PNG Department of Health

Child Morbidity and Mortality

Annual Report 2014

Child Health Advisory Committee
PNG National Department of Health
PNG Paediatric Society

2014 Annual Report on Child Morbidity and Mortality

Summary

- This report covers data on child admissions and outcomes in 2014 from 12 provincial hospitals
- In 2014 there were 20,974 admissions and 1482 deaths recorded (mortality rate 7.1%). There were 1030 post-neonatal deaths and 452 neonatal deaths.
- Pneumonia was the most common reason for admission (27% of admissions)
- Neonatal conditions were the second most common cause for admission (24% of admissions).
- Although malnutrition is usually not the primary reason children present, severe malnutrition was present in 14% of admissions, making it the third most common problem seen in hospitals. Malnutrition either directly caused or contributed to 31% of all deaths.
- Diarrhoea (13% of admissions) was the fourth most common cause of admissions.
- In 2014 a measles epidemic resulted in 2098 admissions recorded in the hospitals participating in the PHR; measles was the 5th most common cause of admission, and had a CFR of 2.8%.
- Anaemia occurred in at least 7% of patients, and was present in 17% of deaths
- Neonatal deaths accounted for 30% of all deaths. The leading causes of death in neonates were: birth asphyxia (41% of neonatal deaths), neonatal infections (37% of neonatal deaths) and very low birth weight (24% of neonatal deaths).

Summary of major recommendations

In response to the findings of this report, the Child Health Advisory Committee of the National Department of Health has made a series of recommendations which are described in this Report:

1. Addressing unnecessary child deaths will depend to a large extent on reducing deaths from pneumonia and neonatal conditions, which together made up 51% of admissions and 50% of deaths in 2014.
2. Reducing cases of severe pneumonia require a comprehensive approach, prevention and treatment. Prevention includes the use of the new pneumococcal conjugate vaccine (PCV), improving breast-feeding and the quality of complementary feeding, and reducing indoor air pollution. Education of mothers is needed on the signs of pneumonia. Improved treatment in health centres and hospitals, including use of triage and pulse oximetry for identification of the sickest children, giving appropriate antibiotics, and oxygen therapy to those with hypoxaemia. Treating co-morbidities including malnutrition and anaemia and identifying children who may have tuberculosis are also essential for reducing severe pneumonia deaths.
3. Reducing neonatal deaths requires improved access to skilled birth attendants, access to obstetric care and early essential newborn care. Essential newborn care includes *immediate and thorough drying*, which stimulates breathing and prevents hypothermia. *Sustained skin-to-skin*

contact prevents hypothermia, reduces infection, calms the baby and facilitates successful intake of colostrum and sustained breastfeeding. *Delaying cord clamping until cord pulsations stop* - typically around one to three minutes from birth - reduces the risk of anaemia and in preterm infants and other complications. *Exclusive breastfeeding and elimination of formula* can prevent a large proportion of neonatal sepsis deaths. *Avoid harmful practices*, such as separation of babies from their mothers in the first hours of life for bathing or unnecessary observation. To reduce deaths from neonatal sepsis, the application of 4% chlorhexidine to the umbilical cord should be done for all newborns.

4. Improvements in care for very low birth weight babies, neonatal sepsis and birth asphyxia are needed. This includes the increased use of Kangaroo Mother Care (skin-to-skin contact), prevention and treatment of hypoxaemia, apnoea, hypoglycaemia, improved feeding with breast milk, more rational use of antibiotics, greater adherence to hand hygiene and other infection control practices, more careful use of IV fluids, audit and ward organisation.
5. Improving obstetric care is necessary to reduce deaths from birth asphyxia. Improved use of partographs during labour is needed. Family planning would reduce many unwanted pregnancies.
6. Malnutrition needs greater emphasis. Prevention of malnutrition at the community level is the best way to avoid children dying from malnutrition. However identification and timely treatment of children with severe malnutrition is also essential and often poorly done in hospitals. Increased use of Mid Upper Arm Circumference (MUAC) measurement would improve identification of the children at highest risk of death. Children with severe malnutrition need special attention to feeding, prevention and treatment of infections, and close monitoring for complications. A step-by-step approach to the management of severe malnutrition should be followed; this is outlined in the Pocket Book of Hospital Care for Children and the PNG Standard Treatment Manual. Major problems in the management of malnutrition are inadequate feeding: starting feeds too late, not giving enough milk feeds and not frequent enough feeds. Use of the new milk formulas F75 and F100 would improve the feeding of malnourished children who are not breast fed.
7. Children with meningitis have a high risk of death, and survivors are at risk of disabilities. Meningitis deaths can be prevented by the Hib vaccine (contained within the Pentavalent vaccine given at 1, 2 and 3 months), and the pneumococcal conjugate vaccine (PCV). Children presenting with meningitis need to be recognised and treated early, and monitored closely in a high dependency area of the ward. The common causes of meningitis are resistant to chloramphenicol so third-generation cephalosporins (such as ceftriaxone or cefotaxime) are the only effective antibiotic to treat meningitis.
8. This year the PHR program has gathered more data on tuberculosis, which causes 12% of child deaths. Extra-pulmonary tuberculosis makes up over 40% of children diagnosed with TB, and children with EPTB have a higher mortality. Every effort should be made to help children complete therapy. For many children this requires keeping them under supervision in a health facility for the 2 months of intensive phase, good education of parents to ensure adherence in the continuation phase, and active community follow-up.

9. There are very major human resource gaps in neonatal and child health at all levels of the health service. Addressing these requires increasing the number of general nurses and post-basic paediatric nurses.
10. The National Child Health Plan outlines a plan for improving child health until 2020. The Child Health Advisory Committee recommends that everyone involved in health care for children be familiar with this, and that Provincial and District Health officials use it to formulate their Annual Activity Plans.

2014 Annual Report on Child Morbidity and Mortality

Introduction

The Child Health Advisory Committee of the National Department of Health releases the fourth Annual Report on Child Morbidity and Mortality in Papua New Guinea. The Committee believes the data and recommendations contained in this report should be read by all health workers and health administrators. It is only by critically examining health outcomes that we can improve our services. The data are current, covering all of 2014, with some comparisons throughout to data collected in the previous 5 years. The recommendations cover clinical and public health issues that if taken on board by all, would result in many children's lives being saved in the coming years.

Paediatric Hospital Reporting System (PHR) 2009-2014

The Paediatric Hospital Reporting System enables hospitals to record admissions, calculate mortality rates and monitor trends in diseases burdens and outcomes over time. When the data are compiled from all hospitals, this can focus on disease or geographical areas of high mortality where there is scope for improvement. The data are reported using standardised diagnostic criteria, consistent with clinical and public health practice in Papua New Guinea.

In 2009-2014, up to 16 hospitals participated, providing data for 12 month periods, although different hospitals contributed data making year to year comparisons more difficult.

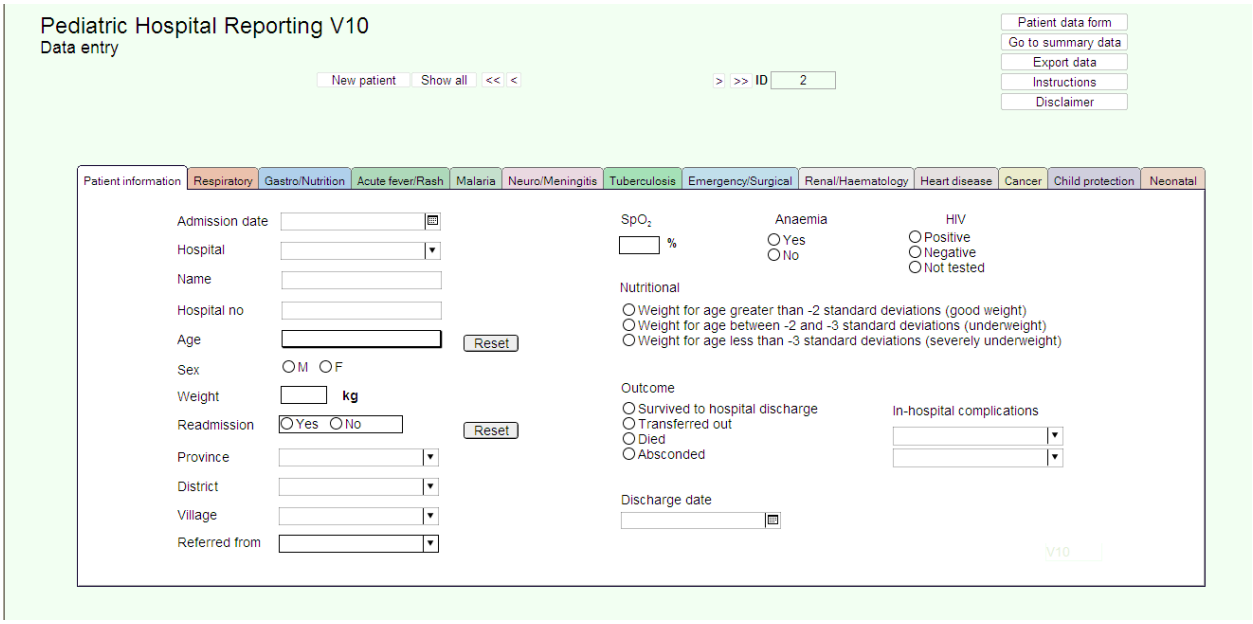
Case fatality rates (CFR) vary quite widely: low overall CFR in the smaller hospitals, such as Alotau (2%) and Vanimo (4.2%); 5.5% in Goroka Hospital; and up to 9.9% in Modilon Hospital and 11.8% in Angau. Differences in CFR reflect many things: including case mix, severity of illness at the time of presentation, human and other resources available to manage seriously ill children, and disease outbreaks.

Table 1 summarises the data for the 8 most common causes of hospital admission in children and case fatality rates in the years 2009-2014.

The Appendices contain summaries of data for each major diagnostic group at each hospital.

Diagnoses	**Admissions**	**Deaths**	**CFR**
	2009-2014		
All admissions	**96,998**	**7,128**	**7.35**
Pneumonia	25,986	1290	**4.96**
Neonatal conditions	19040	2049	**10.76**
Diarrhoea	11019	395	**3.58**
Malaria	7738	342	**4.42**
Severe malnutrition	11457	2088	**18.22**
Tuberculosis	7223	838	**11.6**
Meningitis	5752	1011	**17.58**
HIV	1644	248	**15.09**

Table 1. Most common causes of hospital admission and case fatality rates in children for 2009-2014



The Paediatric Hospital Reporting program

Pneumonia

In 2014 there were 5658 admissions for pneumonia reported through the PHR. Pneumonia makes up 27% of admissions overall.

The overall pneumonia CFR was 5.2% (294 deaths from 5658 cases of pneumonia), comparable with the pneumonia case fatality rate for previous years.

The PHR system enables the calculation of mortality rates for both total cases of pneumonia overall and for cases of *severe* pneumonia. The overall case fatality rate for severe pneumonia was 12.4%.

Severe pneumonia case fatality rates, as they are partly standardised for illness severity at the time of presentation, better reflect systems of practice, staff skills training and resources. High case fatality rates from severe pneumonia may occur if children present late, or are not recognised to be very unwell, if antibiotics and oxygen are not given promptly, or if children are not monitored closely.

Recommendations

It is recommended that hospitals ensure that there is:

- a system of triage and rapid treatment of the sickest patients in the emergency and outpatients departments
- a part of the children's ward that is properly equipped and stocked to provide high dependency care and close monitoring
- adequate oxygen supplies and staff trained in when and how to effectively give oxygen
- appropriate stocks of antibiotics to treat pneumonia
- regular clinical monitoring, including the use of pulse oximetry
- training for staff in the care of seriously ill children
- sufficient nursing and medical staff to provide clinical care at all times
- senior supervision of nursing and medical practice

Chloramphenicol may be becoming less effective in the treatment of very severe pneumonia, and this may be one factor that explains the high case fatality rates in some hospitals. Treatment options include penicillin (or ampicillin) and gentamicin, or ceftriaxone for the seriously ill or deteriorating child with pneumonia.

The high numbers of deaths from pneumonia and meningitis (443 or 30% of all deaths) underline the importance of *Hemophilus influenzae* type b (Hib) vaccine, which was introduced in 2008, and the pneumococcal conjugate vaccine, which was introduced in 2014.

These vaccines are best solution to preventing deaths and disability from bacterial meningitis. In other countries these two vaccines have made a modest difference to pneumonia presentations to hospitals. This is because there are other common causes of pneumonia, including viruses (particularly respiratory syncitial virus, influenza) and bacteria that are not prevented by these two vaccines (such as Group A streptococcus, *Staphylococcus aureus*, enteric gram negative bacilli, Chlamydia, Mycoplasma and tuberculosis). This means that even with these important vaccines,

pneumonia will continue to be a major cause of hospitalisation and death in children in PNG. Therefore improving clinical care and general preventative measures to reduce pneumonia are also essential.

The PNG Child Health Plan 2009-2020 outlines a comprehensive approach to pneumonia. This includes key areas to address:

Prevention

- Nutrition and breast feeding
- Helping parents be aware of the signs of pneumonia and the need for seeking care
- Reduction in indoor air pollution
- Hand-washing
- Vaccines: measles, Hib, pneumococcal

Treatment

- Improving quality of hospital and health centre care of pneumonia through IMCI, Standard Treatment Guidelines and Hospital Care for Children training
- Oxygen, pulse oximetry and CPAP
- Identification and treatment of comorbidities, including anaemia, malnutrition, and HIV.
- Infection control practices, particularly hand hygiene, and addressing rising rates of bacterial resistance and improving rational antibiotic prescribing
- Models of outpatient treatment for moderate pneumonia

Diarrhoea

2739 admissions and 109 deaths (CFR 3.9%) due to diarrhoea were reported in the 12 hospitals in 2014.

Deaths from diarrhoea can be due to (i) severe dehydration where the child does not have access to effective rehydration, (ii) from sepsis from bacillary dysentery, or (iii) other co-morbidity.

Severe diarrhoea can be prevented by timely use of oral rehydration in the community, by parents bringing their child to a health facility if they have diarrhoea, by improved assessment of the severity of dehydration, the use of zinc as additional treatment, and the appropriate use of antibiotics in bloody diarrhoea.

Most watery diarrhoea is due to viruses and does not require antibiotics, but require that children have access to ORS, zinc and breast feeding. If children receive adequate rehydration and nutrition when they have watery diarrhoea, death is very unlikely.

Dysentery is bloody diarrhoea, and is commonly due to a bacterium called *Shigella flexneri*. Studies in PNG found very high levels of resistance to amoxicillin and cotrimoxazole among *Shigella flexneri* isolates causing diarrhoea. The study confirmed that cotrimoxazole is ineffective and ciprofloxacin is needed to treat dysentery. Oral ciprofloxacin is currently recommended treatment by WHO for

dysentery in a dose of 10-15mg/kg twice daily for 5 days. If children are too sick to take oral medications, give ceftriaxone intravenously (IV) or intramuscularly (IM).

Recommendations

- Give ORS and zinc to all children with diarrhoea
- Treat bloody diarrhoea (dysentery) with ciprofloxacin

Malaria

In 2014 malaria accounted for 1033 admissions and 67 deaths (case fatality rate of 6.4%). The number of reported cases of malaria is falling each year (see Appendix, Table 2).

PNG has changed malaria guidelines to:

- Uncomplicated malaria: artemether-lumefantrine
- Severe or complicated malaria: artesunate as initial treatment, followed by artemether-lumefantrine

It is important that health workers are familiar with these new treatments. They are described in the 9th Edition of the Standard Treatment Book for Common Illnesses in Children, published in 2011.

Malnutrition

The PHR records malnutrition as a co-morbidity, so even if it is not the primary diagnosis it is still recorded. In 2014 in the 12 hospitals that reported using the PHR, 2861 children were admitted with severe malnutrition (weight for age <3 SD below the median), or with severe wasting or kwashiorkor. This represented 13.6% of all admissions. Severe malnutrition in these 12 hospitals was associated with 455 deaths: 30% of all deaths, and the case fatality rate for severe malnutrition was 15.9%. Case fatality rate for malnutrition was more than 20% in 4 hospitals.

Recommendations

Health centres and hospitals need early identification and treatment for children with severe *and moderate* malnutrition:

- Breast feeding should be strongly promoted and mothers supported to breast-feed while their babies are in hospital
- growth monitoring should be a regular part of child health care
- There should be ready access in the health centre or hospital to adequate formulas (F75 and F100 ideally), nutritious fresh fruits and vegetables and other fresh food, and ready-to-use therapeutic food (RUTF).
- The main problems in the management of malnutrition are inadequate feeding (starting feeds to late, not enough milk feeds and not frequent enough feeds).
- Guidelines for the management of malnutrition should be in place and used. These include prevention and treatment of fatal complications such as sepsis, hypothermia and hypoglycaemia

- Children with severe acute malnutrition should be nursed in a high dependency area in the children's ward, where close monitoring and identification of complications can occur
- Children with chronic illnesses that are likely to result in malnutrition, such as HIV, tuberculosis, osteomyelitis or chronic cardiac, respiratory or renal disease should be identified early and provided with supplemental feeding
- Zinc and vitamin A should be available
- Staff should be trained in the management of malnutrition

The *prevention* of malnutrition must have the highest priority. This requires improved rates of breast feeding and complimentary (weaning) feeding. This will be helped by increased participation in education by girls and by greater economic empowerment for mothers. Mothers who have been educated to at least primary school completion are much more likely to breast feed their infants for longer, as well as more likely to seek care when their children are sick, and be up-to-date with immunization.

The *management* of malnutrition is outlined in the PNG Standard Treatment Manual and the WHO Pocket Book of Hospital Care for Children. Many children in hospitals are inadequately supplied with food. Steps should be taken to improve the caloric intake of sick hospitalised children. Having trained paediatric nurses skilled in the management of malnutrition is essential to reducing the case fatality rates from malnutrition.

Meningitis

In the 10 hospitals meningitis accounted for 993 admissions, this is a reduction on the previous 3 years. There were 149 deaths, also a significant reduction on the previous 3 years (Appendix Table 2). The case fatality rate for meningitis was 15%.

For every death from meningitis many children survive with serious brain injury which will reduce the child's ability to gain a proper education, or participate in the community or workforce. This is a preventable tragedy.

There were 219 cases of H. influenza meningitis and 60 cases of S. pneumoniae meningitis in 2014. Therefore an aetiology was identified for around a third of cases of meningitis. Many hospitals cannot do bacterial culture of blood or CSF. Latex antigen testing has been available in some of the hospital laboratories.

The best method of preventing meningitis is the use of conjugate Hib and pneumococcal vaccines. Hib vaccine was introduced in PNG in 2008. Too many cases of Hib meningitis are still being reported in 2014, suggesting that the vaccine is not yet reaching all children. Meningitis due to *S. pneumoniae*, one of the two commonest causes, can be prevented by the pneumococcal conjugate vaccine (PCV), which was introduced in 2014.

Most Hib and many pneumococci causing meningitis are resistant to chloramphenicol, so this is now no longer effective treatment for bacterial meningitis. If children receive chloramphenicol for meningitis, rates of death and brain injury will be very high.

Recommendations

All children should receive Pentavalent and PCV vaccines at 1, 2 and 3 months of age. Pentavalent contains the Hib vaccine and also protects against diphtheria (a throat infection), tetanus, pertussus (whooping cough) and hepatitis B (a liver infection which eventually can cause liver cancer in adults).

All children with suspected meningitis should have a lumbar puncture if it is safe to do so. They should be treated with ceftriaxone 50mg/kg twice daily IV or IM for 10 days.

Acute complications can lead to high case fatality rates, and may be minimised by

- Nursing all children with meningitis in a high dependency unit
- Monitoring with pulse oximetry to detect hypoxaemia
- Monitoring the blood glucose and treatment of hypoglycaemia
- Close observation for convulsions
- Avoid use of too much IV fluids in children with meningitis, body and brain swelling can occur and this results in poor outcomes

Recommendations on identification and treatment of severe infections

It is very important that health workers recognise the signs of severe sepsis (severe pneumonia, meningitis, septicaemia), and know how to give emergency management.

There should be a system of Triage in every emergency or outpatients department to enable prompt identification of seriously ill children.

The **general signs of severe sepsis** include:

- high fever
- fast breathing and respiratory distress
- Heart rate >160 with pulses that are difficult to feel
- cold skin of arms and legs
- low blood pressure
- prolonged poor capillary refill
- pallor
- lethargy or unconsciousness

There may be **localising signs suggesting meningitis**

- severe headache
- neck stiffness
- severe vomiting
- repeated convulsions
- bulging fontanelle

There may be **purpura** (red or black spots on the skin).

There may be **signs of Staph infection**

- skin sepsis: boils, pustules, abscess, infected scabies or infected skin sores, cellulitis
- swollen red, hot, tender and painful joint
- empyema (pus in the chest)

The **emergency treatment for severe sepsis** should be known by all health workers. This includes:

- If the child is unconscious or convulsing, nurse on the side and keep the airway clear
- Give oxygen if there is severe respiratory distress, cyanosis or the oxygen saturation is <90%
- If the child has signs of shock (several signs: lethargy or drowsiness, low volume pulses, heart rate >160, cold skin or low blood pressure), give an IV bolus of Normal Saline or Hartmanns, 20ml/kg, then reassess.
- Give appropriate IV or IM antibiotics: ceftriaxone, (plus flucloxacillin if signs of Staph infection are present)
- Monitor in a high dependency area in the ward or in the ICU. Monitor with pulse oximetry to detect hypoxaemia
- Check blood glucose. Give a bolus of glucose if the BSL is low
- Seek assistance from an experienced doctor
- Look up treatment recommendations in the PNG Standard Treatment Book for Children, and the WHO Pocketbook of Hospital Care for Children.

Neonatal admissions

Neonatal admissions made up 4981 (24%) of all 20,974 paediatric admissions to the 10 hospitals in 2013. There were 452 neonatal deaths reported, meaning that 30% of all deaths in children were in the neonatal period.

Neonatal infections

61% of all neonatal admissions were due to infections (n=3085). Neonatal infections included pneumonia, meningitis, cord sepsis, skin sepsis and diarrhoea. The case fatality rate for neonatal infections in the 12 hospitals was 5.6%, consistent with previous years..

Measures to prevent neonatal infections are described below in early essential newborn care.

Birth asphyxia

Birth asphyxia is lack of oxygen at or around the time of birth. Many babies survive without serious damage, but the consequences for some children are severe brain injury or death. There were 1308 hospital admissions due to birth asphyxia, and the CFR was 14.6%% (191 of 1308). 42% of neonatal deaths were due to perinatal asphyxia. Nine of 12 hospitals had more than 50 cases of birth asphyxia for the year, the largest hospitals (Modilon, Goroka and Angau) had between 3 and 4 cases per week on average.

The developmental implications for many surviving children are significant: cerebral palsy, intellectual disability, blindness, and seizures are common. Prevention of perinatal asphyxia requires encouragement of delivery with a skilled midwife, identification of delays in labour, active management of labour and close communication between obstetric / midwifery services and paediatric services. Provision of immediate newborn care described below can also prevent some cases of asphyxia, as babies are stimulated to initiate breathing early by drying. Neonatal resuscitation training for nurses and doctors can also reduce the effects of birth asphyxia.

Very low birth weight

Very low birth weight is a birth weight between 1000 and 1499g. There were 456 very low birth weight admissions in the 12 hospitals. The case fatality rate for these babies was lower in 2014 than in some previous years, but in 2014 30% of VLBW newborns died while in hospital.

	2014		
Diagnoses	**Admissions**	**Deaths**	**CFR**
All neonatal	4981	452	**9.0**
Neonatal sepsis	3085	173	**5.6**
Asphyxia	1308	191	**14.6**
VLBW (1000-1500g)	456	138	**30.3**

Table 4. The most common causes of neonatal admissions and deaths for 2014

Recommendations for improving neonatal care

Provision of early essential newborn care can have a big impact on reducing neonatal sepsis, birth asphyxia and other complications. All newborns need the following:

- ***Immediate and thorough drying*** stimulates breathing and prevents hypothermia which can threaten newborns with delayed foetal-to-newborn circulatory adjustment, acidosis, hyaline membrane disease, coagulation defects, infection, hypogycaemia and brain haemorrhage. In some studies the number of babies who do not breathe at birth was found to decrease by more than half once immediate and thorough drying was instituted.
- ***Sustained skin-to-skin contact*** prevents hypothermia, initiates colonization of the newborn with maternal flora (as opposed to hospital flora which often includes multi-resistant bacteria), calms the baby and facilitates successful intake of colostrum and sustained breastfeeding.
- ***Delaying cord clamping until cord pulsations stop***, typically around one to three minutes from birth, reduces the risk of anaemia and in preterm infants, intraventricular haemorrhages.
- ***Exclusive breastfeeding and elimination of formula*** can prevent a large proportion of neonatal sepsis deaths.
- ***Avoiding harmful practices***, such as separation of babies from their mothers in the first hours of life for bathing or unnecessary observation. Separation reduces the chance a baby will breast feed successfully and means they are less likely to receive colostrum, which contains antibodies that protect against infection.

Babies who require a higher level of care

Despite thorough drying, 2-3% of newborns will not breathe at birth. ***Bag and mask resuscitation*** for all babies who are not breathing at birth reduces neonatal mortality

All hospitals should have neonatal areas that reach a minimum standard to care for babies who require a higher level of care. However in a Special Care Unit it is vital that newborn care practices are as least invasive and most natural as possible, and that babies spend as much time as possible with their mothers having skin-to-skin warming and breast feeding.

MAINTAIN SKIN-TO-SKIN CONTACT WITH THE MOTHER TO PROTECT BABIES FROM HYPOTHERMIA, HYPOGLYCAEMIA, APNOEA AND SEPSIS

Improved care for sick neonates includes early essential newborn care, *plus*:

- Keeping babies warm, best done using Kangaroo Mother Care (KMC). KMC is even safe for many very low birth weight babies, unless they are also very sick with danger signs such as apnoea, cyanosis or severe hypoxaemia.

- Supplemental oxygen administration and pulse oximetry. Because clinical signs predicting hypoxaemia in neonates are relatively insensitive, use of protocols for supplemental oxygen administration based on monitoring of pulse oximetry is recommended.
- Detecting and treating apnoea. Apnoea is a major cause of neonatal mortality among premature neonates and also among babies with sepsis and birth asphyxia. The use of apnoea monitors, aminophyline for premature neonates and close observation of all very sick babies are recommended.
- Prevention and treatment of hypoglycaemia. Hypoglycaemia complicates many neonatal conditions, particularly low birth weight and sepsis. Early breast feeding and close contact with the mother immediately after birth prevents hypoglycaemia – this is best achieved by early skin-to-skin contact and KMC. In neonates hypoglycaemia occurs because of insufficient glycogen stores in the liver, inability to feed or separation from the mother, and increased glucose metabolism during illness. The clinical signs are non-specific, and regular blood glucose monitoring of high-risk ill neonates is required. Contact with the mother is essential for most sick babies. Careful correction of hypoglycaemia using breast feeds in babies who can suck, or nasogastric expressed breast milk feeding or IV glucose in babies too sick to feed should be started.
- Ward organisation to ensure close observation of the most seriously ill and highest risk ill babies
- Safe use of intravenous fluids in seriously ill neonates. In very low birth weight neonates, large volumes of enteral feeding in the first day or two of life is not well tolerated and may increase the risk of necrotising enterocolitis. The use of any artificial formula feeding is not recommended at any time in low birth weight babies. For babies less than 1.5 kg, slow increases in expressed breast milk with cautious intravenous fluids to maintain hydration and prevent hypoglycaemia in the first few days of life is recommended. Babies on IV fluids are at risk of overhydration and nosocomial infection through the IV drip site.
- Antibiotics. Although many seriously ill neonates have bacterial infections, the inappropriate use of broad-spectrum antibiotics will lead to colonization of babies, and of neonatal units, with bacteria that are resistant to standard antibiotics. Standard treatment of neonatal sepsis is benzylpenicillin (or ampicillin or amoxicillin) and gentamicin, which are effective against most bacteria causing sepsis. *Staphylococcus aureus* is another common cause of infection in young infants in some hospitals, and resistant enteric gram negative bacilli are a common cause of neonatal death. Flucloxacillin or cloxacillin should be used if there are signs Staphylococcal infection, such as purulent umbilical cord, skin pustules or purulent conjunctivitis.
- Prevention of neonatal sepsis. Strict hand washing and other basic infection control measures are recommended. There is good evidence now that prolonged antibiotics lead to colonisation of the newborns gastrointestinal tract with pathogenic bacteria that are likely to be invasive, rather than the protective bacteria that comes from the mother. So avoiding antibiotics in babies who do not have serious infections also helps to protect them against

infection. Ceasing antibiotics after 24 or 48 hours if the baby is well will also reduce colonisation with pathogenic or highly-resistance bacteria, and reduce infections in babies.

- Auditing of practice. It is only by keeping accurate records of all admissions and outcomes that patterns of adverse events will become identified. Clinical audit is essential to reduce neonatal mortality.
- Training of nurses in early essential newborn care and neonatal high-dependency care

Tuberculosis

In the 12 hospitals in 2014 there were 1470 children admitted with tuberculosis, with 179 known deaths, and a case fatality rate of 12.2%. This may represent only a fraction of the children with TB in PNG, given that many cases are diagnosed by other hospitals or health facilities or remain undiagnosed in the community. However these data underlines that in its severest forms TB cause many childhood deaths.

Extra-pulmonary tuberculosis (TB meningitis, lymph node TB, spinal TB, abdominal TB, miliary TB) makes up over 40% of children diagnosed with TB.

The source of transmission of TB to a child is usually an adult family member who has sputum smear-positive pulmonary TB (PTB), although many adults who pass on TB to children will not know they are affected. Children who develop TB disease usually do so within a year after being infected. Children under the age of 3 are at much higher risk of developing TB disease if infected.

Recommendations

Every effort should be made to help children complete therapy, and for many children this will require 2 months of hospitalisation to ensure adherence, and active community follow-up

It is important to screen all family members (particularly children) of adult patients who are known to be sputum smear-positive PTB.

If there is a person with sputum smear-positive PTB in the household child contacts should be screened. If they are asymptomatic they should be commenced on Isoniazid Preventive Therapy. If they have symptoms of TB do a TB score. If the score is >7, register them and commence TB treatment.

The most effective way to prevent transmission of TB to children is by early identification and treatment of those people in the community with infectious TB i.e. usually adults and older children with PTB, especially sputum smear-positive PTB.

BCG immunization is effective in preventing severe and disseminated forms of TB (such as miliary TB and TB meningitis) in young children.

Early identification and treatment of children with TB disease will reduce the numbers of childhood deaths and complications (such as bronchiectasis and cerebral palsy) due to TB.

In remote areas, where chest xray and acid fast bacilli staining is not possible, it is valid to diagnose TB clinically, based on symptoms, signs and the TB score. It is better to treat and closely monitor response than to have children deteriorate because diagnostic tests were not available.

The new GeneXpert test can help diagnose TB and multi-drug resistant TB. This is only available in some provincial hospitals. However it should not be relied upon to diagnose TB, the diagnosis of TB is a clinical diagnosis based on the history of contact, the clinical features, and where available radiology, sputum or gastric aspirate for acid fast bacilli and other tests such as GeneXpert. If uncertain refer to the PNG Standard Treatment Guidelines on TB and to your provincial paediatrician, More details are in the National Child Health Plan.

GeneXpert testing should be done on all children who are:

- Contacts of known MDR cases or suspected MDR cases
- Relapsed or re-treatment cases
- HIV positive
- Failing treatment despite supervised treatment and proven adherence

Do not discharge patients with TB too early: keep all children in hospital for the full duration of their intensive phase treatment (2 months) whenever this is feasible. To do this child and family friendly health facilities are needed, where children can go to school while they receive supervised treatment, and parents can receive appropriate education on how to care for their child with TB, and receive treatment themselves if they have TB.

HIV

In 2012 there were 527 new cases of HIV admitted to the 12 hospitals, and 77 known HIV-related deaths. This only represents cases that were reported in hospitals, based on admissions, and may be an underestimate of new cases in the population, as some children are diagnosed as outpatients or through Prevention of Parent to Child Transmission (PPTCT) programs.

Recommendations

- Mothers who are diagnosed with HIV during or after pregnancy are now treated with three anti-retroviral drugs for life, not just for shorter periods to prevent transmission to the baby. The ongoing care of the mother is paramount, and what is good for the mother is good for her children.
- Early infant diagnosis of HIV with PCR testing is now available. Children who have HIV confirmed by early infant diagnosis and start on ante-retroviral therapy (ART) before they become symptomatic have a much better chance of healthy life than children diagnosed in late stages because of AIDS-defining infections.
- All children diagnosed with HIV should see a paediatrician, for starting on antiretroviral therapy.

- All children with HIV need prophylaxis with cotrimoxazole and INAH, treatment of intercurrent infections and good nutrition.

Measles

In 2014 a major outbreak of measles has occurred affecting thousands of children, the PHR recorded 2098 measles admissions and 60 measles deaths, but there were many more in other hospitals and health centres. The case fatality rate was lower trhan in previous epidemics. Young infants are especially vulnerable to severe complications from measles, particularly pneumonia. Provinces should maintain efforts to immunise all children against measles.

Other vaccine preventable diseases

There were 10 cases of acute flaccid paralysis.

Cases of suspected measles, acute flaccid paralysis, and tetanus are all reportable. Measles and AFP require laboratory investigation and confirmation.

Chronic diseases in children

The PHR now gathers data on some chronic or non-communicable diseases. These are of increasing importance. In 2014 there were 48 cases of Rheumatic Heart Disease (RHD) reported. This is a major under-estimate, but in subsequent years we should better understand the national disease burden. Guidelines for the management of RHD and acute rheumatic fever are in the PNG Standard Treatment Manual and the WHO Hospital Care for Children Pocket book.

In 2013 there were 77 reported cases of childhood cancer, again an under-estimate but a start at national reporting. Guidelines for the management of common cancers are available at www.pngpaediatricsociety.org (under Treatment Guidelines, Cancer Protocols)

Child protection

Data on child physical, sexual and other forms of abuse are now being collected by the PHR. There were 35 cases reported in 2014. This is a gross under-estimate of the burden of child abuse and maltreatment, but it is a start at systematic gathering of data on this problem. A study from Goroka in 2013 showed that child sexual abuse was a common reason for children presenting. Many will be managed as outpatients. More emphasis on child protection is needed, and more resources, including a child social worker in each provincial hospital to deal with a range of common social issues. Social issues are the most frequent root causes of malnutrition and its disease risks.

Summary

The Paediatric Hospital Reporting System has highlighted problem areas in hospitals and the health system. Addressing these in a systematic way will lower the death rates from common diseases. The Child Health Advisory Committee asks that all health workers and hospital administrators play their part to address specific problems, adopt the recommendations in this report, and see these results improve in the coming years.

Diagnoses	Deaths / Admissions 2009	Deaths / Admissions 2010	Deaths / Admissions 2011	Deaths / Admissions 2012	Deaths / Admissions 2013	Deaths / Admissions 2014	Total Deaths / Admissions	Case fatality rate
All paediatric admissions	209 / 3456 (6.94)	646 / 10,897	1545 / 20,582	1660 / 20,546	1555 / 20543	1482 / 20,974	7128 / 96,998	7.35
Pneumonia	24 / 836	140 / 2504	299 / 6330	272 / 5458	261 / 5200	294 / 5658	1290 / 25986	4.96
Severe pneumonia	16 / 321	119 / 697	272 / 2322	238 / 2476	221 / 1909	224 / 1818	1090 / 9543	11.42
Neonatal conditions	88 / 834	150 / 1596	480 / 4180	473 / 4012	406 / 3437	452 / 4981	2049 / 19040	10.76
Diarrhoea	12 / 284	35 / 1277	52 / 2122	67 / 1975	120 / 2622	109 / 2739	395 / 11019	3.58
Malaria	26 / 507	50 / 1814	60 / 1774	69 / 1263	70 / 1347	67 / 1033	342 / 7738	4.42
Severe malnutrition	61 / 344	157 / 739	287 / 1544	604 / 2590	524 / 3379	455 / 2861	2088 / 11457	18.22
Tuberculosis	16 / 164	58 / 514	145 / 1375	199 / 1510	241 / 2190	179 / 1470	838 / 7223	11.60
Meningitis	42 / 271	92 / 417	230 / 1305	279 / 1452	219 / 1374	149 / 933	1011 / 5752	17.58
HIV	3 / 20	13 / 54	37 / 195	57 / 470	61 / 378	77 / 527	248 / 1644	15.09
Anaemia *					155 / 1015	253 / 1455	408 / 2470	16.52
Rheumatic heart disease *					4 / 58	3 / 48	7 / 106	6.60
Congenital heart disease *					10 / 24	21 / 59	31 / 83	37.35
Measles	0 / 1	0 / 0	0 / 2	1 / 2	1 / 2	60 / 2098	62 / 2105	2.95
Cancer *					18 / 47	21 / 77	39 / 124	31.45
Tetanus	0 / 2	1 / 6	0 / 47	0 / 8	0 / 0	2 / 14	3 / 77	3.90
Acute flaccid paralysis	0 / 6	0 / 7	0 / 15	0 / 9	1 / 6	1 / 10	2 / 53	3.77
Whooping cough	0 / 15	0 / 16	0 / 3	0 / 41	0 / 0	1 / 15	1 / 90	1.11
Child protection *					0 / 7	3 / 35	3 / 42	7.14

Table 2: Admissions, deaths and case fatality rates for common diagnoses 2009-2014

* Diagnoses that were introduced in later versions of the PHR as annually reported, some hospitals were still using older versions, so data reporting are incomplete, even in 2013-14.

Hospital	No of years reporting	Total Admissions 2009-14	Total Deaths 2009-14	Overall CFR 2009-14 (%)
Alotau	2	2492	49	1.97
Angau	4	8672	1016	11.72
Buka	6	3167	261	8.24
Daru				
Goroka	6	16876	919	5.45
Kavieng	3	1084	63	5.81
Kimbe	5	5242	514	9.81
Kerema				
Kundiawa	2	4695	342	7.28
Manus	3	988	16	1.62
Mendi	2	4405	235	5.33
Modilon	6	8063	794	9.85
Mt Hagen	4	15839	1129	7.13
Nonga	4	3088	213	6.90
Popendetta	2	2810	216	7.69
Port Moresby	3	12976	911	7.02
Vanimo	3	2290	96	4.19
Wabag	5	3265	276	8.45
Wewak	1	1046	50	4.78
Total	**61**	96998	7128	7.35

Table 3. Total admissions and outcomes for each hospital 2009 to 2014

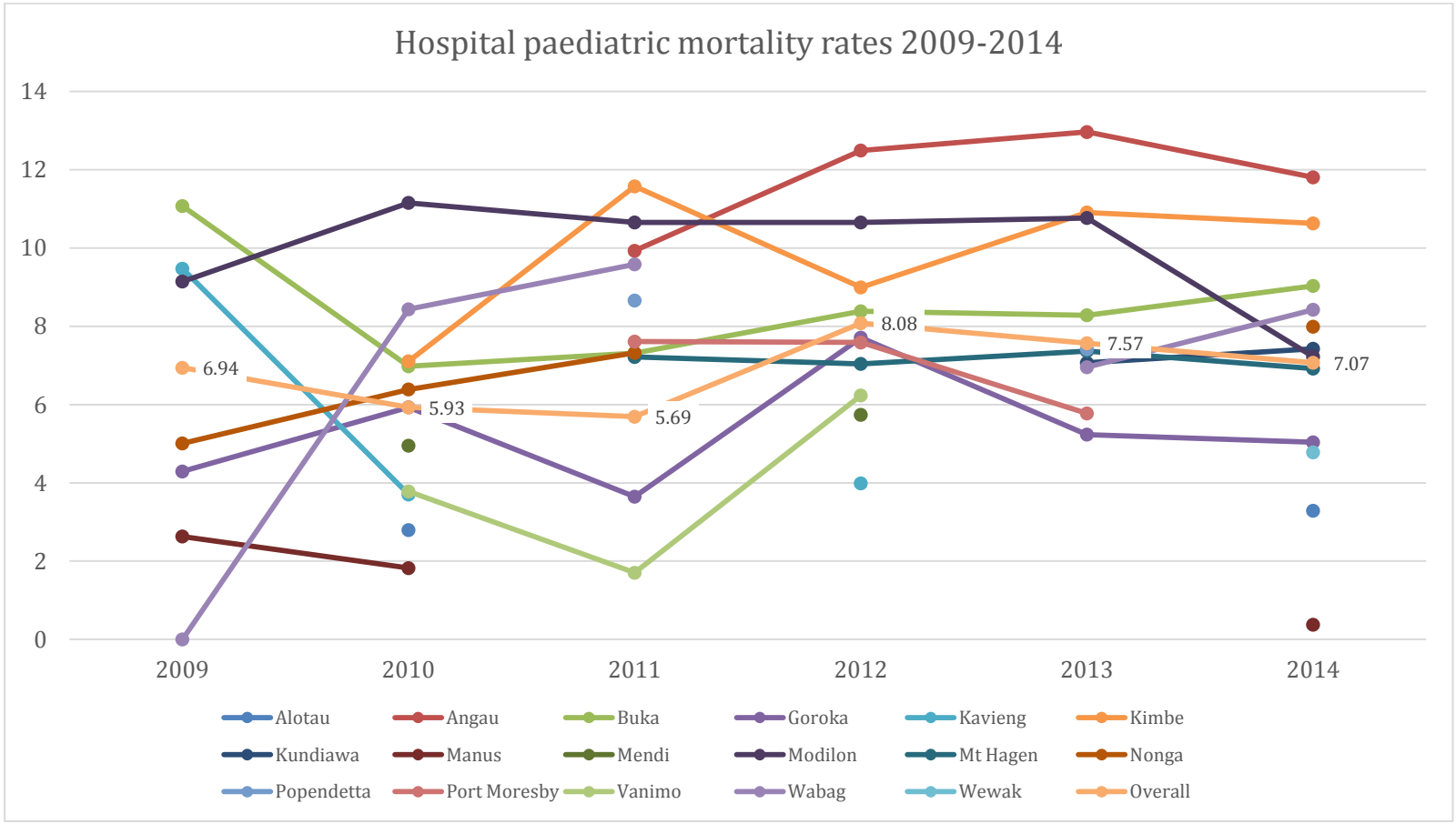


Figure 1: Paediatric case fatality rates per hospital 2009-2014

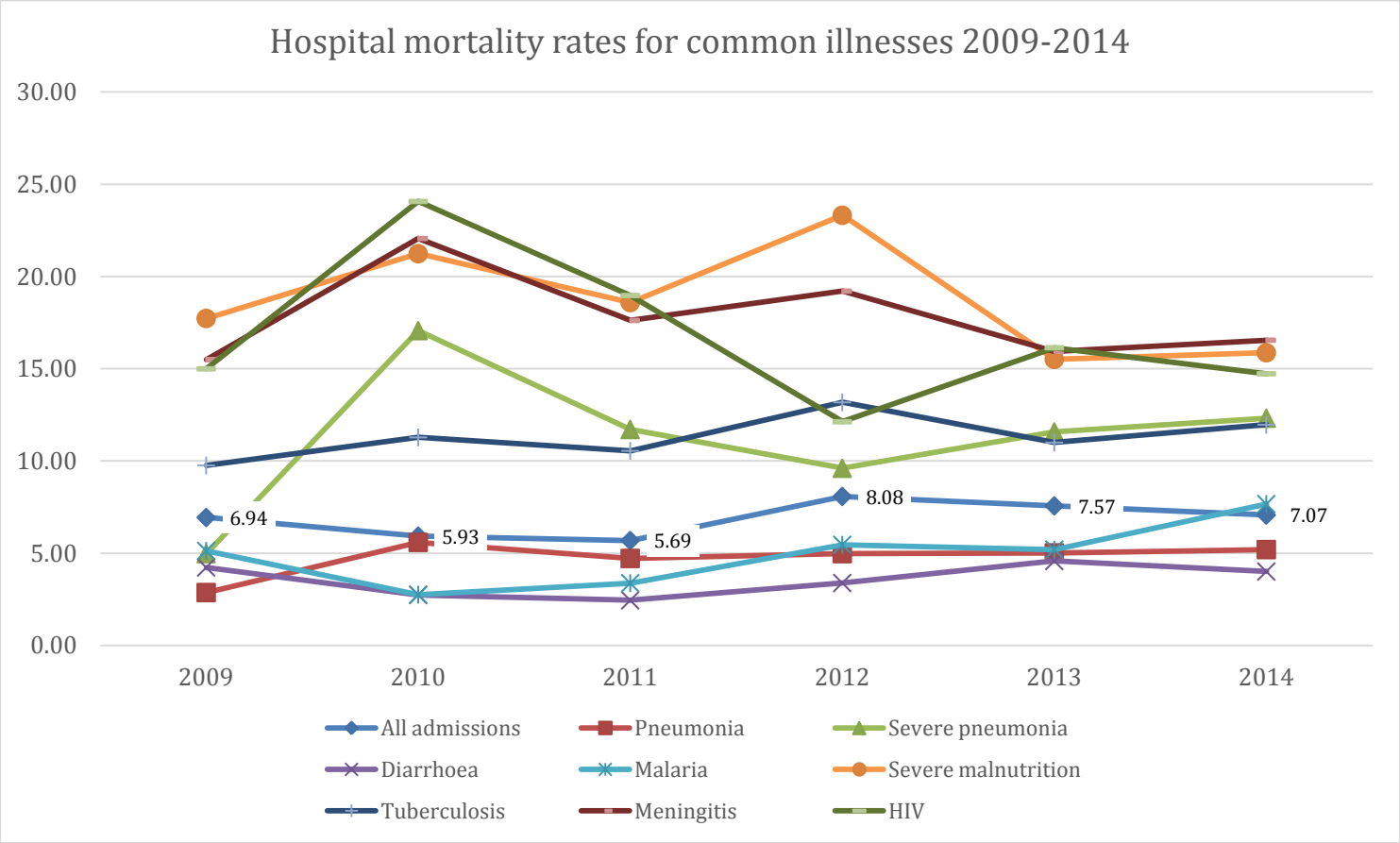


Figure 2: Case fatality rates for common paediatric illnesses 2009-2014

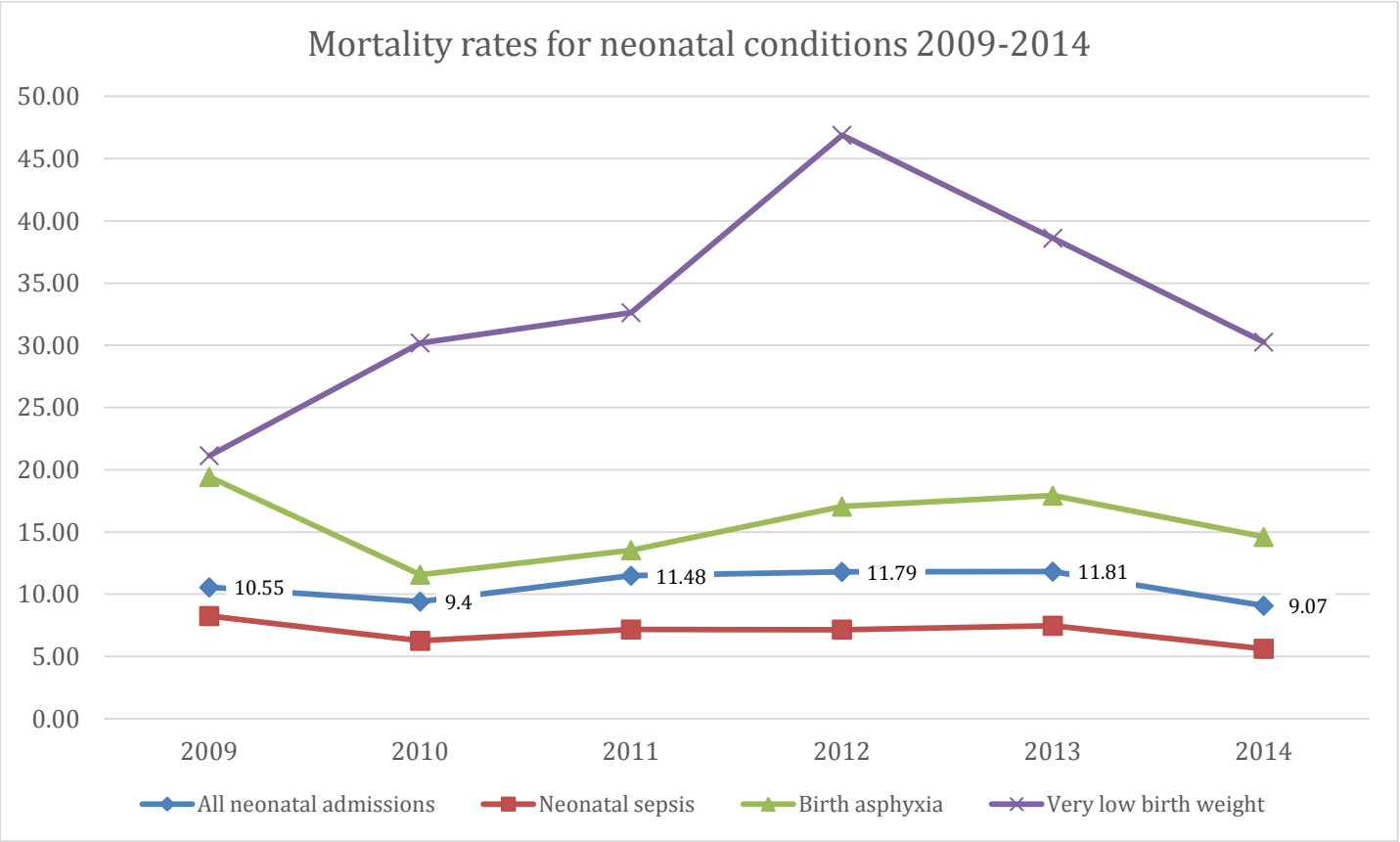


Figure 3: Case fatality rates for common neonatal illnesses 2009-2014

APPENDIX
Total admissions and outcomes for each hospital in 2014

Hospital	Total Admissions 2014	Total Deaths 2014	Overall CFR 2014
Alotau	1490	49	3.3
Angau	2041	241	11.8
Buka	476	43	9.0
Daru			
Goroka	3931	198	5.0
Kavieng			
Kimbe	1204	128	10.6
Kerema			
Kundiawa	2827	210	7.4
Manus	266	1	0.4
Mendi			
Modilon	1813	131	7.2
Mt Hagen	4002	277	
Nonga	976	78	8.0
Oro			
PMGH			
Vanimo			
Wabag	902	76	8.4
Wewak	1046	50	4.8
Total	20974	1482	7.1

Pneumonia admissions and outcomes in 2014

Hospital	Pneumonia admissions 2014	Pneumonia deaths 2014	Pneumonia CFR 2014		Severe pneumonia admissions 2014	Severe pneumonia deaths 2014	Severe pneumonia CFR 2014
Alotau	226	8	3.5		26	5	19.2
Angau	397	30	7.6		183	26	14.2
Buka	100	2	2.0		44	2	4.5
Daru							
Goroka	1474	46	3.1		611	42	6.9
Kavieng							
Kimbe	93	20	21.5		43	17	39.5
Kerema							
Kundiawa	664	46	6.9		263	38	14.4
Manus	55	0	0.0		3	0	0.0
Mendi							
Modilon	409	13	3.2		88	10	11.4
Mt Hagen	1686	98			387	58	
Nonga	157	8	5.1		34	7	20.6
Oro							
PMGH							
Vanimo							
Wabag	295	17	5.8		76	14	18.4
Wewak	102	6	5.9		60	5	8.3
Total	5658	294	5.2		1818	224	12.3

Diarrhoea admissions and outcomes in 2014

Hospital	Diarrhoea admissions 2014	Diarrhoea deaths 2014	Diarrhoea CFR 2014
Alotau	71	2	2.8
Angau	248	18	7.3
Buka	83	1	1.2
Daru			
Goroka	646	9	1.4
Kavieng			
Kimbe	110	11	10.0
Kerema			
Kundiawa	494	18	3.6
Manus	19	1	5.3
Mendi			
Modilon	206	10	4.9
Mt Hagen	621	27	
Nonga	112	6	5.4
Oro			
PMGH			
Vanimo			
Wabag	55	3	5.5
Wewak	74	3	4.1
Total	2739	109	3.98

Malaria admissions and outcomes in 2014

Hospital	Malaria admissions 2014	Malaria Deaths 2014	Malaria CFR 2014
Alotau	42	2	4.8
Angau	147	14	9.5
Buka	12	1	8.3
Daru			
Goroka	93	11	11.8
Kavieng			
Kimbe	72	8	11.1
Kerema			
Kundiawa	37	2	5.4
Manus	14	0	0.0
Mendi			
Modilon	268	11	4.1
Mt Hagen	113	10	8.8
Nonga	52	5	9.6
Oro			
PMGH			
Vanimo			
Wabag	0	0	0.0
Wewak	183	3	1.6
Total	1033	67	6.49

Severe malnutrition admissions and outcomes in 2014

Hospital	Severe malnutrition admission 2014	Severe malnutrition deaths 2014	Malnutrition CFR 2014
Alotau	52	8	15.4
Angau	409	114	27.9
Buka	59.0	10.0	16.9
Daru			
Goroka	1176	104	8.8
Kavieng			
Kimbe	136	41	30.1
Kerema			
Kundiawa	314	66	21.0
Manus	20.0	0.0	0.0
Mendi			
Modilon	198	18	9.1
Mt Hagen	355	66	
Nonga	21	0	0.0
Oro			
PMGH			
Vanimo			
Wabag	46	15	32.0
Wewak	75	13	17.3
Total	2861	455	15.90

Meningitis admissions and outcomes in 2014

Hospital	Meningitis admissions 2014	Meningitis deaths 2014	Meningitis CFR 2014	Meningitis admissions due to S. pneumoniae	Meningitis admissions due to H. influenzae
Alotau	32	3	9.4	0	8
Angau	107	25	23.4	11	7
Buka	18	3	16.7	0	2
Daru					
Goroka	166	33	19.9	2	1
Kavieng					
Kimbe	61	13	21.3	0	2
Kerema					
Kundiawa	81	11	13.6	17	46
Manus	6	0	0.0	0	0
Mendi					
Modilon	75	14	18.7	2	3
Mt Hagen	261	25		28	156
Nonga	15	4	26.7	0	0
Oro					
PMGH					
Vanimo					
Wabag	62	13	20.9	0	2
Wewak	49	5	10.2	33	1
Total	933	149	15.97	93	228

TB admissions and outcomes in 2014

Hospital	TB admissions	TB deaths	TB CFR		Pulmonary TB admissions	Pulmonary TB deaths	Pulmonary TB CFR		Extra Pulmonary TB admissions	Extra Pulmonary deaths	Extra Pulmonary CFR
Alotau	80.0	6.0	7.5		63	5	7.9		17	1	5.9
Angau	207	27	13.0		119	14	11.8		88	13	14.8
Buka	57	6	10.5		38	2	5.3		19.0	4.0	21.1
Daru											
Goroka	233	34	14.6		0	0	0.0		0	0	0.0
Kavieng											
Kimbe	144	21	14.6		65	8	12.3		79	13	16.5
Kerema											
Kundiawa	277	35	12.6		179	16	8.9		98	19	19.4
Manus	4	1	25.0		0	0	0.0		0.0	0.0	0.0
Mendi											
Modilon	142	13	9.2		69	3	4.3		73	10	13.7
Mt Hagen	123	12	9.8		88	11	12.5		35	1	2.9
Nonga	31	2	6.5		13	2	15.4		18	0	0.0
Oro											
PMGH											
Vanimo											
Wabag	60	12	20.0		0	0	0.0		0	0	0.0
Wewak	112	10	8.9		75	5	6.7		37	5	13.5
Total	1470	179	12.1		709	66	9.30		464	66	14.2

PTB = Pulmonary tuberculosis EPTB = Extra-pulmonary tuberculosis

HIV admissions and outcomes in 2014

Hospital	HIV admissions	HIV deaths	HIV CFR
Alotau	16	2	12.5
Angau	18	8	44.4
Buka	2.0	0.0	0.0
Daru			
Goroka	124	13	10.5
Kavieng			
Kimbe	4	2	50.0
Kerema			
Kundiawa	40	9	22.5
Manus	0.0	0.0	0.0
Mendi			
Modilon	25	4	16.0
Mt Hagen	154	16	
Nonga	113	18	15.9
Oro			
PMGH			
Vanimo			
Wabag	29	5	17.2
Wewak	2	0	0.0
Total	527	77	14.6

Total neonatal admissions and outcomes in 2009-2014

Hospital	Neonatal admissions 2014	Neonatal deaths 2014	Neonatal CFR 2014
Alotau	651	25	3.8
Angau	843	82	9.7
Buka	77.0	16.0	20.8
Daru			
Goroka	500	45	9.0
Kavieng			
Kimbe	340	27	7.9
Kerema			
Kundiawa	243	37	15.2
Manus	51.0	0.0	0.0
Mendi			
Modilon	515	45	8.7
Mt Hagen	1080	118	
Nonga	336	41	12.2
Oro			
PMGH			
Vanimo			
Wabag	6	1	16.7
Wewak	339	15	4.4
Total	4981	452	9.07

Neonatal infections in 2009-2014

Hospital	Neonatal Infections Admissions 2014	Neonatal Infections Deaths 2014	Neonatal Infection CFR 2014
Alotau	500	13	2.6
Angau	703	52	7.4
Buka	47.0	7.0	14.9
Daru			
Goroka	221	8	3.6
Kavieng			
Kimbe	207	11	5.3
Kerema			
Kundiawa	104	12	11.5
Manus	11.0	0.0	0.0
Mendi			
Modilon	323	19	5.9
Mt Hagen	496	18	
Nonga	263	27	10.3
Oro			
PMGH			
Vanimo			
Wabag	3	0	0.0
Wewak	207	6	2.9
Total	3085	173	5.6

Very low birth weight (1000-1499g) admissions and deaths in 2009-2014

Hospital	VLBW admissions 2014	VLBW deaths 2014	VLBW CFR 2014
Alotau	24	3	12.5
Angau	44	26	59.1
Buka	8.0	3.0	37.5
Daru			
Goroka	36	13	36.1
Kavieng			
Kimbe	16	6	37.5
Kerema			
Kundiawa	38	23	60.5
Manus	7.0	0.0	0.0
Mendi			
Modilon	51	10	19.6
Mt Hagen	190	42	
Nonga	26	7	26.9
Oro			
PMGH			
Vanimo			
Wabag	0	0	0.0
Wewak	16	5	31.3
Total	456	138	30.2

Perinatal asphyxia admissions and deaths in 2019-2014

Hospital	Asphyxia admissions 2014	Asphyxia deaths 2014	Asphyxia CFR 2014
Alotau	124	13	10.5
Angau	191	38	19.9
Buka	21.0	4.0	19.0
Daru			
Goroka	259	35	13.5
Kavieng			
Kimbe	119	14	11.8
Kerema			
Kundiawa	96	12	12.5
Manus	3.0	0.0	0.0
Mendi			
Modilon	162	20	12.3
Mt Hagen	139	33	
Nonga	60	12	20.0
Oro			
PMGH			
Vanimo			
Wabag	2	0	0.0
Wewak	132	10	7.6
Total	1308	191	14.6

Cancer and Rheumatic heart disease admissions and deaths in 2014

Hospital	Cancer admissions 2014	Cancer deaths 2014	Cancer CFR 2014		Rheumatic heart admissions 2014	Rheumatic heart deaths 2014	RHD CFR 2014
Alotau	5	0	0.0		4	0	0.0
Angau	6	1	16.7		2	0	0.0
Buka	10.0	3.0	30.0		6.0	1.0	16.7
Daru							
Goroka	0	0	0.0		0	0	0.0
Kavieng							
Kimbe	9	4	44.4		0	0	0.0
Kerema							
Kundiawa	11	1	9.1		16	1	6.3
Manus	0.0	0.0	0.0		0.0	0.0	0.0
Mendi							
Modilon	10	4	40.0		9	0	0.0
Mt Hagen	14	5			6	0	0.0
Nonga	10	3	30.0		5	1	20.0
Oro							
PMGH							
Vanimo							
Wabag	0	0	0.0		0	0	0.0
Wewak	2	0	0.0		0	0	0.0
Total	77	21	27.2		48	3	6.25