PNG Department of Health

Child Morbidity and Mortality

Annual Report 2011

Paediatric Department and Child Health Advisory Committee
PNG National Department of Health
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2011 Annual Report on Child Morbidity and Mortality

Summary

- This report covers data on child admissions and outcomes in 2011 from 11 hospitals
- In 2011 there were 20,582 admissions and 1545 deaths recorded (mortality rate 7.5%)
- Pneumonia was the most common reason for admission (31% of admissions), followed by neonatal conditions (20% of admissions), diarrhoeal disease (10% of admissions) and malaria (8.6% of admissions)
- Malnutrition either directly caused or contributed to 19% of all deaths. In the post-neonatal period, pneumonia (20.6% of deaths) and meningitis (14.9% of deaths) were the leading causes of death.
- Neonatal deaths accounted for 31% of all deaths. The leading causes of death in neonates were: birth asphyxia (34% of neonatal deaths), neonatal infections (32% of neonatal deaths) and very low birth weight (35% of neonatal deaths).
- In the post-neonatal period, children presenting with HIV (19% case fatality rate), malnutrition (18.5% case fatality rate), meningitis (17.6% case fatality rate), and severe pneumonia (11.7% case fatality rate) had the highest risk of death
- Among neonates case fatality rates were very low birth weight (33%), birth asphyxia (13.5%) and neonatal sepsis (7.1%).

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 heavily on reducing deaths from pneumonia and neonatal conditions, which combined make up 51% of admissions and 51% of deaths.
2. Reducing deaths from severe pneumonia require a holistic approach, including prevented with vaccines, improving breast-feeding and nutrition (including vitamin A and zinc), reducing indoor air pollution. Reducing pneumonia deaths also requires improved access to early diagnosis and treatment: with better education of mothers on the signs of pneumonia, timely management in health centres or aid posts, and improved hospital case management: triage for identification of the most seriously ill children, giving appropriate antibiotics, monitoring with pulse oximetry, and oxygen therapy.
3. Reducing neonatal deaths requires access to improved obstetric care and immediate newborn care. 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. *Avoiding harmful practices*, such as separation of babies from their mothers in the first hours of life for bathing or unnecessary observation.
4. Achieving minimal standard for care of seriously ill neonates in health facilities is also essential to addressing neonatal deaths. Improvements in high dependency neonatal

care for very low birth weight babies, neonatal sepsis and birth asphyxia is needed. This includes prevention and treatment of hypoxaemia, apnoea, hypoglycaemia, improved feeding with breast milk, judicious use of antibiotics, IV fluids, audit and ward organisation. Models of neonatal care should be introduced in all hospitals. Improving obstetric care is necessary to reduce deaths from birth asphyxia.

5. To reduce death from diarrhoea, oral rehydration salts (ORS) and zinc are the most important treatments. Children with bloody diarrhoea have dysentery and need antibiotics. The antibiotic guidelines for dysentery have been recently revised.
6. Prevention of malnutrition at the community level is the best way to avoid children dying from malnutrition. Children with malnutrition have a very high risk of death. They need special attention to feeding, prevention and treatment of infections, and close monitoring for complications.
7. Children with meningitis have a high risk of death, and survivors are at risk of disability. Meningitis deaths can be prevented by more widespread use of the Hib vaccine (contained within the Pentavalent vaccine given at 1, 2 and 3 months), and by the introduction of the pneumococcal vaccine in 2014. Children presenting with meningitis need to be recognised and treated early, and monitored closely. Rising resistance to chloramphenicol in the common causes of meningitis means that ceftriaxone is the only effective antibiotic to treat meningitis.

2011 Annual Report on Child Morbidity and Mortality

Introduction

The Child Health Advisory Committee of the National Department of Health is pleased to release the second 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 2011. 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)

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 2010, 10 hospitals participated, providing data for the entire 12 months: Angau, Buka, Goroka, Kimbe, Modilon, Mt Hagen, Nonga, Oro, Vanimo and Wabag. 15,681 admissions and 1172 deaths were recorded, with an overall mortality rate of 7.5%. In 2010 10,897 admissions and 646 deaths were reported, for an overall case fatality rate of 5.9%. However this represented some different hospitals, with Alotau, Kaviang, Manus and Mendi not contributing data in 2011, but the inclusion of Mt Hagen and Popendetta. In 2011 Port Moresby General Hospital contributed data that was collected using another method, so there were some missing data, particularly on severe pneumonia and HIV.

Overall case fatality rates varied four fold: from 2.2% in Vanimo Hospital to 10.7 in Modilon Hospital and 11.7 in Kimbe Hospital.

7 hospitals reported data for both 2010 and 2011, and case fatality rates between these two years were consistent in most hospitals (the largest differences in the two years being an increase in overall CFR in Kimbe and a decrease in CFR in Goroka).

Differences in case fatality rates reflect many things: these include 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, outside the neonatal period. A comparison is made with 2010 data, but it must be realised that the hospitals contributing data were not all the same in the 2 years. However there was remarkable consistency in the case fatality rates, suggesting the data are robust.

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

Diagnoses	Admissions 2010	Deaths 2010	CFR 2010	Admissions 2011	Deaths 2011	CFR 2011
All admissions	**10,897**	**646**	**5.9**	**20,582**	**1154**	**7.5**
Pneumonia	2504	140	5.6	6330	319	5.0
Neonatal conditions	1596	150	9.4	4180	480	11.5
Diarrhoea	1277	35	2.7	2122	57	2.7
Malaria	1814	50	2.8	1774	61	3.4
Severe malnutrition	739	157	21.2	1544	287	18.5
Tuberculosis	514	58	11.3	1375	145	10.5
Meningitis	417	92	22.1	1305	230	17.6
HIV	54	13	24.1	195	37	19.0

Table 1. The most common causes of hospital admission and highest case fatality rates in children for 2010 and 2011.

Pneumonia

Case mix varies widely between hospitals. There were 6330 admissions for pneumonia. Of these 3357 68% came from 3 highlands hospitals (Mt Hagen, Goroka, Wabag). Pneumonia makes up 31% of admissions overall; 40% in the three highlands hospitals. However, even in coastal provincial hospitals, pneumonia remains a major killer that needs urgent attention.

The overall pneumonia CFR was 5% (319 deaths from 6330 cases of pneumonia), comparable with the pneumonia case fatality rate for 2010 of 5.6%. Pneumonia case fatality rates vary considerably, from no deaths among 107 admissions in Vanimo, to 47 deaths among 389 admissions in Wabag (CFR 12.1%).

The wide variation in case fatality rates is a concern; in highlands hospitals where pneumonia is similar, the case fatality rate varied nearly four-fold: Goroka (3.1%), Mt Hagen (6.1%) and Wabag 12.1%).

The PHR system enables the calculation of mortality rates for both total cases of pneumonia overall and for cases of *severe* pneumonia (WHO-defined very severe pneumonia). The overall case fatality rate for severe pneumonia was 11.7%. Seven hospitals has case fatality rates in excess of 10%. Three (Buka, Modillon and Nonga) had case fatality rates of 20% or more; however these hospitals had very small numbers of severe pneumonia cases, so it is difficult to draw conclusions. Note that Port Moresby General Hospital did not use the PHR in 2011 so was not able to provide specific data on severe pneumonia.

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 than do overall rates. 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, septic or deteriorating child with pneumonia.

The high numbers of deaths from pneumonia and meningitis (549 or 36% of all deaths) underline the importance of the more widespread use of the *Hemophilus influenzae* type b (Hib) vaccine, which was introduced in 2008, and the pneumococcal conjugate vaccine, which is due for introduction in 2014.

While these vaccines are the only real solution to deaths and disability from bacterial meningitis (see below) 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 and Mycoplasma). 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 systems for clinical care and 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
- Parental awareness of the signs of pneumonia and care seeking
- Reduction in indoor air pollution
- Hand-washing
- Vaccines: measles, Hib, pneumococcal

Curative

- Improving quality of hospital and health centre of pneumonia through IMCI, Standard Treatment Guidelines and Hospital Care for Children training
- Models of community care for pneumonia
- Focus on pneumonia in high risk patients (malnourished, HIV-affected, neonates)
- Oxygen and other methods of respiratory support, such as CPAP
- Addressing rising rates of bacterial resistance and trying to improve rational antibiotic prescribing
- Exploring the role of zinc sulphate in pneumonia treatment

Diarrhoea

2122 admissions and 57 deaths (CFR 2.7%) due to diarrhoea were reported in the 11 hospitals in 2011. The case fatality rate was relatively low compared with that of pneumonia (5%), but unchanged from that in 2010 (diarrhoea case fatality rate 2.7%). In 2010 case fatality rates for diarrhoea in all hospitals were under 4%, but in 2011 3 hospitals (Nonga, Angau and Kimbe) had CFRs for diarrhoea twice that of most other hospitals. Substantial outbreaks of diarrhoea requiring hospitalisation in Port Moresby (660 in 2011), Goroka (515 cases, in 2011, 299 in 2010) and Mt Hagen (372 cases in 2011) are again of great public health concern.

Deaths from diarrhoea can be due to severe dehydration where the child does not have access to effective rehydration, from sepsis from bacillary dysentery, or 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 these when they have watery diarrhoea, death is very unlikely.

Dysentery is bloody diarrhoea, and is commonly due to a bacterium called *Shigella flexneri*. A recent study 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 2011 malaria accounted for 1774 admissions and 61 deaths (case fatality rate of 3.4%). There were over 200 fewer malaria admissions overall in 2011: Buka and Kimbe recording major reductions in malaria cases in 2011. Malaria case fatality rates were around 3-4% in the coastal and islands hospitals that have a substantial burden of malaria. It is notable that Vanimo, despite a number of malaria cases that is comparable to other coastal hospitals, has a very low case fatality rate (0.5%).

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 2011 in the 10 hospitals that used the standardised PHR (i.e. not including PMGH as the data collection method may not have captured all cases), 1406 children were admitted with severe malnutrition (weight for age <60% of expected, or with clinical marasmus or kwashiorkor). This represented 9% of all admissions. However severe malnutrition in these 10 hospitals was associated with 265 deaths: 22.6% of all deaths, a figure consistent with that recorded in 2010 (24.3%). The case fatality rate for severe

malnutrition is high (18.8% in these 10 hospitals, again consistent with 2010 data when CFR for severe malnutrition was 21%). Case fatality rate for malnutrition in 2011 was more than 10% in 9 of 10 hospitals, more than 20% in 2 hospitals, and over 30% in 1 hospital).

Recommendations

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

- staff need to be trained in Infant and Young Child Feeding
- all staff should promote breast feeding
- hospitals should adopt the Baby Friendly Hospital Initiative
- growth monitoring should be a regular part of child health care
- there should be ready access in the health centre or hospital to formulas and diets for the management of children with malnutrition
- 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 acute severe 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 prevention and 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.

Meningitis

In the 11 hospitals meningitis accounted for 1305 admissions, twice as many cases recorded than in 2010 data, partly reflecting different hospitals (Mt Hagen for example reported 330 cases of meningitis in 2011). There were 230 deaths (case fatality rate 18%, which is comparable to 2010, when the CFR was 22%)

With nearly one-fifth of all children admitted to hospital dying from meningitis there is an urgent need to address this. Case fatality rates for meningitis in 2011 were above 10% in all hospitals. This is just part of the tragedy, for every death more 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.

There were 102 cases of meningitis due to S. pneumoniae and 83 cases due to H. influenzae type b recorded through clinical reporting. Therefore an aetiology was identified for only 18% 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 universal use of conjugate Hib and pneumococcal vaccines. Hib vaccine was introduced in PNG in 2008. Cases are still being reported, suggesting that the vaccine is not yet reaching all children. Meningitis due to *S. pneumoniae*, one of the two commonest causes, can only be effectively addressed by the introduction of the conjugate pneumococcal vaccine, which is scheduled for introduction in 2014.

Most Hib and some pneumococci causing meningitis are now 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 vaccine, which contains the Hib vaccine at 1, 2 and 3 months of age. The Pentavalent vaccine also protects against diphtheria (a throat infection), tetanus, pertussus (whooping cough) and hepatitis B (a liver infection which eventually may 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

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 parenteral (IV or IM) antibiotics: ceftriaxone +/- flucloxacillin (if Staph infection is present) or flucloxacillin & gentamicin if there is no ceftriaxone
- Monitor for signs of sepsis 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 4180 (20.3%) of all 15,681 paediatric admissions to the 11 hospitals in 2011. There were 480 neonatal deaths reported, meaning that 31% of all deaths in children were in the neonatal period.

Neonatal infections

51% of all neonatal admissions were due to infections (n=2124). Neonatal infections included pneumonia, meningitis, cord sepsis, skin sepsis and diarrhoea. The case fatality rate for neonatal infections in the 11 hospitals was 7.1%. 1555 cases of neonatal sepsis were recorded in 2011, with 130 deaths in 10 hospitals. This is very likely to be an under-estimate, as some hospitals reported few cases (e.g. Wabag reported 2 cases only).

Measures to prevent neonatal infections are described below in immediate 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 1219 hospital admissions due to birth asphyxia, and the CFR was 13.5% (165 of 1219). 34% of neonatal deaths (11% of deaths in children of all ages) were due to perinatal asphyxia. Seven of 11 hospitals had more than 50 cases of birth asphyxia for the year, the largest hospitals (PMGH, Goroka, Mt Hagen and Angau) had between 3 and 5 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 518 very low birth weight admissions in the 10 hospitals. The case fatality rate for these babies is very high, with 32.6% of VLBW newborns dying while in hospital. Note that as PMGH did not use the PHR, some of the 329 VLBW babies may have had low birth weight, but not fallen into the strict category of VLBW.

	2010			2011		
Diagnoses	**Admissions**	**Deaths**	**CFR**	**Admissions**	**Deaths**	**CFR**
All neonatal	2752	335	12.3	4180	480	11.5
Neonatal sepsis	592	37	6.3	2124	152	7.1
Asphyxia	467	54	11.6	1219	165	13.5
Very Low Birth Weight (weight 1000-1500g)	106	32	30.2	518	169	32.6

Table 4. The most common causes of neonatal admissions and deaths for 2010 and 2011

Recommendations for improving neonatal care

Immediate newborn care is often neglected, and potentially harmful practices reduce the access for babies to basic protective care. Provision of timely immediate newborn care can have a dramatic effect on reducing neonatal sepsis, birth asphyxia and other complications. The following should be done for all newborns:

- ***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.

High dependence care includes:

- 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 apnea. 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.

Hypoglycaemia occurs because of insufficient glycogen stores in the liver, inability to feed, and increased glucose metabolism during illness. The clinical signs are non-specific, and regular blood glucose monitoring of high-risk ill neonates is required. 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 immediate newborn care and neonatal high-dependency care

Tuberculosis

In the 11 hospitals there were 1375 children admitted with tuberculosis, with 145 known deaths, and a case fatality rate of 10.5%. 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 causes many childhood deaths.

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.

Recommendations

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

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.

If there is a known sputum smear-positive PTB in the household child contact screening and the provision of Isoniazid Preventive Therapy for young children (< 5 years) who are asymptomatic is recommended.

In 2009 fixed dose combination therapy has been introduced for children with TB, and guidelines for childhood TB were developed.

HIV

In 2011 there were 195 new cases of HIV reported by the 10 hospitals, with 37 recorded deaths and a case fatality rate of 19%. Mt Hagen (112 cases) and Goroka (42 cases) reported the majority. 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. Note that because PMGH – where a large burden of HIV is managed - did not report using the PHR program in 2011, data on HIV admissions were reported from this hospital.

Recommendations

- All children diagnosed with HIV should see a paediatrician, for consideration for starting on antiretroviral therapy.
- All children with HIV need prophylaxis with cotrimoxazole and INAH, treatment of intercurrent infections and good nutrition.

Other vaccine preventable diseases

In 2011 in 10 hospitals (not including PMGH) there were 71 cases of Pertussis with 3 deaths, a marked increase on the 16 cases reported in 2010. Outbreaks of pertussis are concerning, and occur because of low vaccination coverage, especially waning vaccine coverage in adults who can pass the infection onto small children who are at highest risk of severe illness.

There were 15 cases of acute flaccid paralysis and 2 deaths.

There were 2 cases of measles reported in 2011, although reporting through the PHR may have been done on clinical grounds before laboratory testing confirmed or excluded cases.

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.

Appendices: summaries of data for each major diagnostic group at each hospital

Hospital	Total Admissions 2010	Total Deaths 2010	Overall CFR 2010	Total Admissions 2011	Total Deaths 2011	Overall CFR 2011
Alotau	1002	28	2.8			
Angau				2457	244	9.9
Buka	659	46	7.0	574	42	7.3
Daru						
Goroka	1517	90	5.9	3125	114	3.6
Kavieng	378	14	3.7			
Kimbe	1013	72	7.1	881	102	11.6
Kerema						
Kundiawa						
Manus	494	9	1.8			
Mendi	2262	112	5.0			
Modilon	977	109	11.2	1342	143	10.7
Mt Hagen				4198	303	7.2
Nonga	720	46	6.4	833	61	7.3
Oro				612	53	8.7
PMGH	5180	431	8.3	4901	373	7.6
Vanimo	820	31	3.8	668	15	2.2
Wabag	1055	89	8.4	991	95	9.6
Wewak						
Total	**16077**	**1277**		**20582**	**1545**	**7.5**

Hospital	Pneumonia admissions	Pneumonia deaths	Pneumonia CFR	Severe pneumonia admissions	Severe pneumonia deaths	Severe pneumonia CFR
Alotau						
Angau	594	34	5.7	308	25	8.1
Buka	177	12	6.8	54	11	20.4
Daru						
Goroka	1095	34	3.1	470	33	7.0
Kavieng						
Kimbe	154	18	11.7	74	13	17.6
Kerema						
Kundiawa						
Manus						
Mendi						
Modilon	227	16	7.0	66	15	22.7
Mt Hagen	1873	114	6.1	936	101	10.8
Nonga	116	9	7.8	54	17	31.5
Oro	196	15	7.7	72	14	19.4
PMGH	1302	20	1.5			
Vanimo	107	0	0.0	20	0	0.0
Wabag	389	47	12.1	268	43	16.0
Wewak						
Total	**6330**	**319**	**5.0**	**2322**	**272**	**11.7**

Hospital	Diarrhoea admissions	Diarrhoea deaths	Diarrhoea CFR
Alotau			
Angau	125	11	8.8
Buka	85	2	2.4
Daru			
Goroka	515	7	1.4
Kavieng			
Kimbe	76	6	7.9
Kerema			
Kundiawa			
Manus			
Mendi			
Modilon	65	2	3.1
Mt Hagen	372	14	3.8
Nonga	34	7	20.6
Oro	29	0	0.0
PMGH	660	5	1.3
Vanimo	62	0	0.0
Wabag	99	3	3.0
Wewak			
Total	**2122**	**57**	**2.7**

Hospital	Malaria admissions 2010	Malaria deaths 2010	Malaria CFR 2010	Malaria admissions 2011	Malaria deaths 2011	Malaria CFR 2011
Alotau	284	7	2.5			
Angau				373	17	4.6
Buka	233	5	2.1	127	4	3.1
Daru						
Goroka	20	2	10.0	20	0	0.0
Kavieng	128	4	3.1			
Kimbe	467	15	3.2	169	8	4.7
Kerema						
Kundiawa						
Manus	52	1	1.9			
Mendi	150	3	2.0			
Modilon	130	3	2.3	174	8	4.6
Mt Hagen				294	10	3.4
Nonga	170	5	2.9	160	9	5.6
Oro				127	3	2.4
PMGH	270	1	0.3	140	1	0.7
Vanimo	175	4	2.3	190	1	0.5
Wabag	5	1	20.0	0	0	0
Wewak						
Total	**2084**	**51**	**2.4**	**1774**	**61**	**3.4**

Hospital	Malnutrition admission	Malnutrition deaths	Malnutrition CFR
Alotau			
Angau	342	83	24.3
Buka	23	4	17.4
Daru			
Goroka	96	10	10.4
Kavieng			
Kimbe	77	24	31.2
Kerema			
Kundiawa			
Manus			
Mendi			
Modilon	24	6	25.0
Mt Hagen	379	73	19.3
Nonga	35	3	8.6
Oro	60	11	18.3
PMGH	138	22	15.9
Vanimo	35	5	14.3
Wabag	335	46	13.7
Wewak			
Total	**1544**	**287**	**18.6**

Hospital	Meningitis admissions	Meningitis deaths	Meningitis CFR	Meningitis admissions (deaths) due to S. pneumoniae	Meningitis admissions (deaths) due to H. influenzae
Alotau					
Angau	222	43	19.4	14 (3)	3 (1)
Buka	31	9	29.0	0	5 (1)
Daru					
Goroka	103	12	11.7	34 (1)	6 (1)
Kavieng					
Kimbe	98	19	19.4	2 (1)	53 (11)
Kerema					
Kundiawa					
Manus					
Mendi					
Modilon	117	30	25.6	1 (0)	3 (2)
Mt Hagen	330	60	18.2	48 (11)	10 (2)
Nonga	4	1	25.0	1 (0)	0 (0)
Oro	69	10	14.5		1 (0)
PMGH	272	34	12.5		
Vanimo	24	3	12.5	1 (0)	0
Wabag	35	9	25.7	1 (1)	2 (0)
Wewak					
Total	**1305**	**230**	**17.6**	**102 (17)**	**83 (18)**

Hospital	TB admissions	TB deaths	TB CFR	HIV admissions	HIV deaths	HIV CFR
Alotau						
Angau	195	33	16.9	20	3	15
Buka	60	4	6.7	0	0	0
Daru						
Goroka	200	7	3.5	42	3	7.1
Kavieng						
Kimbe	79	6	7.6	0	0	0
Kerema						
Kundiawa						
Manus						
Mendi						
Modilon	95	8	8.4	9	2	22.2
Mt Hagen	187	27	14.4	112	26	23.2
Nonga	20	1	5.0	0	0	0
Oro	89	8	9.0	2	1	50
PMGH	386	40	10.4			
Vanimo	14	2	14.3	1	0	0
Wabag	50	9	18.0	9	2	22.2
Wewak						
Total	**1375**	**145**	**10.5**	**195**	**37**	**19.0**

Hospital	Neonatal admissions 2010	Neonatal deaths 2010	Neonatal CFR 2010	Neonatal admissions 2011	Neonatal deaths 2011	Neonatal CFR 2011
Alotau	212	10	4.7			
Angau				665	72	10.8
Buka	30	10	33.3	54	9	16.7
Daru						
Goroka	188	7	3.7	420	19	4.5
Kavieng	61	6	9.8			
Kimbe	40	7	17.5	217	34	15.7
Kerema						
Kundiawa						
Manus	165	4	2.4			
Mendi	248	21	8.5			
Modilon	271	56	20.7	417	45	10.8
Mt Hagen				827	103	12.5
Nonga	217	21	9.7	256	21	8.2
Oro				94	13	13.8
PMGH	1156	185	16.0	1102	162	14.7
Vanimo	159	8	5.0	126	2	1.6
Wabag	5	0	0.0	2	0	0.0
Wewak						
Total	2752	335	12.3	4180	480	11.5

Hospital	Neonatal infections admissions	Neonatal infections deaths	Neonatal infection CFR
Alotau			
Angau	334	21	6.3
Buka	40	5	12.5
Daru			
Goroka	223	3	1.3
Kavieng			
Kimbe	87	14	16.1
Kerema			
Kundiawa			
Manus			
Mendi			
Modilon	62	10	16.1
Mt Hagen	577	63	10.9
Nonga	124	11	8.9
Oro	47	3	6.4
PMGH	569	22	5.6
Vanimo	59	0	0.0
Wabag	2	0	0.0
Wewak			
Total	2124	152	7.1

Hospital	Asphyxia admissions	Asphyxia deaths	Asphyxia CFR	VLBW admissions	VLBW deaths	VLBW CFR
Alotau						
Angau	263	43	16.3	46	25	54.3
Buka	10	2	20.0	3	1	33.3
Daru						
Goroka	169	13	7.7	29	15	51.7
Kavieng						
Kimbe	94	12	12.8	22	7	31.8
Kerema						
Kundiawa						
Manus						
Mendi						
Modilon	102	19	18.6	39	14	35.9
Mt Hagen	246	35	14.2	33	14	42.4
Nonga	84	5	6.0	10	5	50.0
Oro	41	8	19.5	4	0	0.0
PMGH	152	27	17.7	329	86	26.1
Vanimo	58	1	1.7	3	2	66.7
Wabag	0	0	0	0	0	0
Wewak						
Total	**1219**	**165**	**13.5**	**518**	**169**	**32.6**