synthesis during metabolic processes, altered the $\Delta^{15}\text{N}$ values of the participants.

120 **Namdarian B, Willder S, Steele G, Leona R, Grills R.**

Establishment of a urology service in a developing country: an observational study of outcomes in transurethral prostate resection procedures in Vanuatu.

Lancet 2015 Apr 27;385 Suppl 2:S26. doi: 10.1016/S0140-6736(15)60821-2. Epub 2015 Apr 26.

BACKGROUND: The Royal Australasian College of Surgeons (RACS) via the Pacific Island Program (PIP) administers yearly urology visits to Vanuatu to perform surgery and deliver training in the management of urological conditions. In conjunction with the Vanuatu Ministry of Health a self-sufficient urology service has developed, specifically performing transurethral resection of the prostate (TURP) procedures. We review the TURP outcomes for the PIP and detail the development and outcomes of the first independent TURP service in the Pacific. **METHODS:** With retrospective local and RACS medical records, an observational study was performed of TURP procedures undertaken in Port Vila Central Hospital, Vanuatu over 6 years. Outcome measures comprised significant morbidity, prolonged post-operative admission, blood transfusion, TUR syndrome, successful trial of void, postoperative urinary incontinence, and perioperative mortality. Comparisons were made with univariate analysis between the RACS, local team, and international standardised values, with t-tests for continuous variables, and with Fisher's exact test for binary variables. **FINDINGS:** Since 2009, a total of 117 TURP procedures were performed: 84 by the PIP team and following training both in Vanuatu and Australia the local team independently performed 33 TURPs. Comparisons of all outcomes measured between the local and PIP teams showed no statistically significant differences (appendix). 29 patients overall (22 in the PIP group and seven in the local group) required blood transfusions, eight (seven and one) failed their trial of void, 10 (seven and three) had a prolonged post-operative admission (>7 days); two patients died in the post-operative period (both in the PIP group). 10 (seven and three)

had postoperative urinary incontinence. There was no difference between mean length of stay (4.07 days vs 4.7 days; $p=0.2081$) and haemoglobin loss with no cases of TUR syndrome. Only the rate of transfusion was statistically significantly higher in the Vanuatu cohorts when compared with international standards (appendix). **INTERPRETATION:** The development of a local urological service and in particular a TURP service is a first for a Pacific Island Nation. Baseline data were obtained with encouraging outcomes reflecting careful patient selection, cautious management, and expertise accumulation. Planned prospective audit should overcome some of the difficulties encountered in performing a longitudinal study in a developing nation with suboptimum follow-up and challenging medical records. Through linkage between the PIP and the Vanuatu Ministry of Health capacity building an independent service provision can be achieved. This model could be replicated to establish a sustainable and self-sufficient surgical service in a developing country.

121 Nazeri P, Mirmiran P, Shiva N, Mehrabi Y, Mojjarrad M, Azizi F.

Iodine nutrition status in lactating mothers residing in countries with mandatory and voluntary iodine fortification programs: an updated systematic review. *Thyroid* 2015 Jun;25(6):611-620. doi: 10.1089/thy.2014.0491. Epub 2015 May 14.

BACKGROUND: The aim of this review is to assess data available on iodine nutrition status in lactating mothers residing in countries with mandatory and voluntary iodine fortification programs and/or iodine supplementation. **SUMMARY:** A systematic review was conducted by searching articles published between 1964 and 2013 in Pub Med, ISI Web, and Cochrane Library using iodine nutrition, lactation, iodine supplementation, and iodine fortification as keywords for titles and/or abstracts. Relevant articles were included if they reported urinary iodine concentration (UIC) in lactating mothers and, if determined, the type of iodine fortification program and/or iodine supplementation. Forty-two studies met the inclusion criteria. Among these, 21 studies assessed lactating mothers in countries with a mandatory iodine fortification program, 17 studies were from countries with voluntary and/or without iodine fortification programs and four studies assessed iodine nutrition status in lactating mothers undergoing iodine supplementation. Among countries with mandatory iodine fortification programs, the range of salt iodization level in lactating mothers with a UIC $<100 \mu\text{g/L}$ was between 8 and 40 ppm, whereas among lactating mothers with UIC $>100 \mu\text{g/L}$, it was between 15 and 60 ppm. Levels of UIC $<100 \mu\text{g/L}$ were observed among lactating women in India, Denmark, Mali, New Zealand, Australia, Slovakia, Sudan, and Turkey, whereas in countries such as Chile, Iran, Mongolia, New Guinea and Nigeria, the median or mean of UIC was $>100 \mu\text{g/L}$. There was a median or mean UIC $<100 \mu\text{g/L}$ in nearly all lactating mothers residing in countries where implementation of universal salt iodization program was voluntary, including Switzerland, Australia, New Zealand, Ireland, and Germany. However, in some countries with voluntary iodine fortification programs, such as the United States, Spain, and Japan, a mean or median UIC of $>100 \mu\text{g/L}$ has been reported. **CONCLUSIONS:** Although universal salt iodization

is still the most feasible and cost-effective approach for iodine deficiency control in pregnant and lactating mothers, UIC in lactating mothers of most countries with voluntary programs and in areas with mandatory iodine fortification is still within the iodine deficiency range, indicating that iodine supplementation in daily prenatal vitamin/mineral supplements in lactating mothers is warranted. However, further investigations are still recommended in this regard.

122 Nguyen HT, Hickson RI, Kompas T, Mercer GN, Lokuge KM.

Strengthening tuberculosis control overseas: who benefits?

Value Health 2015 Mar;18(2):180-188. doi: 10.1016/j.jval.2014.11.008. Epub 2015 Jan 13.

BACKGROUND: Although tuberculosis is a major cause of morbidity and mortality worldwide, available funding falls far short of that required for effective control. Economic and spillover consequences of investments in the treatment of tuberculosis are unclear, particularly when steep gradients in the disease and response are linked by population movements, such as that between Papua New Guinea (PNG) and the Australian cross-border region. **OBJECTIVE:** To undertake an economic evaluation of Australian support for the expansion of basic Directly Observed Treatment, Short Course in the PNG border area of the South Fly from the current level of 14% coverage. **METHODS:** Both cost-utility analysis and cost-benefit analysis were applied to models that allow for population movement across regions with different characteristics of tuberculosis burden, transmission, and access to treatment. Cost-benefit data were drawn primarily from estimates published by the World Health Organization, and disease transmission data were drawn from a previously published model. **RESULTS:** Investing \$16 million to increase basic Directly Observed Treatment, Short Course coverage in the South Fly generates a net present value of roughly \$74 million for Australia (discounted 2005 dollars). The cost per disability-adjusted life-year averted and quality-adjusted life-year saved for PNG is \$7 and \$4.6, respectively. **CONCLUSIONS:** Where regions with major disparities in tuberculosis burden and health system resourcing are connected through population movements, investments in tuberculosis control are of mutual benefit, resulting in net health and economic gains on both sides of the border. These findings are likely to inform the case for appropriate investment in tuberculosis control globally.

123 Norton HL, Werren E, Friedlaender J.

MC1R diversity in Northern Island Melanesia has not been constrained by strong purifying selection and cannot explain pigmentation phenotype variation in the region.

BMC Genet 2015 Oct 19;16:122. doi: 10.1186/s12863-015-0277-x.

BACKGROUND: Variation in human skin pigmentation evolved in response to the selective pressure of ultra-violet radiation (UVR). Selection to maintain darker skin in high UVR environments is expected to constrain pigmentation phenotype and variation in pigmentation loci. Consistent with this hypothesis, the gene *MC1R* exhibits reduced diversity in African populations from high UVR regions compared to low-UVR non-African populations. However, *MC1R* diversity in non-African populations that have evolved under high-UVR

conditions is not well characterized. **METHODS:** In order to test the hypothesis that *MC1R* variation has been constrained in Melanesians the coding region of the *MC1R* gene was sequenced in 188 individuals from Northern Island Melanesia. The role of purifying selection was assessed using a modified McDonald Kreitman's test. Pairwise *F_{ST}* was calculated between Melanesian populations and populations from the 1000 Genomes Project. The SNP rs2228479 was genotyped in a larger sample (*n* = 635) of Melanesians and tested for associations with skin and hair pigmentation. **RESULTS:** We observe three nonsynonymous and two synonymous mutations. A modified McDonald Kreitman's test failed to detect a significant signal of purifying selection. Pairwise *F_{ST}* values calculated between the four islands sampled here indicate little regional substructure in *MC1R*. When compared to African, European, East and South Asian populations, Melanesians do not exhibit reduced population divergence (measured as *F_{ST}*) or a high proportion of haplotype sharing with Africans, as one might expect if ancestral haplotypes were conserved across high UVR populations in and out of Africa. The only common nonsynonymous polymorphism observed, rs2228479, is not significantly associated with skin or hair pigmentation in a larger sample of Melanesians. **CONCLUSIONS:** The pattern of sequence diversity here does not support a model of strong selective constraint on *MC1R* in Northern Island Melanesia. This absence of strong constraint, as well as the recent population history of the region, may explain the observed frequencies of the derived rs2228479 allele. These results emphasize the complex genetic architecture of pigmentation phenotypes, which are controlled by multiple, possibly interacting loci. They also highlight the role that population history can play in influencing phenotypic diversity in the absence of strong natural selection.

- 124 **Olszowy KM, Pomer A, Dancause KN, Sun C, Silverman H, Lee G, Chan CW, Tarivonda L, Regenvanu R, Kaneko A, Weitz CA, Lum JK, Garruto RM.**

Impact of modernization on adult body composition on five islands of varying economic development in Vanuatu.

Am J Hum Biol 2015 Nov-Dec;27(6):832-844. doi: 10.1002/ajhb.22734. Epub 2015 May 19.

OBJECTIVE: The Republic of Vanuatu, similar to other South Pacific island nations, is undergoing a rapid health transition as a consequence of modernization. The pace of modernization is uneven across Vanuatu's 63 inhabited islands, resulting in differential impacts on overall body composition and prevalence of obesity among islands, and between men and women. In this study, we investigated (1) how modernization impacts body composition between adult male and female Melanesians living on four islands of varying economic development in Vanuatu, and (2) how body composition differs between adult Melanesians and Polynesians living on rural islands in Vanuatu. **METHODS:** Anthropometric measurements were taken on adult male and female Melanesians aged 18 years and older (*n*=839) on the islands of Ambae (rural), Aneityum (rural with tourism), Nguna (rural with urban access), and Efate (urban) in Vanuatu, in addition to Polynesian adults on Futuna (rural). **RESULTS:** Mean measurements of body mass and fatness, and prevalence of obesity,

were greatest on the most modernized islands in our sample, particularly among women. Additionally, differences between men and women became more pronounced on islands that were more modernized. Rural Polynesians on Futuna exhibited greater body mass, adiposity, and prevalence of obesity than rural Melanesians on Ambae. **CONCLUSIONS:** We conclude that Vanuatu is undergoing an uneven and rapid health transition resulting in increased prevalence of obesity, and that women are at greatest risk for developing obesity-related chronic diseases in urbanized areas in Vanuatu.

- 125 **Ome-Kaius M, Unger HW, Singirok D, Wangnapi RA, Hanieh S, Umbers AJ, Elizabeth J, Siba P, Mueller I, Rogerson SJ.**

Determining effects of areca (betel) nut chewing in a prospective cohort of pregnant women in Madang Province, Papua New Guinea

BMC Pregnancy Childbirth 2015 Aug 19;15:177. doi: 10.1186/s12884-015-0615-z.

BACKGROUND: Chewing areca nut (AN), also known as betel nut, is common in Asia and the South Pacific and the habit has been linked to a number of serious health problems including oral cancer. Use of AN in pregnancy has been associated with a reduction in mean birthweight in some studies, but this association and the relationship between AN chewing and other adverse pregnancy outcomes remain poorly understood. **METHODS:** We assessed the impact of AN chewing on adverse outcomes including stillbirth, low birthweight (LBW, <2,500 g) and anaemia at delivery (haemoglobin <11.0 g/dL) in a longitudinal cohort of 2,700 pregnant women residing in rural lowland Papua New Guinea (PNG) from November 2009 until February 2013. Chewing habits and participant characteristics were evaluated at first antenatal visit and women were followed until delivery. **RESULTS:** 83.3% [2249/2700] of pregnant women used AN, and most chewed on a daily basis (86.2% [1939/2249]). Smoking and alcohol use was reported by 18.9% (511/2700) and 5.0% (135/2688) of women, respectively. AN use was not associated with pregnancy loss or congenital abnormalities amongst women with a known pregnancy outcome (*n* = 2215). Analysis of 1769 birthweights did not demonstrate an association between AN and LBW (chewers: 13.7% [200/1459] vs. non-chewers: 14.5% [45/310], *p* = 0.87) or reduced mean birthweight (2957 g vs. 2966 g; *p* = 0.76). Women using AN were more likely to be anaemic (haemoglobin <11 g/dL) at delivery (75.2% [998/1314] vs. 63.9% [182/285], adjusted odds ratio [95% CI]: 1.67 [1.27-2.20], *p* <0.001). Chewers more commonly had male babies than non-chewers (46.1% [670/1455] vs. 39.8% [123/309], *p* = 0.045). **CONCLUSIONS:** AN chewing may contribute to anaemia. Although not associated with other adverse pregnancy outcomes in this cohort, gestational AN use should be discouraged, given the potential adverse effects on haemoglobin and well-established long-term health risks including oral cancer. Future research evaluating the potential association of AN use and anaemia may be warranted.

- 126 **Palmqvist CL, Ariyaratnam R, Watters DA, Laing GL, Stupart D, Hider P, Ng-Kamstra JS, Wilson L, Clarke DL, Hagander L, Greenberg SL, Gruen RL.** Monitoring and evaluating surgical care: defining perioperative mortality rate and standardising data collection.

Lancet 2015 Apr 27;385 Suppl 2:S27. doi: 10.1016/S0140-6736(15)60822-4. Epub 2015 Apr 26.

BACKGROUND: Case volume per 100 000 population and perioperative mortality rate (POMR) are key indicators to monitor and strengthen surgical services. However, comparisons of POMR have been restricted by absence of standardised approaches to when it is measured, the ideal denominator, need for risk adjustment, and whether data are available. We aimed to address these issues and recommend a minimum dataset by analysing four large mixed surgical datasets, two from well-resourced settings with sophisticated electronic patient information systems and two from resource-limited settings where clinicians maintain locally developed databases. **METHODS:** We obtained data from the New Zealand (NZ) National Minimum Dataset, the Geelong Hospital patient management system in Australia, and purpose-built surgical databases in Pietermaritzburg, South Africa (PMZ) and Port Moresby, Papua New Guinea (PNG). Information was sought on inclusion and exclusion criteria, coding criteria, and completeness of patient identifiers, admission, procedure, discharge and death dates, operation details, urgency of admission, and American Society of Anesthesiologists (ASA) score. Date-related errors were defined as missing dates and impossible discrepancies. For every site, we then calculated the POMR, the effect of admission episodes or procedures as denominator, and the difference between in-hospital POMR and 30-day POMR. To determine the need for risk adjustment, we used univariate and multivariate logistic regression to assess the effect on relative POMR for each site of age, admission urgency, ASA score, and procedure type. **FINDINGS:** 1,365,773 patient admissions involving 1,514,242 procedures were included, among which 8655 deaths were recorded within 30 days. Database inclusion and exclusion criteria differed substantially. NZ and Geelong records had less than 0.1% date-related errors and greater than 99.9% completeness. PMZ databases had 99.9% or greater completeness of all data except date-related items (94.0%). PNG had 99.9% or greater completeness for date of birth or age and admission date and operative procedure, but 80-83% completeness of patient identifiers and date-related items. Coding of procedures was not standardised, and only NZ recorded ASA status and complete post-discharge mortality. In-hospital POMR range was 0.38% in NZ to 3.44% in PMZ, and in NZ it underestimated 30-day POMR by roughly a third. The difference in POMR by procedures instead of admission episodes as denominator ranged from 10% to 70%. Age older than 65 years and emergency admission had large independent effects on POMR, but relatively little effect in multivariate analysis on the relative odds of in-hospital death at each site. **INTERPRETATION:** Hospitals can collect and provide data for case volume and POMR without sophisticated electronic information systems. POMR should initially be defined by in-hospital mortality because post-discharge deaths are not usually recorded, and with procedures as denominator because details allowing linkage of several operations within one patient's admission are not always present. Although age and admission urgency are independently associated with POMR, and ASA and case mix were not included, risk adjustment might not be essential because the relative odds between sites persisted. Standardisation of inclusion criteria

and definitions is needed, as is attention to accuracy and completeness of dates of procedures, discharge and death. A one-page, paper-based form, or alternatively a simple electronic data collection form, containing a minimum dataset commenced in the operating theatre could facilitate this process.

127 Paudel P, Khadka J, Burnett A, Hani Y, Naduvilath T, Fricke TR.

Papua New Guinea vision-specific quality of life questionnaire: a new patient-reported outcome instrument to assess the impact of impaired vision. *Clin Experiment Ophthalmol* 2015 Apr;43(3):202-213. doi: 10.1111/ceo.12413. Epub 2014 Oct 2.

BACKGROUND: The aim of this study was to develop and validate a new vision-specific quality of life (VS QoL) instrument and to assess the impact of vision impairment and eye disease on the quality of life of adults in Papua New Guinea (PNG). **DESIGN:** This study was designed as community based cross-sectional. **PARTICIPANTS:** Six hundred fourteen adults aged 18 and above were included in this study. **METHODS:** Focus groups and interviews guided development of a 41-item instrument. Two valid subscales of the instrument were obtained using pilot data after an iterative item reduction process guided by Rasch-based parameters. The person measures (in logits) of 614 participants were used to assess quality of life using univariate and multivariate regression analysis. **MAIN OUTCOME MEASURES:** Rasch logits. **RESULTS:** Rasch analysis confirmed a 17-item instrument containing an 8-item activity limitation subscale and a 9-item well-being subscale. Both subscales were unidimensional and demonstrated good fit statistics, measurement precisions and absence of significant differential item functioning. A consistent deterioration in vision-specific quality of life was independently and significantly associated with levels of vision. Severity of vision impairment and ocular morbidity were independently associated with activity limitation and emotional well-being. Participants with refractive error had lower quality of life score than those with no ocular abnormality but higher score than those with cataract and other eye diseases. **CONCLUSIONS:** The 17-item PNG-VS QoL instrument is a valid and reliable instrument for the assessment of impact of impaired vision on quality of life in PNG. Vision-specific quality of life was significantly worse among participants who were older and less-educated, had lower income and had ocular morbidities.

128 Pedersen DM, Pedersen KJ, Barker DS.

Rainforest physician assistants – the Papua New Guinea health extension officer: an international physician assistant analogue. *J Physician Assist Educ* 2015 Sep;26(3):155-158. doi: 10.1097/JPA.0000000000000037.

129 Peltzer K, Pengpid S.

Early substance use initiation and suicide ideation and attempts among school-aged adolescents in four Pacific Island countries in Oceania. *Int J Environ Res Public Health* 2015 Sep 30;12(10):12291-12303. doi: 10.3390/ijerph121012291.

This study aimed to investigate the correlations between early initiation (<12 years) of smoking cigarettes, alcohol use, and drug use (cannabis) with suicidal ideation and suicide attempts in school-

aged adolescents in four Pacific Island countries in Oceania. The sample included 6540 adolescents (≥ 13 to ≤ 16 years old) from Kiribati, Samoa, Solomon Islands, and Vanuatu. Bivariate and multivariable analyses were conducted to assess the association between pre-adolescent substance use initiation and suicidal ideation and suicide attempts. Results indicate a prevalence of 25.8% suicidal ideation in the past 12 months (ranging from 17.2% in Vanuatu to 34.7% in Kiribati) and 34.9% suicide attempts in the past 12 months (ranging from 23.5% in Vanuatu to 62.0% in Samoa). The prevalence of early cigarette smoking initiation was 15.7%, early alcohol initiation 13.8%, and early drug use initiation 12.9%. Students who reported pre-adolescent substance use initiation, compared with non-substance users, were more likely to report suicidal ideation and suicide attempts. The concurrent initiation of cigarette smoking, alcohol, and drug use should be targeted in early prevention programmes in order to prevent possible subsequent suicidal behaviours.

130 Pengpid S, Peltzer K.

Overweight and obesity and associated factors among school-aged adolescents in six Pacific Island countries in Oceania.

Int J Environ Res Public Health 2015 Nov 13;12(11):14505-14518. doi: 10.3390/ijerph121114505.

The aim of this study was to assess overweight and obesity and associated factors in school-going adolescents in six Pacific Island countries in Oceania. The sample included 10,424 school-going adolescents predominantly 13-16 years old from Fiji, Kiribati, Samoa, Solomon Islands, Tonga, and Vanuatu. Bivariate and multivariable analyses were conducted to assess the relationship between dietary behaviour, substance use, physical activity, psychosocial factors, social-familial influences, and overweight or obesity. The prevalence of overweight and obesity was determined based on self-reported height and weight and the international child body mass index standards. Results indicate a prevalence of overweight or obesity of 24.3% and obesity of 6.1% in the six countries, ranging in terms of overweight or obesity and obesity from 12.0% and 0.4% in Vanuatu to 58.7% and 21.1% in Tonga, respectively. In multivariable regression analysis, being female was associated with overweight, carbonated soft drink use with obesity, sedentary behaviour with overweight or obesity, suicidal ideation with overweight, having close friends and peer support with overweight and obesity, parental or guardian supervision with overweight, and parental or guardian bonding with overweight or obesity. High prevalence rates of overweight and obesity were found and several factors identified which can help guide interventions.

131 Prescott TA, Briggs M, Kiapranis R, Simmonds MS.

Medicinal plants of Papua New Guinea's Miu speaking population and a focus on their use of plant-slaked lime mixtures.

J Ethnopharmacol 2015 Nov 4;174:217-223. doi: 10.1016/j.jep.2015.08.019. Epub 2015 Aug 20.

ETHNOPHARMACOLOGICAL RELEVANCE: Here we present the results of an ethnobotanical survey of the medicinal plants used by the Miu, a virtually unresearched ethnolinguistic group who live in the mountainous interior of Papua New

Guinea's West New Britain Province. We compare the findings for those previously reported for the neighbouring inland Kaulong speaking population. Three species, *Trema orientalis*, *Spondias dulcis* and *Ficus botryocarpa* are used in combination with locally prepared slaked lime to produce intensely coloured mixtures which are applied to dermatological infections. Their effects on dermal fibroblast viability with and without slaked lime are examined. The sap of *F. botryocarpa* which is used to treat tropical ulcers was examined further with assays relevant to wound healing. **MATERIALS AND METHODS:** Focus groups and semi-structured interviews were used to acquire information on the uses of plants, vouchers of which were collected and identified by comparison with authentic herbarium specimens. LC-MS and NMR were used to identify chemical components. Cell viability assays were used to examine the effects of added slaked lime on dermal fibroblasts. For the sap of *F. botryocarpa*, fibroblast stimulation assays and antibacterial growth inhibition with *Bacillus subtilis* were carried out. **RESULTS:** The survey identified 33 plants and one fungal species, and clear differences with the inland Kaulong group despite their close proximity. Added slaked lime does not greatly increase the cytotoxicity of plant material towards dermal fibroblasts. The sap of *F. botryocarpa* contains the alkaloid ficuseptine as a single major component and displays antibacterial activity. **CONCLUSIONS:** The results demonstrate the potential for variation in medicinal plant use amongst Papua New Guinea's numerous language groups. The addition of slaked lime to plant material does not appear to present a concern for wound healing in the amounts used. The sap of *F. botryocarpa* displays antibacterial activity at concentrations that would occur at the wound surface and could be used as a highly accessible alternative to conventional antiseptics for remote communities in Papua New Guinea.

132 Puilingi CG, Kudo Y, Cho Y, Konoki K, Yotsu-Yamashita M.

Tetrodotoxin and its analogues in the pufferfish *Arothron hispidus* and *A. nigropunctatus* from the Solomon Islands: a comparison of their toxin profiles with the same species from Okinawa, Japan.

Toxins (Basel) 2015 Aug 26;7(9):3436-3454. doi: 10.3390/toxins7093436.

Pufferfish poisoning has not been well documented in the South Pacific, although fish and other seafood are sources of protein in these island nations. In this study, tetrodotoxin (TTX) and its analogues in each organ of the pufferfish *Arothron hispidus* and *A. nigropunctatus* collected in the Solomon Islands were investigated using high resolution LC-MS. The toxin profiles of the same two species of pufferfish from Okinawa, Japan were also examined for comparison. TTXs concentrations were higher in the skin of both species from both regions, and relatively lower in the liver, ovary, testis, stomach, intestine, and flesh. Due to higher TTX concentrations (51.0 and 28.7 $\mu\text{g/g}$ at highest) detected in the skin of the two species from the Solomon Islands (saxitoxin was $<0.02 \mu\text{g/g}$), these species should be banned from consumption. Similar results were obtained from fish collected in Okinawa, Japan: TTX in the skin of *A. hispidus* and *A. nigropunctatus* were 12.7 and 255 $\mu\text{g/g}$, respectively, at highest, and saxitoxin was also detected in the skin (2.80 $\mu\text{g/g}$ at highest) and

ovary of *A. hispidus*. TTX, 5,6,11-trideoxyTTX (with its 4-epi form), and its anhydro forms were the most abundant, and 11-oxoTTX was commonly detected in the skin.

133 Qin P, Stoneking M.

Denisovan ancestry in East Eurasian and Native American populations.

Mol Biol Evol 2015 Oct;32(10):2665-2674. doi: 10.1093/molbev/msv141. Epub 2015 Jun 23.

Although initial studies suggested that Denisovan ancestry was found only in modern human populations from island Southeast Asia and Oceania, more recent studies have suggested that Denisovan ancestry may be more widespread. However, the geographic extent of Denisovan ancestry has not been determined, and moreover the relationship between the Denisovan ancestry in Oceania and that elsewhere has not been studied. Here we analyze genome-wide single nucleotide polymorphism data from 2,493 individuals from 221 worldwide populations, and show that there is a widespread signal of a very low level of Denisovan ancestry across Eastern Eurasian and Native American (EE/NA) populations. We also verify a higher level of Denisovan ancestry in Oceania than that in EE/NA; the Denisovan ancestry in Oceania is correlated with the amount of New Guinea ancestry, but not the amount of Australian ancestry, indicating that recent gene flow from New Guinea likely accounts for signals of Denisovan ancestry across Oceania. However, Denisovan ancestry in EE/NA populations is equally correlated with their New Guinea or their Australian ancestry, suggesting a common source for the Denisovan ancestry in EE/NA and Oceanian populations. Our results suggest that Denisovan ancestry in EE/NA is derived either from common ancestry with, or gene flow from, the common ancestor of New Guineans and Australians, indicating a more complex history involving East Eurasians and Oceanians than previously suspected.

134 Quiñones ML, Norris DE, Conn JE, Moreno M, Burkot TR, Bugoro H, Keven JB, Cooper R, Yan G, Rosas A, Palomino M, Donnelly MJ, Mawejje HD, Eapen A, Montgomery J, Coulibaly MB, Beier JC, Kumar A.

Insecticide resistance in areas under investigation by the International Centers of Excellence for Malaria Research: a challenge for malaria control and elimination.

Am J Trop Med Hyg 2015 Sep;93(3 Suppl):69-78. doi: 10.4269/ajtmh.14-0844. Epub 2015 Aug 10.

Scale-up of the main vector control interventions, residual insecticides sprayed on walls or structures and/or impregnated in bed nets, together with prompt diagnosis and effective treatment, have led to a global reduction in malaria transmission. However, resistance in vectors to almost all classes of insecticides, particularly to the synthetic pyrethroids, is posing a challenge to the recent trend of declining malaria. Ten International Centers of Excellence for Malaria Research (ICEMR) located in the most malaria-endemic regions of the world are currently addressing insecticide resistance in the main vector populations, which not only threaten hope for elimination in malaria-endemic countries but also may lead to reversal where notable reductions in malaria have been documented. This communication illustrates the current status of insecticide resistance with a focus on the countries

where activities are ongoing for 9 out of the 10 ICEMRs. Most of the primary malaria vectors in the ICEMR countries exhibit insecticide resistance, albeit of varying magnitude, and spanning all mechanisms of resistance. New alternatives to the insecticides currently available are still to be fully developed for deployment. Integrated vector management principles need to be better understood and encouraged, and viable insecticide resistance management strategies need to be developed and implemented.

135 Reddy SB, Anders RF, Cross N, Mueller I, Senn N, Stanisic DI, Siba PM, Wahlgren M, Kironde F, Beeson JG, Persson KE.

Differences in affinity of monoclonal and naturally acquired polyclonal antibodies against *Plasmodium falciparum* merozoite antigens.

BMC Microbiol 2015 Jul 3;15:133. doi: 10.1186/s12866-015-0461-1.

BACKGROUND: Malaria is a major global cause of deaths and a vaccine is urgently needed. **RESULTS:** We have employed the *P. falciparum* merozoite antigens MSP2-3D7/FC27 and AMA1, used them in ELISA, and coupled them in different ways using surface plasmon resonance (SPR) and estimated affinity (measured as kd) of monoclonal as well as naturally-acquired polyclonal antibodies in human plasma. There were major differences in kd depending on how the antigens were immobilized and where the His-tag was placed. For AMA1 we could see correlations with invasion inhibition. Using different immobilizations of proteins in SPR, we could see only moderate correlations with levels of antibodies in ELISA, indicating that in ELISA the proteins were not uniformly bound and that antibodies with many specificities exist in natural immunisation. The correlations between ELISA and SPR were enhanced when only parasite positive samples were included, which may indicate that high affinity antibodies are difficult to maintain over long periods of time. We found higher kd values for MSP2 (indicating lower affinity) compared to AMA1, which might be partly explained by MSP2 being an intrinsically disordered protein, while AMA1 is globular. **CONCLUSIONS:** For future vaccine studies and for understanding immunity, it is important to consider how to present proteins to the immune system to achieve highest antibody affinities.

136 Requena P, Barrios D, Robinson LJ, Samol P, Umbers AJ, Wangnapi R, Ome-Kaius M, Rosanas-Urgell A, Mayor A, López M, de Lazzari E, Arévalo-Herrera M, Fernández-Becerra C, del Portillo H, Chitnis CE, Siba PM, Rogerson S, Mueller I, Bardaji A, Menéndez C, Dobaño C.

Proinflammatory responses and higher IL-10 production by T cells correlate with protection against malaria during pregnancy and delivery outcomes.

J Immunol 2015 Apr 1;194(7):3275-3285. doi: 10.4049/jimmunol.1401038. Epub 2015 Feb 27.

Pregnancy triggers immunological changes aimed to tolerate the fetus. However, it has not been properly addressed whether similar changes occur in tropical areas with high infection pressure and whether these changes render women more susceptible to infectious diseases. We compared the frequencies of T cell subsets, including regulatory T cells, in pregnant and nonpregnant women from Papua New Guinea, a high malaria transmission

area, and from Spain, a malaria-free country. We also assessed the relationship among these cellular subsets, malaria infection, and delivery outcomes. CD4(+)FOXP3(+)CD127(low) T cells (Tregs) were decreased in pregnant women in both countries but were not associated with malaria infection or poor delivery outcomes. An expansion of IFN- γ -producing cells and intracytoplasmic IFN- γ levels was found in pregnant compared with nonpregnant women only in Papua New Guinea. Increased CD4(+)IL-10(+) IFN- γ (+) frequencies and Treg-IFN- γ production were found in women with current *Plasmodium falciparum* infection. Higher CD4(+)IL-10(-)IFN- γ (+) T cell frequencies and production of proinflammatory cytokines (including TNF and IL-2) at recruitment (first antenatal visit) had a protective association with birth weight and future (delivery) *P. falciparum* infection, respectively. Higher intracellular IL-10 levels in T cells had a protective association with future *P. falciparum* infection and hemoglobin levels at delivery. The protective associations were found also with nonmalaria-specific T cell responses. Treg frequencies positively correlated with plasma eotaxin concentrations, but this subset did not express eotaxin receptor CCR3. Thus, an activated immune system during pregnancy might contribute to protection against malaria during pregnancy and poor delivery outcomes.

137 Richmond M.

Frontier work in the remote highlands of Papua New Guinea.
Physician Leadersh J 2015 Mar-Apr;2(2):14-16,18.

138 Robinson LJ, Wampfler R, Betuela I, Karl S, White MT, Li Wai Suen CS, Hofmann NE, Kiniboro B, Waltmann A, Brewster J, Lorry L, Tarongka N, Samol L, Silkey M, Bassat Q, Siba PM, Schofield L, Felger I, Mueller I.

Strategies for understanding and reducing the *Plasmodium vivax* and *Plasmodium ovale* hypnozoite reservoir in Papua New Guinean children: a randomized placebo-controlled trial and mathematical model.
PLoS Med 2015 Oct 27;12(10):e1001891. doi: 10.1371/journal.pmed.1001891. eCollection 2015.

BACKGROUND: The undetectable hypnozoite reservoir for relapsing *Plasmodium vivax* and *P. ovale* malaria presents a major challenge for malaria control and elimination in endemic countries. This study aims to directly determine the contribution of relapses to the burden of *P. vivax* and *P. ovale* infection, illness, and transmission in Papua New Guinean children. **METHODS AND FINDINGS:** From 17 August 2009 to 20 May 2010, 524 children aged 5-10 y from East Sepik Province in Papua New Guinea (PNG) participated in a randomized double-blind placebo-controlled trial of blood- plus liver-stage drugs (chloroquine [CQ], 3 d; artemether-lumefantrine [AL], 3 d; and primaquine [PQ], 20 d, 10 mg/kg total dose) (261 children) or blood-stage drugs only (CQ, 3 d; AL, 3 d; and placebo [PL], 20 d) (263 children). Participants, study staff, and investigators were blinded to the treatment allocation. Twenty children were excluded during the treatment phase (PQ arm: 14, PL arm: 6), and 504 were followed actively for 9 mo. During the follow-up time, 18 children (PQ arm: 7, PL arm: 11) were lost to follow-up. Main primary and secondary outcome measures were time to first *P. vivax* infection (by qPCR), time to first clinical episode, force of infection, gametocyte

positivity, and time to first *P. ovale* infection (by PCR). A basic stochastic transmission model was developed to estimate the potential effect of mass drug administration (MDA) for the prevention of recurrent *P. vivax* infections. Targeting hypnozoites through PQ treatment reduced the risk of having at least one qPCR-detectable *P. vivax* or *P. ovale* infection during 8 mo of follow-up (*P. vivax*: PQ arm 0.63/y versus PL arm 2.62/y, HR = 0.18 [95% CI 0.14-0.25], $p < 0.001$; *P. ovale*: 0.06 versus 0.14, HR = 0.31 [95% CI 0.13-0.77], $p = 0.011$) and the risk of having at least one clinical *P. vivax* episode (HR = 0.25 [95% CI 0.11-0.61], $p = 0.002$). PQ also reduced the molecular force of *P. vivax* blood-stage infection in the first 3 mo of follow-up (PQ arm 1.90/y versus PL arm 7.75/y, incidence rate ratio [IRR] = 0.21 [95% CI 0.15-0.28], $p < 0.001$). Children who received PQ were less likely to carry *P. vivax* gametocytes (IRR = 0.27 [95% CI 0.19-0.38], $p < 0.001$). PQ had a comparable effect irrespective of the presence of *P. vivax* blood-stage infection at the time of treatment ($p = 0.14$). Modelling revealed that mass screening and treatment with highly sensitive quantitative real-time PCR, or MDA with blood-stage treatment alone, would have only a transient effect on *P. vivax* transmission levels, while MDA that includes liver-stage treatment is predicted to be a highly effective strategy for *P. vivax* elimination. The inclusion of a directly observed 20-d treatment regime maximises the efficiency of hypnozoite clearance but limits the generalisability of results to real-world MDA programmes. **CONCLUSIONS:** These results suggest that relapses cause approximately four of every five *P. vivax* infections and at least three of every five *P. ovale* infections in PNG children and are important in sustaining transmission. MDA campaigns combining blood- and liver-stage treatment are predicted to be a highly efficacious intervention for reducing *P. vivax* and *P. ovale* transmission.

139 Ryan B, Orotaloa P, Araitewa S, Gaoifa D, Moreen J, Kiloe E, Same W, Goding M, Ng C.

Mental health in the Solomon Islands: developing reforms and partnerships.
Australas Psychiatry 2015 Dec;23(6):662-666. doi: 10.1177/1039856215592323. Epub 2015 Jun 30.

OBJECTIVES: The Solomon Islands face significant shortages and geographical imbalances in the distribution of skilled health workers and resources, which severely impact the delivery of mental health services. The government's Integrated Mental Health Service has emphasised the importance of greater community ownership and involvement in community-based mental health care, and of moving from centralised services to increased local and accessible care. **METHODS:** From 2012 to 2014, the Solomon Islands Integrated Mental Health service worked with Asia-Australia Mental Health to build workforce capacity and deliver sustainable community mental health programs. **RESULTS:** Supported by the Australian Aid Program's Public Sector Linkages Program, this project shared resources and fostered links between public sector agencies in Australia, Fiji and the Solomon Islands. **CONCLUSIONS:** Key learning points from the collaboration included the critical need to establish partnerships with community stakeholders, the importance of sustaining a well-functioning mental health team, and optimising the strengths of the local resources in the Solomon Islands. Through

this project, national policies, promotion and service delivery were strengthened, through the exchange of experiences and mobilisation of north-south (Australia-Solomon Islands) and south-south (Solomon Islands-other Pacific nations) technical expertise. This project demonstrates the potential for international partnerships to contribute to the development of culturally-appropriate and integrated mental health services.

140 Sane S, Saulova A, McLaren R, White H.

A fatal case of primary dengue infection with myocarditis and cerebral oedema.

Australas Med J 2015 Sep 30;8(9):299-303. doi: 10.4066/AMJ.2015.2489. eCollection 2015.

With dengue fever emerging as a global health problem and more Australians travelling to endemic areas, imported dengue infection is on the rise and clinicians need to remain vigilant. Primary cardiac and neurologic involvement in dengue infection has been rarely described in the medical literature and the pathophysiology is poorly understood. A rare and fatal case of primary dengue infection in a 34-year-old woman who returned from Papua New Guinea is reported; the unusual features of this case include severe primary dengue infection, myocarditis, and acute cerebral oedema resulting in death. This case demonstrates that severe atypical manifestations and fatality can occur with primary dengue infection.

141 Seebaluck R, Gurib-Fakim A, Mahomoodally F.

Medicinal plants from the genus *Acalypha* (Euphorbiaceae) – a review of their ethnopharmacology and phytochemistry.

J Ethnopharmacol 2015 Jan 15;159:137-157. doi: 10.1016/j.jep.2014.10.040. Epub 2014 Oct 30.

ETHNOPHARMACOLOGICAL RELEVANCE: *Acalypha* is the fourth largest genus of the Euphorbiaceae family with approximately 450-570 species. Several *Acalypha* species are used as medicinal plants in Africa and in the Mascarene Islands. Almost every part of the plant including the leaves, stem and roots are used as traditional remedies to treat and manage a panoply of ailments. However, there is no updated compilation of traditionally important medicinal plants from the *Acalypha* genus. The present review, therefore, endeavors to provide for the first time an updated compilation of documented ethnopharmacological information in relation to the ethnomedicinal, ethnoveterinary, zoopharmacognosy, phytochemistry and biological activities of medicinal plants from the *Acalypha* genus which can subsequently open new *Acalypha* species using ethnobotanical text books and scientific databases such as Pubmed, Scopus, EBSCO and Google perspectives for further pharmacological research. **MATERIALS AND METHODS:** A literature search was performed on Scholar and other web sources such as records from PROTA, PROSEA, and Botanical Dermatology Database. The Plant List, International Plant Name index and Kew Botanical Garden Plant name databases were used to validate scientific names. **RESULTS AND DISCUSSION:** Plants from *Acalypha* genus are traditionally used in the treatment and/or management of diverse ailments such as diabetes, jaundice, hypertension, fever, liver inflammation, schistosomiasis, dysentery, respiratory problems including bronchitis, asthma and pneumonia as well as skin conditions such as scabies, eczema and mycoses. Approximately 124 species were

listed in ethnobotanical studies with some botanical description and others mentioned from different web sources. However, only 40 species have been included in the present review due to the unavailability of ethnopharmacological data on the remaining species. Among the 40 cited species, 30 were traditionally used for the treatment and/or management of approximately 70 human diseases or health conditions. Two species, *Acalypha alnifolia* and *Acalypha fruticosa* are used as insecticides and sand fly repellent respectively. Only 2 species (*Acalypha fruticosa* and *Acalypha indica*) are used in ethnoveterinary practice and have similar human and veterinary applications. In zoopharmacognosy, only *Acalypha ornata* has been mentioned. Natives from Africa, Central America, North America, Southern China, India, Bangladesh, Papua New Guinea and Mascarene Islands utilize *Acalypha* species as ethnomedicine. Traditionally used *Acalypha* species have been reported to possess at least one of the following biological activities: antimicrobial, anti-diabetic, antioxidant, anti-inflammatory, larvicidal, pupicidal, hepatoprotective, anticancer, leishmanicidal, antihyperglycemic, antihypertensive, anti-venom, analgesic, anthelmintic, antiemetic, laxative, expectorant, diuretic, post-coital antifertility effects and wound healing. A total of 167 compounds have been identified from 19 species, with 16 from eight species reported to be bioactive. **CONCLUSION:** The present review represents 32.3% of species from the *Acalypha* genus and can be considered as the first compilation of ethnopharmacologically useful plants from this genus. There is a great potential to discover new biologically active phytochemicals from the *Acalypha* genus because only few species have been studied comprehensively. Therefore, the clinical evaluation of species from this genus is warranted in future studies to confirm the ethnomedicinal claims and for the safety approval of therapeutic applications.

142 Serina P, Riley I, Stewart A, James SL, Flaxman AD, Lozano R, Hernandez B, Mooney MD, Luning R, Black R, Ahuja R, Alam N, Alam SS, Ali SM, Atkinson C, Baqui AH, Chowdhury HR, Dandona L, Dandona R, Dantzer E, Darmstadt GL, Das V, Dhingra U, Dutta A, Fawzi W, Freeman M, Gomez S, Gouda HN, Joshi R, Kalter HD, Kumar A, Kumar V, Lucero M, Maraga S, Mehta S, Neal B, Ohno SL, Phillips D, Pierce K, Prasad R, Praveen D, Premji Z, Ramirez-Villalobos D, Rarau P, Remolador H, Romero M, Said M, Sanvictores D, Sazawal S, Streatfield PK, Tallo V, Vadhatpour A, Vano M, Murray CJ, Lopez AD.

Improving performance of the Tariff Method for assigning causes of death to verbal autopsies. *BMC Med* 2015 Dec 8;13:291. doi: 10.1186/s12916-015-0527-9.

BACKGROUND: Reliable data on the distribution of causes of death (COD) in a population are fundamental to good public health practice. In the absence of comprehensive medical certification of deaths, the only feasible way to collect essential mortality data is verbal autopsy (VA). The Tariff Method was developed by the Population Health Metrics Research Consortium (PHMRC) to ascertain COD from VA information. Given its potential for improving information about COD, there is interest in refining the method. We describe the further development of the Tariff Method. **METHODS:** This study uses data from the PHMRC and the National

- Health and Medical Research Council (NHMRC) of Australia studies. Gold standard clinical diagnostic criteria for hospital deaths were specified for a target cause list. VAs were collected from families using the PHMRC verbal autopsy instrument including health care experience (HCE). The original Tariff Method (Tariff 1.0) was trained using the validated PHMRC database for which VAs had been collected for deaths with hospital records fulfilling the gold standard criteria (validated VAs). In this study, the performance of Tariff 1.0 was tested using VAs from household surveys (community VAs) collected for the PHMRC and NHMRC studies. We then corrected the model to account for the previous observed biases of the model, and Tariff 2.0 was developed. The performance of Tariff 2.0 was measured at individual and population levels using the validated PHMRC database. RESULTS: For median chance-corrected concordance (CCC) and mean cause-specific mortality fraction (CSMF) accuracy, and for each of three modules with and without HCE, Tariff 2.0 performs significantly better than the Tariff 1.0, especially in children and neonates. Improvement in CSMF accuracy with HCE was 2.5%, 7.4%, and 14.9% for adults, children, and neonates, respectively, and for median CCC with HCE it was 6.0%, 13.5%, and 21.2%, respectively. Similar levels of improvement are seen in analyses without HCE. CONCLUSIONS: Tariff 2.0 addresses the main shortcomings of the application of the Tariff Method to analyze data from VAs in community settings. It provides an estimation of COD from VAs with better performance at the individual and population level than the previous version of this method, and it is publicly available for use.
- 143 **Siefken K, Schofield G, Schulenkorf N.** Process evaluation of a walking programme delivered through the workplace in the South Pacific island Vanuatu. *Glob Health Promot* 2015 Jun;22(2):53-64. doi: 10.1177/1757975914539179. Epub 2014 Aug 8. BACKGROUND: The South Pacific region is experiencing significant rates of chronic diseases. Well-evaluated health promotion programmes are needed as a central piece of a strategic solution. Just as important as the evaluation itself is how that evaluation outcome can be communicated for future programme use by local programme planners. The objective of this study is to evaluate a physical activity (PA) programme that was designed for Pacific women in urban Vanuatu, and subsequently to develop new techniques to display data that support the understanding and communication of programme success and challenges. METHODS: Data collection methods included quantitative Likert scale questions and qualitative open-ended questions. A new analysis technique visualises open-ended process evaluation data. We present themes using word sizes proportional to the frequency of the themes identified through thematic analysis. RESULTS: The Likert scale technique revealed little meaningful information; almost all participants rated most elements of the programme highly. This may be related to Pacific people being frequently inclined to assent with external ideas. Open-ended questions provided more significant insights. For example, we found a stronger change in eating habits (68.9%) than in exercise behaviour (28.2%). CONCLUSION: We present an evaluation of the first pedometer-based PA intervention in the Pacific and respond to the paucity of process evaluations that have been carried out in the context of low- and middle-income countries. Moreover, the new thematic data visualisation (TDV) approach may aid in understanding complex and cluttered data in a constructive and coordinated way; we present a new approach in health promotion research.
- 144 **Solomon AW, Marks M, Martin DL, Mikhailov A, Flueckiger RM, Mitjā O, Asiedu K, Jannin J, Engels D, Mabey DC.** Trachoma and yaws: common ground? *PLoS Negl Trop Dis* 2015 Dec 3;9(12):e0004071. doi: 10.1371/journal.pntd.0004071. eCollection 2015.
- 145 **Stanisic DI, Moore KA, Baiwog F, Ura A, Clapham C, King CL, Siba PM, Beeson JG, Mueller I, Fowkes FJ, Rogerson SJ.** Risk factors for malaria and adverse birth outcomes in a prospective cohort of pregnant women resident in a high malaria transmission area of Papua New Guinea. *Trans R Soc Trop Med Hyg* 2015 May;109(5):313-324. doi: 10.1093/trstmh/trv019. Epub 2015 Mar 10. BACKGROUND: Low birth weight (LBW), anaemia and malaria are common in Papua New Guinean women. METHODS: To identify risk factors for LBW, anaemia and preterm delivery (PTD), pregnant women recruited into a cohort study in Madang, Papua New Guinea, were followed to delivery. RESULTS: Of 470 women enrolled, delivery data were available for 328 (69.7%). By microscopy, 34.4% (113/328) of women had malaria parasitaemia at enrolment and 12.5% (41/328) at delivery; at each time point, PCR detected sub-microscopic parasitaemia in substantially more. Most infections were with *Plasmodium falciparum*, the remainder being predominantly *P. vivax*. Anaemia and smoking were associated with lower birth weight, and LBW (16.7%; 51/305) and PTD (21.8%; 63/290) were common. Histopathologically diagnosed chronic placental malaria was associated with LBW (adjusted odds ratio [aOR] 3.3; $p = 0.048$) and PTD (aOR 4.2; $p = 0.01$). Lack of maternal education predisposed to PTD. Sub-microscopic parasitaemia at delivery appeared to increase the risk of LBW. Of the genetic polymorphisms, Southeast Asian ovalocytosis, α (+)-thalassaemia and complement receptor 1 (CR1) deficiency, a CR1 heterozygous genotype, was associated with decreased risk of anaemia and substantial but non-significant effects were noted in other comparisons. CONCLUSIONS: In coastal Papua New Guinea, malaria and anaemia are important causes of adverse pregnancy outcomes.
- 146 **Stanisic DI, Fowkes FJ, Koinari M, Javati S, Lin E, Kiniboro B, Richards JS, Robinson LJ, Schofield L, Kazura JW, King CL, Zimmerman P, Felger I, Siba PM, Mueller I, Beeson JG.** Acquisition of antibodies against *Plasmodium falciparum* merozoites and malaria immunity in young children and the influence of age, force of infection, and magnitude of response. *Infect Immun* 2015 Feb;83(2):646-660. doi: 10.1128/IAI.02398-14. Epub 2014 Nov 24. Individuals in areas of *Plasmodium falciparum* endemicity develop immunity to malaria after repeated exposure. Knowledge of the acquisition and nature of protective immune responses to *P.*

falciparum is presently limited, particularly for young children. We examined antibodies (IgM, IgG, and IgG subclasses) to merozoite antigens and their relationship to the prospective risk of malaria in children 1 to 4 years of age in a region of malaria endemicity in Papua New Guinea. IgG, IgG1, and IgG3 responses generally increased with age, were higher in children with active infection, and reflected geographic heterogeneity in malaria transmission. Antigenic properties, rather than host factors, appeared to be the main determinant of the type of IgG subclass produced. High antibody levels were not associated with protection from malaria; in contrast, they were typically associated with an increased risk of malaria. Adjustment for malaria exposure, using a novel molecular measure of the force of infection by *P. falciparum*, accounted for much of the increased risk, suggesting that the antibodies were markers of higher exposure to *P. falciparum*. Comparisons between antibodies in this cohort of young children and in a longitudinal cohort of older children suggested that the lack of protective association was explained by lower antibody levels among young children and that there is a threshold level of antibodies required for protection from malaria. Our results suggest that in populations with low immunity, such as young children, antibodies to merozoite antigens may act as biomarkers of malaria exposure and that, with increasing exposure and responses of higher magnitude, antibodies may act as biomarkers of protective immunity.

147 Stewart MJ, Negin J, Farrell P, Houasia P, Munamua AB, Martiniuk A.

Extent, causes and impact of road traffic crashes in the Solomon Islands 1993-2012: data from the orthopaedic department at the National Referral Hospital, Honiara.
Rural Remote Health 2015 Jul-Sep;15(3):2945. Epub 2015 Jul 26.

INTRODUCTION: Road traffic crashes constitute a considerable public health burden and represent the eighth leading cause of death and tenth leading cause of disability adjusted life years (DALYs) globally. However, very little is known about the extent, causes and impact of crashes in low- and middle-income countries including those in the Pacific. This lack of data is particularly true for the Solomon Islands. **METHODS:** The study is a retrospective record review of a pre-existing, de-identified dataset. A standardised trauma form is completed for all patients presenting to the orthopaedic department at the National Referral Hospital in Honiara with a suspected fracture following a trauma. Data are coded using one of 27 unique codes. Data related to road traffic crashes were extracted from the larger dataset, cleaned and analysed in Microsoft Excel. **RESULTS:** The database contained 699 records coded with one of seven codes related to road traffic crashes. Patients in the database were most frequently injured whilst a passenger in a car (27.8%), as a pedestrian (24.0%), or as a passenger in an open truck (21.6%). Almost three-quarters of patients were male. Just under half (48.5%) were aged between 10 and 29 years. Alcohol was listed as a contributing factor in 23.8% of presentations. **CONCLUSIONS:** This is one of the first studies to provide data on road traffic crashes in the Solomon Islands. In this database, young males were most likely to be involved in a crash that resulted in a suspected fracture. Young males are

in their prime years of productivity, and injuries that remove them from the workforce could have severe socioeconomic implications. This study found that more than half of injuries were borne by vulnerable road users such as pedestrians and motorcyclists, indicating a need for interventions that take these users into account. Finally, the study provides insight into the large impact that alcohol has on the risk of road traffic crashes.

148 Tachibana M, Suwanabun N, Kaneko O, Iriko H, Otsuki H, Sattabongkot J, Kaneko A, Herrera S, Torii M, Tsuboi T.

Plasmodium vivax gametocyte proteins, Pvs48/45 and Pvs47, induce transmission-reducing antibodies by DNA immunization.

Vaccine 2015 Apr 15;33(16):1901-1908. doi: 10.1016/j.vaccine.2015.03.008. Epub 2015 Mar 10.

Malaria transmission-blocking vaccines (TBV) aim to interfere with the development of the malaria parasite in the mosquito vector, and thus prevent spread of transmission in a community. To date three TBV candidates have been identified in *Plasmodium vivax*, namely, the gametocyte/gamete protein Pvs230, and the ookinete surface proteins Pvs25 and Pvs28. The *Plasmodium falciparum* gametocyte/gamete stage proteins Pfs48/45 and Pfs47 have been studied as TBV candidates, and Pfs48/45 shown to induce transmission-blocking antibodies, but the candidacy of their orthologs in *P. vivax*, Pvs48/45 (PVX_083235) and Pvs47 (PVX_083240), for vivax TBV have not been tested. Herein we investigated whether targeting Pvs48/45 and Pvs47 can inhibit parasite transmission to mosquitoes, using *P. vivax* isolates obtained in Thailand. Mouse antisera directed against the products from plasmids expressing Pvs48/45 and Pvs47 detected proteins of approximately 45- and 40-kDa, respectively, in the *P. vivax* gametocyte lysate, by Western blot analysis under non-reducing conditions. In immunofluorescence assays Pvs48/45 was detected predominantly on the surface and Pvs47 was detected in the cytoplasm of gametocytes. Membrane feeding transmission assays demonstrated that anti-Pvs48/45 and -Pvs47 mouse sera significantly reduced the number of *P. vivax* oocysts developing in the mosquito midgut. Limited amino acid polymorphism of these proteins was observed among 27 *P. vivax* isolates obtained from Thailand, Vanuatu, and Colombia, suggesting that polymorphism may not be an impediment for the utilization of Pvs48/45 and Pvs47 as TBV antigens. In one Thai isolate we found that the fourth cysteine residue in the Pvs47 cysteine-rich domain (CRD) III (amino acid position 337) is substituted to phenylalanine. However, antibodies targeting Pvs47 CRD-III showed a significant transmission-reducing activity against this isolate, suggesting that this substitution in Pvs47 was not critical for recognition by the generated antibodies. In conclusion, our results indicate that Pvs48/45 and Pvs47 are potential transmission-blocking vaccine candidates of *P. vivax*.

149 Taime T.

'Forgotten': a personal comment and communiqué on West Papuan refugees.

Australas Psychiatry 2015 Dec;23(6 Suppl):59-60. doi: 10.1177/1039856215612979.

OBJECTIVE: To raise awareness of the ongoing human rights violations of the indigenous residents of

West Papua and their mental health consequences. **METHOD:** The author, herself a refugee from West Papua, provides a summary comment from a presentation to the Leadership in Mental Health: Island Nations course, based on personal experience in West Papua and Papua New Guinea, and a telephone survey of West Papuan refugees resident in Australia. **RESULT:** A communiqué in solidarity from all course delegates was produced and is included. **CONCLUSION:** Human rights violations continue in West Papua, and the plight of its indigenous residents and West Papuan refugees in Papua New Guinea and Australia are dire and should not be 'forgotten'.

150 Tassi F, Ghirotto S, Mezzavilla M, Vilaça ST, De Santi L, Barbujani G.

Early modern human dispersal from Africa: genomic evidence for multiple waves of migration.

Investig Genet 2015 Nov 6;6:13. doi: 10.1186/s13323-015-0030-2. eCollection 2015.

BACKGROUND: Anthropological and genetic data agree in indicating the African continent as the main place of origin for anatomically modern humans. However, it is unclear whether early modern humans left Africa through a single, major process, dispersing simultaneously over Asia and Europe, or in two main waves, first through the Arab Peninsula into southern Asia and Oceania, and later through a northern route crossing the Levant. **RESULTS:** Here, we show that accurate genomic estimates of the divergence times between European and African populations are more recent than those between Australo-Melanesia and Africa and incompatible with the effects of a single dispersal. This difference cannot possibly be accounted for by the effects of either hybridization with archaic human forms in Australo-Melanesia or back migration from Europe into Africa. Furthermore, in several populations of Asia we found evidence for relatively recent genetic admixture events, which could have obscured the signatures of the earliest processes. **CONCLUSIONS:** We conclude that the hypothesis of a single major human dispersal from Africa appears hardly compatible with the observed historical and geographical patterns of genome diversity and that Australo-Melanesian populations seem still to retain a genomic signature of a more ancient divergence from Africa.

151 Tay AK, Rees S, Chen J, Kareth M, Silove D.

Pathways from conflict-related trauma and ongoing adversity to posttraumatic stress disorder symptoms amongst West Papuan refugees: the mediating role of anxiety and panic-like symptoms.

Compr Psychiatry 2015 Nov;63:36-45. doi: 10.1016/j.comppsy.2015.08.005. Epub 2015 Aug 11.

BACKGROUND: Although the relationship involving exposure to traumatic events (TEs), conditions of adversity, and posttraumatic stress disorder (PTSD) is well established in the refugee field, the psychological factors mediating the relevant pathways are not as clearly delineated. In the present path analysis, we examined a model in which anxiety and panic-like symptoms mediated the path between conflict-related TEs, ongoing adversity, and PTS symptoms amongst 230 refugees from West Papua. **METHODS:** Culturally adapted measures were applied to assess TE exposure, ongoing adversity, anxiety, and panic-like, PTS and depressive symptoms. **RESULTS:** Our model identified two pathways leading from

conflict-related exposure to PTS symptoms, one a direct path, the other mediated by a sequence of ongoing adversity, anxiety and panic-like symptoms. Older refugees from West Papua had higher levels of anxiety and panic-like symptoms than the younger adult generation born in PNG. **CONCLUSIONS:** Our findings suggest that a focus on reducing anxiety and panic together with addressing social deprivations and threats may improve anxiety and panic amongst refugees, ultimately improving outcomes for PTS symptoms.

152 Tay AK, Rees S, Chen J, Kareth M, Silove D.

The structure of post-traumatic stress disorder and complex post-traumatic stress disorder amongst West Papuan refugees.

BMC Psychiatry 2015 May 7;15:111. doi: 10.1186/s12888-015-0480-3.

BACKGROUND: The validity of applying the construct of post-traumatic stress disorder (PTSD) across cultures has been the subject of contention. Although PTSD symptoms have been identified across multiple cultures, questions remain whether the constellation represents a coherent construct with an interpretable factor structure across diverse populations, especially those naïve to western notions of mental disorder. An important additional question is whether a constellation of Complex-PTSD (C-PTSD) can be identified and if so, whether there are distinctions between that disorder and core PTSD in patterns of antecedent traumatic events. Our study amongst West Papuan refugees in Papua New Guinea (PNG) aimed to examine the factorial structure of PTSD based on the DSM-IV, DSM-5, ICD-10 and ICD-11 definitions, and C-PTSD according to proposed ICD-11 criteria. We also investigated domains of traumatic events (TEs) and broader psychosocial effects of conflict (sense of safety and injustice) associated with the factorial structures identified. **METHODS:** Culturally adapted measures were applied to assess exposure to conflict-related traumatic events (TEs), refugees' sense of safety and justice, and symptoms of PTSD and C-PTSD amongst 230 West Papuan refugees residing in Port Moresby, PNG. **RESULTS:** Confirmatory factor analysis (CFA) supported a unitary construct of both ICD-10 and ICD-11 PTSD, comprising the conventional symptom subdomains of intrusion, avoidance, and hyperarousal. In contrast, CFA did not identify a unitary construct underlying C-PTSD. The interaction of witnessing murders and sense of injustice was associated with both the intrusion and avoidance domains of PTSD, but not with the unique symptom clusters characterizing C-PTSD. **CONCLUSIONS:** Our findings support the ICD PTSD construct and its three-factor structure in this transcultural refugee population. Traumatic experiences of witnessing murder associated with a sense of injustice were specifically related to the intrusion and avoidance domains of PTSD. The unitary nature of C-PTSD across cultures remains in question.

153 Tay AK, Rees S, Chen J, Kareth M, Silove D.

The coherence and correlates of intermittent explosive disorder amongst West Papuan refugees displaced to Papua New Guinea.

J Affect Disord 2015 May 15;177:86-94. doi: 10.1016/j.jad.2015.02.009. Epub 2015 Feb 19.

Questions remain about the nosological status of intermittent explosive disorder (IED) as

a universal diagnosis. Cross-cultural studies are needed to establish whether IED symptoms form a coherent pattern and are distinguishable from other related symptom constellations. A study amongst a refugee population also allows further inquiry of the relationship between exposure to potentially traumatic events (PTEs) and other adversities with the IED constellation. In the present study amongst West Papuan refugees residing in Port Moresby, Papua New Guinea, we apply culturally adapted interview modules to assess symptoms of IED, post-traumatic stress disorder (PTSD), and depression, as well as the potentially traumatic events (PTEs) of conflict and ongoing adversity in the post-migration environment. Latent class analysis yielded a PTSD class (23%), a posttraumatic depressive class (14%), an IED class (12%), and a low/no-symptom class (49%). Compared to the low/no-symptom class, the PTSD class had high levels of exposure to all PTE domains including childhood-related adversities, witnessing murder, human rights trauma, and traumatic losses, as well as ongoing adversity relating to displacement and separation from families, safety concerns, and lack of access to basic needs and health care. The posttraumatic depression class had greater exposure to traumatic losses and childhood-related adversities, higher levels of stress relating to material loss and deprivation, as well as to displacement and separation from families. In contrast, the IED class was distinguished only by the ongoing stress of displacement and separation from families in the homeland. Our findings provide support for the phenomenological distinctiveness of IED symptoms in this transcultural setting. Although not exclusive to IED, conditions of long-term displacement and separation appear to be a source of ongoing anger and explosive aggression amongst this population.

- 154 **Tay AK, Rees S, Chan J, Kareth M, Silove D.** Examining the broader psychosocial effects of mass conflict on PTSD symptoms and functional impairment amongst West Papuan refugees resettled in Papua New Guinea (PNG). *Soc Sci Med* 2015 May;132:70-78.

Mass conflict and displacement erode the core psychosocial foundations of society, but there is a dearth of quantitative data examining the long-term mental health effects of these macrocosmic changes, particularly in relation to posttraumatic stress disorder (PTSD) symptoms. In 2013, we conducted a cross-sectional community study ($n = 230$) of West Papuan refugees residing in Port Moresby, Papua New Guinea, testing a moderated-mediation structural equation model of PTSD symptoms in which we examined relationships involving the psychosocial effects of mass conflict and displacement based on the Adaptation and Development after Persecution and Trauma (ADAPT) model, a trauma count (TC) of traumatic events (TEs) related to mass conflict, and a count index of current adversity (AC). A direct and an indirect path via AC led to PTSD symptoms. The ADAPT index exerted two effects on PTSD symptoms, an indirect effect via AC, and a moderating effect on TC. PTSD symptoms were directly associated with functional impairment. Although based on cross-sectional data, our findings provide support for a core prediction of the ADAPT model, that is, that undermining of the core psychosocial foundations of society brought about by mass conflict and displacement exerts an indirect

and moderating influence on PTSD symptoms. The path model supports the importance of repairing the psychosocial pillars of society as a foundation for addressing trauma-related symptoms and promoting the functioning of refugees.

- 155 **Tay AK, Rees S, Chen J, Kareth M, Lahe S, Kitau R, David K, Sonoling J, Silove D.**

Associations of conflict-related trauma and ongoing stressors with the mental health and functioning of West Papuan refugees in Port Moresby, Papua New Guinea (PNG).

PLoS One 2015 Apr 29;10(4):e0125178. doi: 10.1371/journal.pone.0125178. eCollection 2015.

Documentation is limited in relation to the mental health of the people of West Papua, a territory that has been exposed to decades-long political persecution. We examined associations of traumatic events (TEs) and current stressors with mental disorder and functioning, amongst 230 West Papuan refugees residing in six settlements in Port Moresby, Papua New Guinea (PNG). We used culturally adapted modules to assess exposure to TEs and mental disorders. Current stressors and functioning were assessed using modifications of measures developed by the World Health Organization (WHO). 129 of 230 respondents (56%) reported exposure to at least one traumatic event (TE), including: political upheaval (36.5%), witnessing or hearing about family members tortured and murdered (33.9%), and not being able to access medical care for family members (33%). One-fifth of respondents (47, 20.4%) experienced exposure to high levels of TEs (16 to 23). 211 (91.7%) endorsed at least one or more ongoing stressors, including: exposure to illicit substance use in the community (91.7%), problems with safety and the protection of women (89.6%), no access to legal rights and citizenship (88.3%), and lack of adequate shelter and facilities (85.2%). A quarter (26.9%) met criteria for one or more current mental disorder, and 69.1% reported functional impairment ranging from mild to extreme. Mental disorder was associated with being male (adjusted odds ratio = 2.00; 95% CI = 1.01-3.97), and exposure to the highest category of ongoing stressors (AOR = 2.89; 95% CI = 1.08-7.72). The TE count showed a dose-response pattern in its relationship with functional impairment, the greatest risk (AOR = 11.47; 95% CI = 2.11-62.37) being for those experiencing the highest level of TE exposure (16-23 events). West Papuans living in settlements in Port Moresby reported a range of TEs, ongoing stressors and associated mental disorders characteristic of populations exposed to mass conflict and persecution, prolonged displacement, and ongoing conditions of extreme hardship.

- 156 **Teo A, Hasang W, Randall LM, Unger HW, Siba PM, Mueller I, Brown GV, Rogerson SJ.**

Malaria preventive therapy in pregnancy and its potential impact on immunity to malaria in an area of declining transmission.

Malar J 2015 May 26;14:215. doi: 10.1186/s12936-015-0736-x.

BACKGROUND: Regular anti-malarial therapy in pregnancy, a pillar of malaria control, may affect malaria immunity, with therapeutic implications in regions of reducing transmission. **METHODS:** Plasma antibodies to leading vaccine candidate merozoite antigens and opsonizing antibodies to endothelial-binding and placental-binding infected

erythrocytes were quantified in pregnant Melanesian women receiving sulfadoxine-pyrimethamine (SP) with chloroquine taken once, or three courses of SP with azithromycin. **RESULTS:** Malaria prevalence was low. Between enrolment and delivery, antibodies to recombinant antigens declined in both groups ($p < 0.0001$). In contrast, median levels of opsonizing antibodies did not change, although levels for some individuals changed significantly. In multivariate analysis, the malaria prevention regimen did not influence antibody levels. **CONCLUSION:** Different preventive anti-malarial chemotherapy regimens used during pregnancy had limited impact on malarial immunity in a low-transmission region of Papua New Guinea.

- 157 **Tessema SK, Monk SL, Schultz MB, Tavul L, Reeder JC, Siba PM, Mueller I, Barry AE.**

Phylogeography of var gene repertoires reveals fine-scale geospatial clustering of *Plasmodium falciparum* populations in a highly endemic area. *Mol Ecol* 2015 Jan;24(2):484-497. doi: 10.1111/mec.13033. Epub 2015 Jan 9.

Plasmodium falciparum malaria is a major global health problem that is being targeted for progressive elimination. Knowledge of local disease transmission patterns in endemic countries is critical to these elimination efforts. To investigate fine-scale patterns of malaria transmission, we have compared repertoires of rapidly evolving var genes in a highly endemic area. A total of 3680 high-quality DBLα-sequences were obtained from 68 *P. falciparum* isolates from ten villages spread over two distinct catchment areas on the north coast of Papua New Guinea (PNG). Modelling of the extent of var gene diversity in the two parasite populations predicts more than twice as many var gene alleles circulating within each catchment (Mugil = 906; Wosera = 1094) than previously recognized in PNG (Amele = 369). In addition, there were limited levels of var gene sharing between populations, consistent with local parasite population structure. Phylogeographic analyses demonstrate that while neutrally evolving microsatellite markers identified population structure only at the catchment level, var gene repertoires reveal further fine-scale geospatial clustering of parasite isolates. The clustering of parasite isolates by village in Mugil, but not in Wosera was consistent with the physical and cultural isolation of the human populations in the two catchments. The study highlights the microheterogeneity of *P. falciparum* transmission in highly endemic areas and demonstrates the potential of var genes as markers of local patterns of parasite population structure.

- 158 **Thedja MD, Muljono DH, Ie SI, Sidarta E, Turyadi, Verhoef J, Marzuki S.**

Genogeography and immune epitope characteristics of hepatitis B virus genotype C reveals two distinct types: Asian and Papua-Pacific.

PLoS One 2015 Jul 10;10(7):e0132533. doi: 10.1371/journal.pone.0132533. eCollection 2015.

Distribution of hepatitis B virus (HBV) genotypes/subgenotypes is geographically and ethnologically specific. In the Indonesian archipelago, HBV genotype C (HBV/C) is prevalent with high genome variability, reflected by the presence of 13 of currently existing 16 subgenotypes. We investigated the association between HBV/C molecular characteristics with host ethnicity and geographical distribution by examining various

subgenotypes of HBV/C isolates from the Asia and Pacific region, with further analysis on the immune epitope characteristics of the core and surface proteins. A phylogenetic tree was constructed based on complete HBV/C genome sequences from Asia and Pacific region, and genetic distance between isolates was also examined. HBV/C surface and core immune epitopes were analyzed and grouped by comparing the amino acid residue characteristics and geographical origins. Based on the phylogenetic tree and geographical origins of isolates, two major groups of HBV/C isolates – East-Southeast Asia and Papua-Pacific – were identified. Analysis of core and surface immune epitopes supported these findings with several amino acid substitutions distinguishing the East-Southeast Asia isolates from the Papua-Pacific isolates. A west-to-east gradient of HBsAg subtype distribution was observed with adrq+ prominent in the East and Southeast Asia and adrq- in the Pacific, with several adrq-indeterminate subtypes observed in Papua and Papua New Guinea (PNG). This study indicates that HBV/C isolates can be classified into two types, the Asian and the Papua-Pacific, based on the virus genome diversity, immune epitope characteristics, and geographical distribution, with Papua and PNG as the molecular evolutionary admixture region in the switching from adrq+ to adrq-.

- 159 **Thomas A, Litvack AD.**

Community tuberculosis education: lessons learned in Tanna Island, Vanuatu.

Aust NZ J Public Health 2015 Feb;39(1):95-96. doi: 10.1111/1753-6405.12313. Epub 2015 Jan 5.

- 160 **Tierney D, Bolton P, Matanu B, Garasu L, Barnabas E, Silove D.**

The aftermath of the Bougainville Crisis: mental health and psychosocial impacts and the need for services.

Aust NZ J Psychiatry 2015 May;49(5):481-482. doi: 10.1177/0004867415575381. Epub 2015 Mar 10.

- 161 **Tran DN, Bero LA.**

Barriers and facilitators to the quality use of essential medicines for maternal health in low-resource countries: an Ishikawa framework.

J Glob Health 2015 Jun;5(1):010406. doi: 10.7189/jogh.05.010406.

BACKGROUND: An estimated 800 women die every day due to complications related to pregnancy or childbirth. Complications such as postpartum haemorrhage (PPH) and pre-eclampsia and eclampsia can be prevented by the appropriate use of essential medicines. The objective of this study was to identify the common barriers and facilitators to the availability and use of oxytocin, ergometrine, and magnesium sulfate (MgSO₄) – essential medicines indicated for the prevention and treatment of PPH and pre-eclampsia and eclampsia. **METHODS:** We analyzed seven UNFPA/WHO reports published in 2008-2010. These reports summarized country-wide rapid assessments of access to and use of essential medicines for maternal health in Mongolia, Nepal, Laos, the Democratic People's Republic of Korea (DPRK), the Philippines, Vanuatu, and the Solomon Islands. We used a 'fishbone' (Ishikawa) diagram as the analytic framework to identify facilitators and barriers at four health-system levels: government/regulatory, pharmaceutical supply, health facility, and health professional. **RESULTS:**

Common facilitators to the quality use of essential medicines for maternal health were observed at the government/regulatory and health professional level. A majority of countries had these medicines listed in their essential medicines lists. Awareness of the medicines was generally high among health professionals. Common barriers were identified at all health-system levels. First, standard treatment guidelines were not available, updated, or standardized. Second, there was an inadequate capacity to forecast and procure medicines. Third, a required MgSO₄ antidote was often not available and the storage conditions for oxytocin were deficient. CONCLUSIONS: The 'fishbone' Ishikawa diagram is a useful tool for describing the findings of rapid assessments of quality use of essential medicines for maternal health across countries. The facilitators and barriers identified should guide the development of tailored intervention programs to improve and expand the use of these life-saving medicines.

- 162 **Tsukahara T, Ogura S, Sugahara T, Sekihara M, Furusawa T, Kondo N, Mita T, Endo H, Hombhanje F.**

The choice of healthcare providers for febrile children after introducing non-professional health workers in a malaria endemic area in Papua New Guinea. *Front Public Health* 2015 Dec 24;3:275. doi: 10.3389/fpubh.2015.00275. eCollection 2015.

BACKGROUND: Disease burden of malaria in Papua New Guinea (PNG) is the highest in Asia and the Pacific, and prompt access to effective drugs is the key strategy for controlling malaria. Despite the rapid economic growth, primary healthcare services have deteriorated in rural areas; the introduction of non-professional health workers [village health volunteers (VHVs)] is expected to improve antimalarial drug deliveries. Previous studies in PNG suggested that distance from households negatively affected the utilization of health services; however, price effect on healthcare demand decisions has not been explored. Empirical studies on household's affordability as well as accessibility of healthcare services contribute to policy implications, such as efficient introduction of out-of-pocket costs and effective allocation of health facilities. Therefore, we investigate price responsiveness and other determinants of healthcare provider choice for febrile children in a malaria endemic rural area wherein VHVs were introduced. METHODS: Cross-sectional surveys were conducted using a structured questionnaire distributed in a health center's catchment area of East Sepik Province in the 2011/2012 rainy seasons. Caretakers were interviewed and data on fever episodes of their children in the preceding 2 weeks were collected. A mixed logit model was employed to estimate the determinants of healthcare provider choice. RESULTS: Among 257 fever episodes reported, the main choices of healthcare providers were limited to self-care, VHV, and a health center. Direct cost and walking distance negatively affected the choice of a VHV and the health center. An increase of VHV's direct cost or walking distance did not much affect predicted probability of the health center, but rather that of self-care, while drug availability and illness severity increased the choice probability of a VHV and the health center. CONCLUSION: The results suggest that the net healthcare demand increases with the introduction of a VHV. Allocations from the government's budget are required to sustain

VHV activities because the introduction of a small user fee could impede the utilization of a VHV. A large travel cost related to the choice of the health center suggests that resource allocation is required for the expansion of formal healthcare providers to adequately operate a referral system.

- 163 **Umbers AJ, Unger HW, Rosanas-Urgell A, Wangnapi RA, Kattenberg JH, Jally S, Silim S, Lufele E, Karl S, Ome-Kaius M, Robinson LJ, Rogerson SJ, Mueller I.**

Accuracy of an HRP-2/panLDH rapid diagnostic test to detect peripheral and placental *Plasmodium falciparum* infection in Papua New Guinean women with anaemia or suspected malaria. *Malar J* 2015 Oct 19;14(1):412. doi: 10.1186/s12936-015-0927-5.

BACKGROUND: The diagnosis of malaria during pregnancy is complicated by placental sequestration, asymptomatic infection, and low-density peripheral parasitaemia. Where intermittent preventive treatment (IPT) with sulfadoxine-pyrimethamine is threatened by drug resistance, or is inappropriate due to low transmission, intermittent screening and treatment (ISTp) with rapid diagnostic tests for malaria (RDT) could be a valuable alternative. Therefore, the accuracy of RDTs to detect peripheral and placental infection was assessed in a declining transmission setting in Papua New Guinea (PNG). METHODS: The performance of a combination RDT detecting histidine-rich protein-2 (HRP-2) and *Plasmodium* lactate dehydrogenase (pLDH), and light microscopy (LM), to diagnose peripheral *Plasmodium falciparum* and *Plasmodium vivax* infections during pregnancy, were assessed using quantitative real-time PCR (qPCR) as the reference standard. Participants in a malaria prevention trial in PNG with a haemoglobin ≤ 90 g/L, or symptoms suggestive of malaria, were tested. Ability of RDT and LM to detect active placental infection on histology was evaluated in some participants. RESULTS: Among 876 women, 1162 RDTs were undertaken (anaemia: 854 [73.5%], suspected malaria: 308 [26.5%]). qPCR detected peripheral infection during 190 RDT episodes (165 *P. falciparum*, 19 *P. vivax*, 6 mixed infections). Overall, RDT detected peripheral *P. falciparum* infection with 45.6% sensitivity (95% CI 38.0-53.4), a specificity of 96.4% (95.0-97.4), a positive predictive value of 68.4% (59.1-76.8), and a negative predictive value of 91.1% (89.2-92.8). RDT performance to detect *P. falciparum* was inferior to LM, more so amongst anaemic women (18.6 vs 45.3% sensitivity, Liddell's exact test, $p < 0.001$) compared to symptomatic women (72.9 vs 82.4% sensitivity, $p = 0.077$). RDT and LM missed 88.0% (22/25) and 76.0% (19/25) of *P. vivax* infections, respectively. In a subset of women tested at delivery and who had placental histology ($n = 158$) active placental infection was present in 19.6%: all three peripheral blood infection detection methods (RDT, LM, qPCR) missed >50% of these infections. CONCLUSIONS: In PNG, HRP-2/pLDH RDTs may be useful to diagnose peripheral *P. falciparum* infections in symptomatic pregnant women. However, they are not sufficiently sensitive for use in intermittent screening amongst asymptomatic (anaemic) women. These findings have implications for the management of malaria in pregnancy. The adverse impact of infections undetected by RDT or LM on pregnancy outcomes needs further evaluation.

- 164 Unger HW, Ome-Kaius M, Wangnapi RA, Umbers AJ, Hanieh S, Suen CS, Robinson LJ, Rosanas-Urgell A, Wapling J, Lufele E, Kongs C, Samol P, Sui D, Singirok D, Bardaji A, Schofield L, Menendez C, Betuela I, Siba P, Mueller I, Rogerson SJ.

Sulphadoxine-pyrimethamine plus azithromycin for the prevention of low birthweight in Papua New Guinea: a randomised controlled trial.

BMC Med 2015 Jan 16;13:19. doi: 10.1186/s12916-014-0258-3.

BACKGROUND: Intermittent preventive treatment in pregnancy has not been evaluated outside of Africa. Low birthweight (LBW, <2,500 g) is common in Papua New Guinea (PNG) and contributing factors include malaria and reproductive tract infections. **METHODS:** From November 2009 to February 2013, we conducted a parallel group, randomised controlled trial in pregnant women (≤ 26 gestational weeks) in PNG. Sulphadoxine-pyrimethamine (1,500/75 mg) plus azithromycin (1 g twice daily for 2 days) (SPAZ) monthly from second trimester (intervention) was compared against sulphadoxine-pyrimethamine and chloroquine (450 to 600 mg, daily for three days) (SPCQ) given once, followed by SPCQ placebo (control). Women were assigned to treatment (1:1) using a randomisation sequence with block sizes of 32. Participants were blinded to assignments. The primary outcome was LBW. Analysis was by intention-to-treat. **RESULTS:** Of 2,793 women randomised, 2,021 (72.4%) were included in the primary outcome analysis (SPCQ: 1,008; SPAZ: 1,013). The prevalence of LBW was 15.1% (305/2,021). SPAZ reduced LBW (risk ratio [RR]: 0.74, 95% CI: 0.60-0.91, $p = 0.005$; absolute risk reduction (ARR): 4.5%, 95% CI: 1.4-7.6; number needed to treat: 22), and preterm delivery (0.62, 95% CI: 0.43-0.89, $p = 0.010$), and increased mean birthweight (41.9 g, 95% CI: 0.2-83.6, $p = 0.049$). SPAZ reduced maternal parasitaemia (RR: 0.57, 95% CI: 0.35-0.95, $p = 0.029$) and active placental malaria (0.68, 95% CI: 0.47-0.98, $p = 0.037$), and reduced carriage of gonorrhoea (0.66, 95% CI: 0.44-0.99, $p = 0.041$) at second visit. There were no treatment-related serious adverse events (SAEs), and the number of SAEs (intervention 13.1% [181/1,378], control 12.7% [174/1,374], $p = 0.712$) and AEs (intervention 10.5% [144/1,378], control 10.8% [149/1,374], $p = 0.737$) was similar. A major limitation of the study was the high loss to follow-up for birthweight. **CONCLUSIONS:** SPAZ was efficacious and safe in reducing LBW, possibly acting through multiple mechanisms including the effect on malaria and on sexually transmitted infections. The efficacy of SPAZ in the presence of resistant parasites and the contribution of AZ to bacterial antibiotic resistance require further study. The ability of SPAZ to improve pregnancy outcomes warrants further evaluation.

- 165 Unger HW, Karl S, Wangnapi RA, Siba P, Mola G, Walker J, Mueller I, Ome M, Rogerson SJ.

Fetal size in a rural Melanesian population with minimal risk factors for growth restriction: an observational ultrasound study from Papua New Guinea.

Am J Trop Med Hyg 2015 Jan;92(1):178-186. doi: 10.4269/ajtmh.14-0423. Epub 2014 Nov 10.

We conducted a prospective longitudinal study of fetal size in rural Papua New Guinea (PNG) involving 439 ultrasound-dated singleton pregnancies with

no obvious risk factors for growth restriction. Sonographically estimated fetal weights (EFWs; $N = 788$) and birth weights ($N = 376$) were included in a second-order polynomial regression model (optimal fit) to generate fetal weight centiles. Means for specific fetal biometric measurements were also estimated. Fetal weight centiles from a healthy PNG cohort were consistently lower than those derived from Caucasian and Congolese populations, which overestimated the proportion of fetuses measuring small for gestational age (SGA; <10th centile). Tanzanian and global reference centiles (Caucasian weight reference adapted to our PNG cohort) were more similar to those observed in our cohort, but the global reference underestimated SGA. Individual biometric measurements did not differ significantly from other cohorts. In rural PNG, a locally derived nomogram may be most appropriate for detection of SGA fetuses.

- 166 Unger HW, Ome-Kaius M, Karl S, Singirok D, Siba P, Walker J, Wangnapi RA, Mueller I, Rogerson SJ.

Factors associated with ultrasound-aided detection of suboptimal fetal growth in a malaria-endemic area in Papua New Guinea.

BMC Pregnancy Childbirth 2015 Apr 3;15:83. doi: 10.1186/s12884-015-0511-6.

BACKGROUND: Fetal growth restriction (FGR) is associated with increased infant mortality rates and ill-health in adulthood. Evaluation of fetal growth requires ultrasound. As a result, ultrasound-assisted evaluations of causes of FGR in malaria-endemic developing countries are rare. We aimed to determine factors associated with indicators of abnormal fetal growth in rural lowland Papua New Guinea (PNG). **METHODS:** Weights and growth of 671 ultrasound-dated singleton pregnancies (<25 gestational weeks) were prospectively monitored using estimated fetal weights and birthweights. Maternal nutritional status and haemoglobin levels were assessed at enrolment, and participants were screened for malaria on several occasions. FGR was suspected upon detection of an estimated fetal weight or birthweight <10(th) centile (small-for-gestational age) and/or low fetal weight gain, defined as a change in weight z-score in the first quartile. Factors associated with fetal weight and fetal weight gain were additionally assessed by evaluating differences in weight z-scores and change in weight z-scores. Log-binomial and linear mixed effect models were used to determine factors associated with indicators of FGR. **RESULTS:** SGA and low weight gain were detected in 48.3% and 37.0% of pregnancies, respectively. Of participants, 13.8%, 21.2%, and 22.8% had a low mid-upper arm circumference (MUAC, <22 cms), short stature (<150 cms) and anaemia (haemoglobin <90 g/L) at first antenatal visit. 24.0% (161/671) of women had at least one malaria infection detected in peripheral blood. A low MUAC (adjusted risk ratio [aRR] 1.51, 95% CI 1.29-1.76, $p < 0.001$), short stature (aRR 1.27, 95% CI 1.04-1.55, $p = 0.009$), and anaemia (aRR 1.27, 95% CI 1.06-1.51, $p = 0.009$) were associated with SGA, and a low body mass index was associated with low fetal weight gain (aRR 2.10, 95% CI 1.62-2.71, $p < 0.001$). Additionally, recent receipt of intermittent preventive treatment in pregnancy was associated with increased weight z-scores, and anaemia with reduced change in weight z-scores. Malaria infection was associated

with SGA on crude but not adjusted analyses (aRR 1.13, 95% CI 0.95-1.34, $p=0.172$). **CONCLUSION:** Macronutrient undernutrition and anaemia increased the risk of FGR. Antenatal nutritional interventions and malaria prevention could improve fetal growth in PNG.

- 167 **Unger HW, Aho C, Ome-Kaius M, Wangnapi RA, Umbers AJ, Jack W, Lafana A, Michael A, Hanieh S, Siba P, Mueller I, Greenhill AR, Rogerson SJ.**

Impact of intermittent preventive treatment in pregnancy with azithromycin-containing regimens on maternal nasopharyngeal carriage and antibiotic sensitivity of *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Staphylococcus aureus*: a cross-sectional survey at delivery. *J Clin Microbiol* 2015 Apr;53(4):1317-1323. doi: 10.1128/JCM.03570-14. Epub 2015 Feb 11.

Sulfadoxine-pyrimethamine (SP) plus azithromycin (AZ) (SPAZ) has the potential for intermittent preventive treatment of malaria in pregnancy (IPTp), but its use could increase circulation of antibiotic-resistant bacteria associated with severe pediatric infections. We evaluated the effect of monthly SPAZ-IPTp compared to a single course of SP plus chloroquine (SPCQ) on maternal nasopharyngeal carriage and antibiotic susceptibility of *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Staphylococcus aureus* at delivery among 854 women participating in a randomized controlled trial in Papua New Guinea. Serotyping was performed, and antibiotic susceptibility was evaluated by disk diffusion and Etest. Potential risk factors for carriage were examined. Nasopharyngeal carriage at delivery of *S. pneumoniae* (SPAZ, 7.2% [30/418], versus SPCQ, 19.3% [84/436]; $p < 0.001$) and *H. influenzae* (2.9% [12/418] versus 6.0% [26/436], $p = 0.028$), but not *S. aureus*, was significantly reduced among women who had received SPAZ-IPTp. The number of macrolide-resistant pneumococcal isolates was small but increased in the SPAZ group (13.3% [4/30], versus SPCQ, 2.2% [2/91]; $p = 0.033$). The proportions of isolates with serotypes covered by the 13-valent pneumococcal conjugate vaccine were similar (SPAZ, 10.3% [3/29], versus SPCQ, 17.6% [16/91]; $p = 0.352$). Although macrolide-resistant isolates were rare, they were more commonly detected in women who had received SPAZ-IPTp, despite the significant reduction of maternal carriage of *S. pneumoniae* and *H. influenzae* observed in this group. Future studies on SPAZ-IPTp should evaluate carriage and persistence of macrolide-resistant *S. pneumoniae* and other pathogenic bacteria in both mothers and infants and assess the clinical significance of their circulation.

- 168 **Vallely LM, Homiehombo P, Kelly-Hanku A, Whittaker A.**

Unsafe abortion requiring hospital admission in the Eastern Highlands of Papua New Guinea – a descriptive study of women's and health care workers' experiences. *Reprod Health* 2015 Mar 21;12:22. doi: 10.1186/s12978-015-0015-x.

BACKGROUND: In Papua New Guinea induced abortion is restricted under the Criminal Code Law. Unsafe abortions are known to be widely practiced and sepsis due to unsafe abortion is a leading cause of maternal mortality. **METHODS:** We undertook a six month, prospective, mixed methods study at

the Eastern Highlands Provincial Hospital. Semi-structured and in-depth interviews were undertaken with women presenting following induced abortion. This paper describes the reasons why women resorted to unsafe abortion, the techniques used, decision to seek post abortion care and women's reflections post abortion. **RESULTS:** 28 women were admitted to hospital following an induced abortion. Reasons for inducing an abortion included: wanting to continue with studies, relationship problems and socio-cultural factors. Misoprostol was the most frequently used method to end the pregnancy. Physical and mechanical means, traditional herbs and spiritual beliefs were also reported. Women sought care post abortion due to excessive vaginal bleeding, and severe abdominal pain with some afraid they would die if they did not seek help. **CONCLUSION:** In the absence of contraceptive information and services to avoid, postpone or space pregnancies, women in this setting are resorting to unsafe means to end an unwanted pregnancy, putting their lives at risk. Women need access to safe, effective means of abortion.

- 169 **Vallely LM, Homiehombo P, Kelly-Hanku A, Vallely A, Homer CS, Whittaker A.**

Childbirth in a rural highlands community in Papua New Guinea: a descriptive study. *Midwifery* 2015 Mar;31(3):380-387. doi: 10.1016/j.midw.2014.11.002. Epub 2014 Nov 13.

OBJECTIVES: to explore men's and women's experiences, beliefs and practices surrounding childbirth in a rural highlands community in Papua New Guinea. **DESIGN:** a qualitative study comprising focus group discussions, key informant and in-depth interviews. **SETTING:** the study was undertaken in a rural community in Eastern Highlands Province, Papua New Guinea. **PARTICIPANTS:** 51 women and 26 men participated in 11 focus group discussions. Key informant and in-depth interviews were undertaken with 21 women and five men. **FINDINGS:** both women and men recognised the importance of health facility births, linking village births with maternal and newborn deaths. Despite this, many women chose to give birth in the community in circumstances influenced by cultural and customary beliefs and practices. Women giving birth in the community frequently gave birth in an isolated location. Traditional beliefs surrounding reasons for difficult births, including spiritual beliefs, were reported along with the use of traditional methods used to help prolonged and difficult births. **CONCLUSIONS:** while the importance of health facility births is recognised in this rural community many women continue to give birth in the village. Identifying and understanding local customs, beliefs and practices, particularly those that may be harmful to women and their newborn infants, is critical to the development of locally-appropriate community-based strategies for improving maternal and infant health in rural communities in PNG and other resource-limited, high-burden settings.

- 170 **Veronese V, van Gemert C, Bulu S, Kwarteng T, Bergari I, Badman S, Vella A, Stoové M.**

Sexually transmitted infections among transgender people and men who have sex with men in Port Vila, Vanuatu. *Western Pac Surveill Response J* 2015 Mar 5;6(1):55-59. doi: 10.2471/WPSAR.2014.5.1.001.

Despite high sexually transmitted infection (STI)

prevalence in the Pacific, there are limited data on STIs and risk among men who have sex with men (MSM) and transgender people (TG). In 2011, an Integrated Bio-Behavioural Survey recruited self-identified MSM and TG in Port Vila, Vanuatu. Descriptive findings were stratified by sexuality. Among 28 (55%) MSM and 23 (45%) TG, recent anal sex with male partners was more common among MSM (94% vs 71%; $p < 0.1$), including with casual (47% vs 35%), regular (59% vs 29%) and paying partners (28% vs 12%). MSM more commonly reported lifetime ($p < 0.01$) and recent sex with female partners ($p < 0.01$). Reported condom use with any partner type was low. More MSM (35%) than TG (24%) were diagnosed with an STI; previous treatment-seeking behaviour when symptomatic was lower among TG ($p < 0.1$). Tailored strategies acknowledging differences between MSM and TG are required to reduce STI vulnerability in Vanuatu.

171 Vince JD.

Millennium Development Goals: progress in Oceania.
Arch Dis Child 2015 Feb;100 Suppl 1:S63-S65. doi: 10.1136/archdischild-2013-305618.

172 Viney K, Hoy D, Roth A, Kelly P, Harley D, Sleight A.

The epidemiology of tuberculosis in the Pacific, 2000 to 2013.
Western Pac Surveill Response J 2015 Aug 19;6(3):59-67. doi: 10.5365/WPSAR.2015.6.3-059.

OBJECTIVE: Tuberculosis (TB) poses a significant public health challenge in the 22 Pacific island countries and territories. Using TB surveillance data and World Health Organization (WHO) estimates from 2000 to 2013, we summarize the epidemiology of TB in the Pacific. **METHODS:** This was a descriptive study of incident TB cases reported annually by Pacific island national TB programmes to WHO. We counted cases and calculated proportions and case notification rates per 100,000 population. We calculated the proportion of TB patients who completed TB treatment and summed estimates of national incidence, prevalence and mortality, provided by WHO, to produce regional incidence, prevalence and mortality rates per 100,000 population. **RESULTS:** Estimated TB incidence in the Pacific has remained high but stable from 2000 to 2013; estimated prevalence and mortality have fallen by 20% and 47%, respectively. The TB case notification rate increased by 58%, from 146 to 231 per 100,000 population in the same time period. In 2013, 24,145 TB cases were notified, most (94% or 22,657) were from Papua New Guinea. Kiribati had the highest TB case notification rate at 398 cases per 100,000 population. TB case notification rates were also high in Papua New Guinea, the Marshall Islands and Tuvalu (309, 283 and 182, respectively). **DISCUSSION:** TB in the Pacific is improving in some areas; however, high rates affect many countries and the estimated regional incidence rate is stable. To further reduce the burden of TB, a combination of dedicated public health and system-wide approaches are required along with poverty reduction and social protection initiatives.

173 Waltmann A, Darcy AW, Harris I, Koepfli C, Lodo J, Vahi V, Piziki D, Shanks GD, Barry AE, Whittaker M, Kazura JW, Mueller I.

High rates of asymptomatic, sub-microscopic

Plasmodium vivax infection and disappearing *Plasmodium falciparum* malaria in an area of low transmission in Solomon Islands.

PLoS Negl Trop Dis 2015 May 21;9(5):e0003758. doi: 10.1371/journal.pntd.0003758. eCollection 2015.

INTRODUCTION: Solomon Islands is intensifying national efforts to achieve malaria elimination. A long history of indoor spraying with residual insecticides, combined recently with distribution of long lasting insecticidal nets and artemether-lumefantrine therapy, has been implemented in Solomon Islands. The impact of these interventions on local endemicity of *Plasmodium* spp. is unknown. **METHODS:** In 2012, a cross-sectional survey of 3501 residents of all ages was conducted in Ngella, Central Islands Province, Solomon Islands. Prevalence of *Plasmodium falciparum*, *P. vivax*, *P. ovale* and *P. malariae* was assessed by quantitative PCR (qPCR) and light microscopy (LM). Presence of gametocytes was determined by reverse transcription quantitative PCR (RT-qPCR). **RESULTS:** By qPCR, 468 *Plasmodium* spp. infections were detected (prevalence = 13.4%; 463 *P. vivax*, five mixed *P. falciparum/P. vivax*, no *P. ovale* or *P. malariae*) versus 130 by LM (prevalence = 3.7%; 126 *P. vivax*, three *P. falciparum* and one *P. falciparum/P. vivax*). The prevalence of *P. vivax* infection varied significantly among villages (range 3.0-38.5%, $p < 0.001$) and across age groups (5.3-25.9%, $p < 0.001$). Of 468 *P. vivax* infections, 72.9% were sub-microscopic, 84.5% afebrile and 60.0% were both sub-microscopic and afebrile. Local residency, low education level of the household head and living in a household with at least one other *P. vivax* infected individual increased the risk of *P. vivax* infection. Overall, 23.5% of *P. vivax* infections had concurrent gametocytaemia. Of all *P. vivax* positive samples, 29.2% were polyclonal by MS16 and msp1F3 genotyping. All five *P. falciparum* infections were detected in residents of the same village, carried the same *msp2* allele and four were positive for *P. falciparum* gametocytes. **CONCLUSION:** *P. vivax* infection remains endemic in Ngella, with the majority of cases afebrile and below the detection limit of LM. *P. falciparum* has nearly disappeared, but the risk of re-introductions and outbreaks due to travel to nearby islands with higher malaria endemicity remains.

174 Wand H, Siba P.

Prevalence and correlates of HIV infection among sex workers in Papua New Guinea: first results from the Papua New Guinea and Australia Sexual Health Improvement Project (PASHIP).
AIDS Behav 2015 Dec;19(12):2194-2203. doi: 10.1007/s10461-015-1096-9.

The primary objective of this study was to estimate the individual and combined impacts of socio-demographic and sexual behaviours on HIV diagnosis among 523 female sex workers who participated in the Papua New Guinea and Australia Sexual Health Improvement Project. Logistic regression models were used to identify the factors associated with HIV positivity. We estimated their population level impacts in order to quantify the proportion of HIV seropositivity attributed to these factors. Less than 40% of women consented to get tested for HIV. HIV prevalence was 7% (95% CI 4-11%); lack of education and knowledge/awareness of HIV accounted for ~70% of the HIV diagnoses.

A major obstacle is lack of interest for testing. Our study underscored the major challenges in this culturally, linguistically heterogeneous country. The epidemic in Papua New Guinea requires targeted prevention interventions among those at highest risk of acquiring or transmitting infection.

- 175 **Wangnapi RA, Soso S, Unger HW, Sawera C, Ome M, Umbers AJ, Ndrewei N, Siba P, Li Wai Suen CS, Vallye A, Wapling J, Ryan C, Mueller I, Rogerson SJ.**

Prevalence and risk factors for *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and *Trichomonas vaginalis* infection in pregnant women in Papua New Guinea.

Sex Transm Infect 2015 May;91(3):194-200. doi: 10.1136/sextrans-2014-051670. Epub 2014 Oct 13.

OBJECTIVE: To determine the prevalence of, and risk factors associated with, *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and *Trichomonas vaginalis* infection in pregnant women in Madang, Papua New Guinea (PNG). **METHODS:** A cross-sectional survey was conducted among 400 pregnant women presenting to antenatal clinics. Sociodemographic and behavioural data were collected and real-time PCR diagnostic methods were used to detect the presence of chlamydia, gonorrhoea and trichomonas in self-collected vaginal swabs. The relationships between symptoms, sociodemographic and behavioural factors and infection were assessed. **RESULTS:** The prevalence of *C. trachomatis* was 11.1%, *N. gonorrhoeae* was 9.7% and *T. vaginalis* was 21.3%. One-third of women (33.7%) had at least one infection. The most common symptom was abdominal pain (48.0%), but only abnormal vaginal discharge was consistently associated with infection ($p < 0.001$). Women diagnosed with vaginal discharge syndrome were more likely to have at least one treatable infection (50.0% (47/94) vs 26.8% (68/254), $p < 0.001$), yet 59.1% of women with infection would have been missed by the current clinically-based syndromic diagnosis. Risk factors included having a partner at perceived risk of infection, maternal extramarital intercourse, early sexual debut, lack of formal education, urban residence and smoking. 78.8% of women reported never using condoms. **CONCLUSIONS:** The prevalences of *T. vaginalis*, *C. trachomatis* and *N. gonorrhoeae* were high among pregnant women in coastal PNG. The poor performance of clinically based syndromic diagnosis suggests that alternative strategies are urgently required to improve detection and reduce the burden of sexually transmitted infections and their associated adverse pregnancy outcomes in this population.

- 176 **Ward MP, Hernández-Jover M.**

A generic rabies risk assessment tool to support surveillance.

Prev Vet Med 2015 Jun 1;120(1):4-11. doi: 10.1016/j.pvetmed.2014.11.005. Epub 2014 Nov 13.

The continued spread of rabies in Indonesia poses a risk to human and animal populations in the remaining free islands, as well as the neighbouring rabies-free countries of Timor Leste, Papua New Guinea and Australia. Here we describe the development of a generic risk assessment tool which can be used to rapidly determine the vulnerability of rabies-free islands, so that scarce resources can be targeted to surveillance activities and the sensitivity of surveillance systems increased. The

tool was developed by integrating information on the historical spread of rabies, anthropological studies, and the opinions of local animal health experts. The resulting tool is based on eight critical parameters that can be estimated from the literature, expert opinion, observational studies and information generated from routine surveillance. In the case study presented, results generated by this tool were most sensitive to the probability that dogs are present on private and fishing boats and it was predicted that rabies-infection (one infected case) might occur in a rabies-free island (upper 95% prediction interval) with a volume of 1000 boat movements. With 25,000 boat movements, the median of the probability distribution would be equal to one infected case, with an upper 95% prediction interval of six infected cases. This tool could also be used at the national-level to guide control and eradication plans. An initial recommendation from this study is to develop a surveillance programme to determine the likelihood that boats transport dogs, for example by port surveillance or regularly conducted surveys of fisherman and passenger ferries. However, the illegal nature of dog transportation from rabies-infected to rabies-free islands is a challenge for developing such surveillance.

- 177 **Watanabe N, Kaneko A, Yamar S, Taleo G, Tanihata T, Lum JK, Larson PS, Shearer NB.**

A prescription for sustaining community engagement in malaria elimination on Aneityum Island, Vanuatu: an application of Health Empowerment Theory.

Malar J 2015 Jul 31;14:291. doi: 10.1186/s12936-015-0779-z.

BACKGROUND: Community engagement has contributed to disease control and elimination in many countries. Community engagement in malaria elimination (ME) on Aneityum Island has been sustained since its introduction in the early 1990s. Capacity developed within this population has led to a health empowered community response. Health Empowerment Theory (HET) can account for the innovative community actions and capacity development efforts taken to realize and sustain meaningful changes in well-being. This study used the HET framework to investigate participant perceptions of ME efforts on the island focusing on two HET elements, personal and social-contextual resources. The purpose of this study was to explore the role of empowerment as a critical element of community engagement. **METHODS:** Six focus group discussions, ten key informant interviews and 17 in-depth interviews were conducted in July 2012 on Aneityum. Both deductive and inductive approaches to qualitative content analysis were used to identify themes, which were condensed, coded and classified based on the HET elements above. **RESULTS:** Awareness and use of personal and social-contextual resources played an important role in ME efforts. Most participants shared their knowledge to prevent malaria reintroduction. Many participants reported their skills needed for behavioral maintenance, problem-solving or leadership. Participants who perceived a threat took preventive actions even in the dry season. Community leaders focused on second generation capacity development. A local health coalition provided ME services. Members of networks were sources of information and assistance. Face-to-face was the preferred method of communication. Barriers to engagement (eg, financial difficulties, health literacy

issues and underdeveloped infrastructure) were minimized through active collaboration and mutual assistance. **CONCLUSIONS:** In the community engagement continuum, health empowerment develops incrementally over time as people gain their knowledge and skills, form coalitions and develop collaborative networks (social capital) to make decisions and take action for change. Community engagement, which facilitates local personal and social-contextual resource development, has potential for ME and multilevel empowerment through community-based capacity development processes. These self-empowered communities have written and will continue to write a 'prescription' for sustaining high levels of engagement.

178 Watson AH, Poima R.

Healthy phoning: Papua New Guinea's first ever health call centre.

Australas Psychiatry 2015 Dec;23(6 Suppl):48-51. doi: 10.1177/1039856215609770.

OBJECTIVE: The paper reports on the establishment of Papua New Guinea's first ever health call centre. **METHOD:** Details of the phone calls received during the first nine weeks of the call centre's operation are presented. **RESULTS:** The data on phone call rates and types indicate a slight increase in utilisation of the service over the initial period. A total of 113 health-related phone calls were received during the first nine weeks of the call centre's operation. Most of these calls were from the public, while a small number were from rural health workers. Prank calls and calls enquiring about the service were also received. During establishment, mental health was not considered and calls that may fall into this category have not been logged separately. **CONCLUSIONS:** Further analysis would need to be undertaken to determine the effectiveness of the health call centre model in the Papua New Guinea context. Scripts, protocols and analysis regarding mental health may need to be developed.

179 Watson AH, Sabumei G, Mola G, Iedema R.

Maternal health phone line: saving women in Papua New Guinea.

J Pers Med 2015 Apr 27;5(2):120-139. doi: 10.3390/jpm5020120.

This paper presents the findings of a research project which has involved the establishment of a maternal health phone line in Milne Bay Province of Papua New Guinea (PNG). Mobile phones and landline phones are key information and communication technologies (ICTs). This research study uses the 'ICTs for healthcare development' model to ascertain benefits and barriers to the successful implementation of the Childbirth Emergency Phone. PNG has a very high maternal mortality rate. The 'three stages of delay' typology was developed by Thaddeus and Maine to determine factors that might delay provision of appropriate medical treatment and hence increase risk of maternal death. The 'three stages of delay' typology has been utilised in various developing countries and also in the present study. Research undertaken has involved semi-structured interviews with health workers, both in rural settings and in the labour ward in Alotau. Additional data has been gathered through focus groups with health workers, analysis of notes made during phone calls, interviews with women and community leaders, observations and

field visits. One hundred percent of interviewees (n = 42) said the project helped to solve communication barriers between rural health workers and Alotau Provincial Hospital. Specific examples in which the phone line has helped to create positive health outcomes will be outlined in the paper, drawn from research interviews. The Childbirth Emergency Phone project has shown itself to play a critical role in enabling healthcare workers to address life-threatening childbirth complications. The project shows potential for rollout across PNG, potentially reducing maternal morbidity and maternal mortality rates by overcoming communication challenges.

180 Watson-Jones RE, Busch JT, Legare CH.

Interdisciplinary and cross-cultural perspectives on explanatory coexistence.

Top Cogn Sci 2015 Oct;7(4):611-623. doi: 10.1111/tops.12162. Epub 2015 Sep 8.

Natural and supernatural explanations are used to interpret the same events in a number of predictable and universal ways. Yet little is known about how variation in diverse cultural ecologies influences how people integrate natural and supernatural explanations. Here, we examine explanatory coexistence in three existentially arousing domains of human thought: illness, death, and human origins using qualitative data from interviews conducted in Tanna, Vanuatu. Vanuatu, a Melanesian archipelago, provides a cultural context ideal for examining variation in explanatory coexistence due to the lack of industrialization and the relatively recent introduction of Christianity and Western education. We argue for the integration of interdisciplinary methodologies from cognitive science and anthropology to inform research on explanatory coexistence.

181 Williams DJ.

Snake bite: a global failure to act costs thousands of lives each year.

BMJ 2015 Oct 27;351:h5378. doi: 10.1136/bmj.h5378.

182 Win Tin ST, Iro G, Gadabu E, Colagiuri R.

Counting the cost of diabetes in the Solomon Islands and Nauru.

PLoS One 2015 Dec 23;10(12):e0145603. doi: 10.1371/journal.pone.0145603. eCollection 2015.

AIM: To determine the costs associated with diabetes to governments and people with diabetes and their carers, and its impact on quality of life in two Pacific Island countries – the Solomon Islands and Nauru. **MATERIALS AND METHODS:** This cross-sectional cost of illness study was conducted on 330 people with type 2 diabetes (197 from the Solomon Islands and 133 from Nauru) using a structured cost of illness survey questionnaire adapted from the Australian DiabCoSt study. Quality of life was measured by the EQ-5D Visual Analogue Scale. **RESULTS:** There were 330 respondents (50% female; mean duration of diabetes 10.9 years; mean age 52.6 years). The estimated annual national cost of diabetes incurred by the Solomon Islands government was AUD12.8 million (AUD281 per person/year) and by Nauru government was AUD1.2 million (AUD747 per person/year). The major contribution to the government costs was inpatient services cost (71% in the Solomon Islands and 83% in Nauru). Annual expenditure for diabetes was approximately 20% of the governments' annual

health care expenditure. Considerable absenteeism and retirement from work due to diabetes was found. CONCLUSIONS: This study found substantial public and personal costs associated with diabetes. The findings provide objective data on which health policy, funding and planning decisions about the prevention and control of diabetes in the Solomon Islands and Nauru can be reliably based and subsequently evaluated.

183 Zurovac D, Guintran JO, Donald W, Naket E, Malinga J, Taleo G.

Health systems readiness and management of febrile outpatients under low malaria transmission in Vanuatu.

Malar J 2015 Dec 2;14(1):489. doi: 10.1186/s12936-015-1017-4.

BACKGROUND: Vanuatu, an archipelago country in the Western Pacific harbouring low *Plasmodium falciparum* and *Plasmodium vivax* malaria transmission, has been implementing a malaria case management policy, recommending parasitological testing of patients with fever and anti-malarial treatment for test-positive only patients. A health facility survey to evaluate the health system's readiness to implement the policy and the quality of outpatient management for patients with fever was undertaken. **METHODS:** A cross-sectional, cluster sample survey, using a range of quality-of-care methods, included all health centres and hospitals in Vanuatu. The main outcome measures were coverage of health facilities and health workers with commodities and support interventions, adherence to test and treatment recommendations, and factors influencing malaria testing. **RESULTS:** The survey

was undertaken in 2014 during the low malaria season and included 41 health facilities, 67 health workers and 226 outpatient consultations for patients with fever. All facilities had capacity for parasitological diagnosis, 95.1% stocked artemether-lumefantrine and 63.6% primaquine. The coverage of health workers with support interventions ranged from 50 to 70%. Health workers' knowledge was high only regarding treatment policy for uncomplicated *P. falciparum* malaria (83.4%). History taking and clinical examination practices were sub-optimal. Some 35.0% (95% CI 23.4-48.6) of patients with fever were tested for malaria, of which all results were negative and only one patient received anti-malarial treatment. Testing was significantly higher for patients aged 5 years and older (OR = 2.33; 95% CI 1.48-5.02), seen by less qualified health workers (OR = 2.73; 95% CI 1.48-5.02), health workers who received malaria case management training (OR = 2.39; 95% CI 1.28-4.47) and patients with increased temperature (OR = 2.56; 95% CI 1.17-5.57), main complaint of fever (OR = 5.82; 95% CI 1.26-26.87) and without runny nose (OR = 3.75; 95% CI 1.36-10.34). Antibiotic use was very high (77.4%) with sub-optimal dispensing and counselling practices. **CONCLUSIONS:** Health facility and health worker readiness to implement policy is higher for falciparum than vivax malaria. Clinical and malaria testing practices are sub-optimal; however, adherence to test negative results is nearly universal. Use of antibiotics is irrational. Quantitative and qualitative improvements of ongoing interventions are needed to re-inforce clinical practices in this area characterized by difficult access, human resource shortages but aspiring towards malaria elimination.

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- 3 **Garner PA, Hill G.** Brainwashing in tuberculosis management. *PNG Med J* 1985;28:291-293.
- 4 **Cochrane RG.** A critical appraisal of the present position of leprosy. In: Lincicome DP, ed. *International Review of Tropical Medicine*. New York: Academic Press, 1961:1-42.

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