PNG Department of Health

Child Morbidity and Mortality

Ninth Annual Report, 2018

Child Health Advisory Committee
PNG National Department of Health
Paediatric Society of Papua New Guinea

Produced by the members of the Paediatric Society of Papua New Guinea

Acknowledgements:
Edilson Yano, Paediatric Surveillance Officer for collating all the hospital's data and coordinating the PHR
Writing contributions from Dr Fiona Kupe, Dr Paulus Ripa
Thanks to all paediatricians, nurses and other health care workers in all participating hospitals who reported their data

Edited by Prof Trevor Duke

With the support of the RE Ross Trust

2018 Annual Report on Child Morbidity and Mortality

Executive summary

Since 2009 we have accurately monitored the admissions, deaths and case fatality rates for children in many provincial hospitals, through the Paediatric Hospital Reporting (PHR) program. From the PHR we know the case fatality rates for pneumonia, diarrhoea, malaria, severe malnutrition, neonatal conditions; in total 25 paediatric and newborn conditions. 18 hospitals have contributed data to the PHR from 2009-2018.

Until 2017 the in-hospital death rate in hospitals was static at 7.1-8.1% of all admitted children. In 2018 we saw the first trend of improvement at 6.7%, a significant change.

Before 2018 case fatality rates for common conditions such as pneumonia (5%), severe pneumonia (10-20%) were static. However in 2018 CFR for pneumonia (3.5%), and for severe pneumonia (9.6%), both significant improvements.

In 2018 severe malnutrition CFR was 12.3%, down from 18-22% each year in 2010-2015.

Report main points

- This report covers admissions and outcomes for children in 2018 from 18 hospitals: 15 provincial hospitals, two rural district hospitals and one urban hospital. This is the highest participation rate since the Paediatric Hospital Reporting (PHR) system began in 2008.
- In 2018 there were 24,960 admissions and 1676 deaths recorded (mortality rate 6.71%). This is a significant improvement in mortality rate. For the first time in the last 7 years the overall CFR was under 7%.
- In 2018 there were 1033 post-neonatal deaths out of a total of 17,235 patients (CFR 3.7%) and 643 neonatal deaths out of 7725 patients (neonatal CFR 8.3%) reported.
- As in past years, in 2018 pneumonia was the most common reason for admission (5292, 21.2% of admissions). However pneumonia case fatality rates were significantly lower than in previous years: 3.5% overall (previously 5%), and 9.62% for severe pneumonia (previously more than 10%).
- 30.9% of all admissions were in the neonatal period. Neonatal deaths accounted for just over one third (38.4%) of all childhood deaths. The leading causes in neonates were combinations of neonatal sepsis, birth asphyxia, and very low birth weight. Neonatal mortality rates in Special Care Nurseries is also reduced in 2018.
- Severe malnutrition was present in 2548 admissions (10.2% of admissions), making it in the top 5 most common problem seen in hospitals. Malnutrition caused or contributed to 315 deaths (18.7% of all deaths and 30.5% of post-neonatal deaths). Many additional children had moderate malnutrition. Case fatality rates for severe malnutrition are significantly lower than in previous years; 12.4% in 2018. This is a big improvement on previous years although still higher than the World Health Organization target of <10%.
- 62 cases of acute flaccid paralysis (AFP) were reported in 2018. On June 22, 2018, the National Department of Health confirmed an outbreak of poliomyelitis caused by circulating vaccine-derived poliovirus type 1 (cVDPV1).The polio

outbreak in PNG means that every child health care worker should promote vaccination, hygiene and sanitation, and report cases of AFP.

- Many children have chronic illnesses – tuberculosis, HIV, cancer, rheumatic and congenital heart disease, chronic lung disease, and epilepsy and cerebral palsy. They need a holistic approach to care in hospitals and their communities.

In response to the PHR results for 2018, the Child Health Advisory Committee of the National Department of Health has made the following recommendations:

To achieve further improvements a **National Paediatric Quality Improvement Program** is needed. Such programs exist in many countries and have been very successful. The components include:

- A quality improvement team in each provincial hospital
- Regular mortality and morbidity audits, and training in how to learn lessons from these and implement changes
- WHO quality standards for the care of children and adolescents in health care facilities
- Training on the care of seriously ill children, through the WHO Hospital Care for Children program
- Continuing professional development for paediatricians and paediatric nurses
- Establishment of intensive care areas in the paediatric wards for the care of the sickest children
- Standardised colour-coded paediatric monitoring and response charts with early warning indicators and escalation processes (see Appendix)
- Infection control and antibiotic stewardship
- Improved systems for managing children with chronic conditions (epilepsy, neurodevelopmental, cardiac, chronic respiratory, cancer, diabetes) Improved diagnostics, especially diagnostics to guide antibiotic use

Further decreases in deaths from **severe pneumonia** will require prevention and treatment. Prevention includes the use of Haemophilus and pneumococcal conjugate vaccines, improving breast-feeding and complementary feeding, hygiene, and reducing indoor air pollution. Education of parents is needed on the signs of pneumonia so that parents recognise the signs of illness and seek care. Improved treatment in health centres and hospitals, including triage, and pulse oximetry for identification of the sickest children, giving appropriate antibiotics, and oxygen therapy to those with hypoxaemia, using paediatric monitoring and response charts, and supportive care. Treating co-morbidities including malnutrition and anaemia and identifying children early who may have tuberculosis are also important for reducing pneumonia deaths.

Reducing **neonatal deaths** further 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 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, all newborns should have 4% chlorhexidine applied to the umbilical cord.

Better care for very low birth weight babies, neonatal sepsis and birth asphyxia is 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, and careful use of IV fluids, using paediatric monitoring and response charts, audit, and ward organisation. In many hospitals nosocomial infections are common, and some of these are resistant to multiple antibiotics. To prevent hospital-acquired infections, it is very important to adhere to hand hygiene and other infection control practices, and reduce the use of unnecessary antibiotics.

Improved obstetric care is needed to reduce deaths from birth asphyxia. Improved use of partograph during labour is needed. Family planning would reduce many unwanted pregnancies.

Malnutrition also needs both prevention and treatment. Prevention of malnutrition at the community level is the best way to avoid children dying from malnutrition. Timely treatment of children with malnutrition is also essential and often poorly done in hospitals. Increased use of Mid Upper Arm Circumference (MUAC) measurement and plotting weights on a growth chart would identify children at highest risk. 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. By addressing these steps the CFR for severe malnutrition has come down from 18-24% to just over 12%, a big improvement in the last 6 years.

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, using a paediatric monitoring and response chart. Third-generation cephalosporins - ceftriaxone or cefotaxime - are the only effective antibiotic to treat meningitis.

Tuberculosis caused 8.7% of all admissions. The case fatality rate for pulmonary TB was significantly lower in 2018 (4.7%) than in previous years (7-9%), but the death rate for extra-pulmonary TB, although falling, remains high (13.5%). This is because extra-pulmonary TB is often a more complex multi-system disease. Every effort should be made to help children complete TB treatment. 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-based follow-up. Identifying children early who may have multi-drug resistant TB is also very important, and requires input from a paediatrician.

There are more children with **chronic diseases**, including asthma, bronchiectasis, epilepsy, rheumatic and congenital heart diseases, cerebral palsy, and diabetes. These children need a long-term treatment plan, good follow-up by a paediatrician or skilled child health nurse, adherence with medications and a continued supply of essential medicines, addressing comorbidities such as vision and hearing loss, going to school regularly and having education about their condition.

The outbreak of polio in several provinces in 2018 means that all health workers need to understand the vaccine schedule, and promote polio vaccination wherever possible (see section on Vaccine preventable diseases for details).

The National Child Health Plan outlines a plan for improving child health up to 2020. The Child Health Advisory Committee recommends that everyone involved in health care for children be familiar with the Plan, and that Provincial and District Health officials use it to formulate their Annual Activity Plans. This plan can be downloaded at http://pngpaediatricsociety.org/png-child-health

2018 Annual Report on Child Morbidity and Mortality

Introduction

The Child Health Advisory Committee of the National Department of Health releases the 9th Annual Report on Child Morbidity and Mortality in Papua New Guinea, for 2018. 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 examining health outcomes that we can improve our services. The data are current, covering all of 2018, with some comparisons to data collected in the previous 8 years. The recommendations cover clinical and public health solutions that would result in many more children's lives being saved each year.

Paediatric Hospital Reporting System (PHR)

The Paediatric Hospital Reporting System enables hospitals to record admissions, calculate mortality rates and monitor trends in disease burdens and outcomes over time. When the data are compiled from all hospitals, this can highlight 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.

Mortality rates for common diseases

The overall case fatality rate (CFR) in 2018 was the lowest in 7 years (6.71%), see Figure 1. Case fatality rates vary widely (from 0.7% in Gerehu to over 8% in Kimbe, Modilon, Port Moresby and Wabag). Differences in CFR reflect many things, including case mix (the types of illnesses seen in the hospitals), the complexity and severity of illness at the time of presentation, referrals, the number of health care workers and other resources available to manage seriously ill children, and serious disease outbreaks. In some hospitals it may also reflect missing data. What matters are broad trends over time, and the fall in overall CFR and the CFRs for pneumonia and malnutrition in 2018 are real progress.

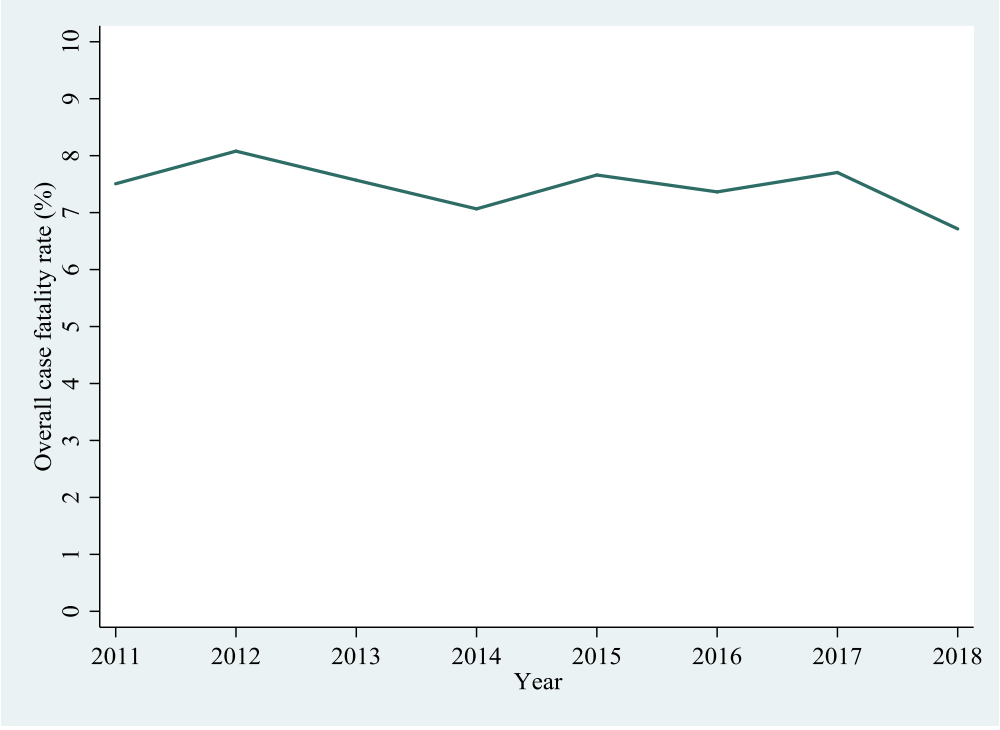

Figure 1. Overall paediatric case fatality rates 2011-2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	615	28	4.6
Angau	2611	204	7.8
Buka	807	61	7.6
Daru			
Gerehu	981	7	0.7
Goroka	2527	178	7.0
Kavieng			
Kimbe	1216	123	8.1
Kerema			
Kompiam	221	12	5.4
Kundiawa	1684	99	5.9
Mabisanda	149	7	4.7
Manus	288	16	5.6
Mendi	1191	64	5.4
Modilon	1324	119	9.0
Mt Hagen	3027	107	3.5
Nonga	1070	77	7.2
Popendetta	828	62	7.5
Port Moresby	4893	415	8.5
Vanimo	655	23	3.5
Wabag	873	74	8.5
Wewak			
Total	**24,960**	**1676**	**6.71**

Table 1. Summary of admission, death and case fatality rates in participating hospitals in 2018

Diagnoses	Admissions 2018	Deaths 2018	CFR 2018	CFR in all years of the PHR 2009-2018
All paediatric admissions	24,960	1676	6.7	7.31
Pneumonia	5292	185	3.5	4.70
Severe pneumonia	1632	157	9.6	11.16
Neonatal conditions	7725	643	8.3	9.48
Diarrhoea	2716	113	4.2	4.31
Malaria	1026	43	4.2	4.38
Severe malnutrition	2548	315	12.4	17.08
Tuberculosis	2175	189	8.7	10.86
Meningitis	859	133	15.5	17.60
HIV	547	87	15.9	15.22
Anaemia *	2553	280	11.0	12.90
Rheumatic heart disease *	92	6	6.5	9.17
Congenital heart disease *	476	70	14.7	19.02
Measles	1	0	0.0	2.97
Cancer *	92	25	27.2	31.87
Tetanus	6	5	83.3	15.13
Acute flaccid paralysis	64	2	3.1	3.49
Whooping cough	24	1	4.2	1.27
Child protection *	195	29	23.3	16.82
Trauma and injuries *				
Total	**24,960**	**1676**	**6.71**	**7.31**

Table 2. Most common causes of hospital admission and case fatality rates in children for 2018, and CFR for years 2009-2018

* Diagnoses added recently, so CFRs do not reflect the complete 10 years of reporting

Pneumonia

In 2018 as in all years, pneumonia was the most common reason for admission (5292 cases; 21.2% of all admissions). However there has been much progress: pneumonia case fatality rates in 2018 were significantly lower than in previous years: 3.5% overall (Figure 2), and 9.62% for severe pneumonia (previously more than 10% and up to 20% or more in many hospitals). This is a very significant improvement, and is due to many things: better clinical care, provision of oxygen and pulse oximetry, and the beneficial effects of conjugate vaccines against *Haemophilus influenzae* type b and *Streptococcus pneumoniae* leading to changes in epidemiology with more viral bronchiolitis.

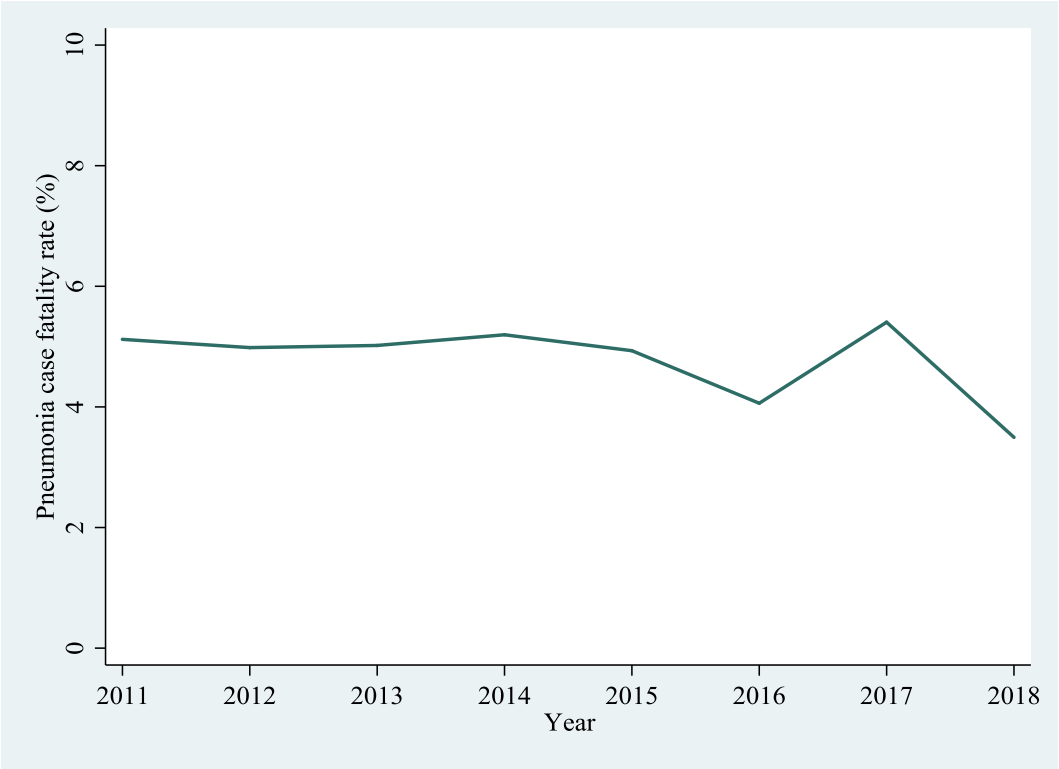

Figure 2. Pneumonia case fatality rates 2011-2018

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 intensive care and close monitoring 24 hours a day
- 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
- supervision of nursing and medical care by senior clinicians

Pneumonia (185) and meningitis (133) combined account for 19% of all deaths. This emphasises the importance of improving coverage of *Hemophilus influenzae* type b vaccine (Hib) – given as part of Pentavalent vaccine, and the pneumococcal conjugate vaccine (PCV, introduced in 2014); both vaccines given at 1, 2 and 3 months. These vaccines prevent deaths and disability from bacterial meningitis, and prevent some cases of pneumonia.

There are other common causes of pneumonia, including viruses (particularly respiratory syncytial virus - RSV, and influenza) and bacteria (such as other types of Haemophilus influenzae, Group A streptococcus, *Staphylococcus aureus*, enteric gram negative bacilli, Chlamydia, Mycoplasma and tuberculosis) which are not prevented by these two vaccines.

This means that even with these 2 important meningitis and pneumonia vaccines, pneumonia and bronchiolitis will continue to be a major cause of hospital presentations for children in PNG.

The best way to deal with this is a comprehensive approach. The PNG Child Health Plan 2009-2020 outlines a comprehensive approach to pneumonia and other acute lower respiratory tract infections (ALRI).

This includes key areas to address:

Prevention

- Breast feeding and good balanced nutrition in the second 6 months of life and beyond, with growth monitoring
- Helping parents be aware of the signs of pneumonia and bronchiolitis and when to seek care
- Reduce indoor air pollution, keeping children away from smoke from cooking stoves, and never smoke in a child's presence
- Hand-washing
- Vaccines: measles, Hib, PCV

Treatment

- Improving hospital and health centre care of pneumonia through Hospital Care for Children training
- Use of a paediatric monitoring and response chart to identify children who are deteriorating and escalate appropriately
- Oxygen, pulse oximetry, careful monitoring and supportive, intensive care
- Identification and treatment of comorbidities, including anaemia, malnutrition, HIV and tuberculosis if present
- Improved infection control practices, particularly hand hygiene, and reducing unnecessary antibiotic usage
- Outpatient or day-care treatment for moderate bronchiolitis, so that hospitals are not crowded by children who can safely be treated without hospitalisation.

Mt Hagen General Hospital Paediatric Department

Figure 3. At Mt Hagen the RHEO, charge nurse and registrar discuss a patient on ward round.

Over the past 2 years Mt Hagen General Hospital has made substantial improvements in outcomes for children, the overall paediatric case fatality rate is now the lowest of any large provincial hospital in the country. The CFRs for severe pneumonia and severe malnutrition have fallen.

There are many possible reasons for these improvements, says Dr Jonah Kurubi, paediatrician and Director of Medical Services states: “Three years ago the hospital introduced a clinical governance program. This includes clinical auditing, information management, training and education, research and development, openness and risk management and clinical effectiveness.”

2018 Annual Report on Child Morbidity and Mortality

Dr Paulus Ripa, Head of Clinical Governance lists some of the important activities and reasons for progress:

1. Monthly clinical governance meetings uniting participation by both medical and nursing staff together as a team and reviewing child deaths and other clinical problems together
2. Implementing changes as necessitated from these meetings
3. Training run for staff in recognising hypoxia and commencing oxygen therapy earlier, and management of severe malnutrition would have contributed significantly
4. The use of oxygen concentrators and the setting up of an acute bay for very sick children and connection with oxygen piping to many beds.
5. Some reductions in pneumonia deaths could be due to pneumococcal and HIB vaccines
6. Improving paediatric registrar cover and having consistent ward rounds every day.
7. Combined quarterly reviews nurses plus medical on department activities
8. Hospital trainings based on skill gaps and priority areas: such as IMCI, IYCF, EENC, SAM, Hospital Care for Children
9. As part of a Quality Improvement Team, we identified focal persons to task certain priority activities and with feedback

Diarrhoea

2716 admissions and 113 deaths (CFR 4.16%) due to diarrhoea were reported in the 18 hospitals in 2018. Diarrhoea case mortality rates varied widely, from less than 1% in 3 hospitals (Alotau, Gerehu and Kundiawa) to more than 8% in Wabag, Modilon and Buka. Diarrhoea mortality rates are dependent on factors similar to those that influence severe pneumonia mortality rates (comorbidities, especially malnutrition, HIV, anaemia), late presentation, and outbreaks.

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, such as severe malnutrition or immune deficiency.

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 requires 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 that ciprofloxacin is needed to treat dysentery. Oral ciprofloxacin is currently recommended treatment by WHO for dysentery in a dose of 10-15 mg/kg twice daily for 5 days. If children are too sick to take oral medications, give ceftriaxone intravenously (IV) or intramuscularly (IM).

Recommendations

- Deaths from watery diarrhoea usually means the child did not receive sufficient fluids
- Give ORS and zinc to all children with diarrhoea
- Treat bloody diarrhoea (dysentery) with ciprofloxacin
- Recognise the high risk of mortality among children with chronic or persistent diarrhoea

Malaria

In 2018 malaria accounted for 1026 admissions and 43 deaths (case fatality rate of 4.2%).

PNG now has established malaria treatment guidelines which include:

- 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 treatments. They are described in the Standard Treatment Book for Common Illnesses in Children, new edition published in 2016.

Malnutrition

The PHR records malnutrition as either a co-morbidity or a main diagnosis, so even if it is not the main diagnosis it is still recorded. In 2018 in the 18 hospitals that reported using the PHR, 2548 children were admitted with severe malnutrition (weight for age <3 SD below the median), or with severe wasting or kwashiorkor. This represented 10.2% of all admissions, a reduction on previous years. The case fatality rate for severe malnutrition was 12.4%, much lower than in earlier years of the PHR reporting where CFR was 15-20% or above (Figure 4 and Table 3). This shows that there has been a consistent gradual improvement in the management of severe malnutrition over recent years, because of an improved systematic approach based on the WHO/UNICEF and Standard Treatment guidelines.

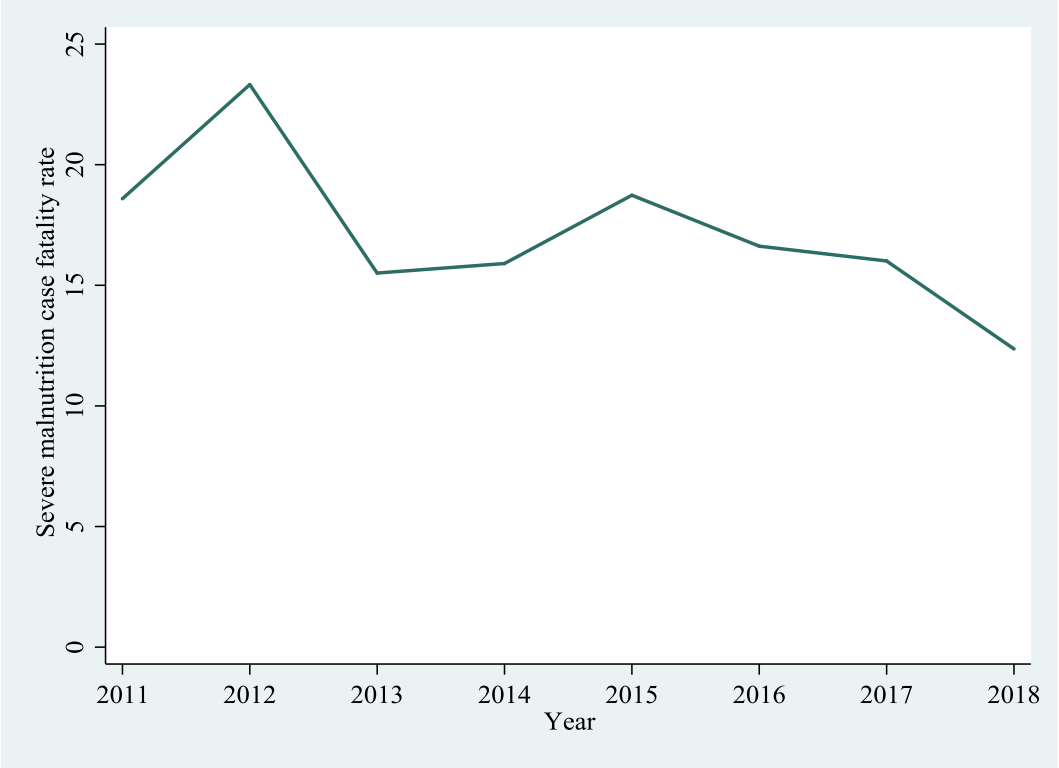

Figure 4. Severe malnutrition case fatality rate 2011-2018

Year	Number admissions	Deaths	CFR	Number of hospitals with CFR >20%
2010	739	157	21.2	4
2011	1544	287	18.6	3
2012	2590	604	23.3	4
2013	3379	524	15.5	4
2014	2861	455	15.9	4
2015	2338	438	18.7	4
2016	2635	438	16.7	4
2017	3049	483	15.8	2
2018	2548	315	12.4	3

Table 3. Cases and outcomes of children with severe malnutrition 2010-2018

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 too 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 independence 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 18 hospitals, meningitis accounted for 859 admissions and 133 deaths. The case fatality rate for meningitis was 15.5%, relatively static in comparison to mortality rates in recent years.

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 tragedy is often preventable by vaccination and early presentation and treatment.

The best method of preventing meningitis is the use of conjugate Hib and pneumococcal vaccines. Hib vaccine (in Pentavalent) was introduced in PNG in 2008. Cases of Hib meningitis are still being reported in 2018, 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 do not use chloramphenicol for children with suspected meningitis. Ceftriaxone or cefotaxime is needed for true meningitis.

There are many causes of the syndrome of febrile encephalopathy that are not bacterial meningitis. The other causes of febrile encephalopathy include viral encephalitis, including dengue, Japanese encephalitis, herpes viruses, influenza. TB meningitis also causes febrile encephalopathy. A good history should be taken to determine if the child has been unwell for several weeks prior to presentation: weight loss, chronic fever, chronic cough, and examination finding of wasting, lymphadenopathy, and enlarged liver suggest a more chronic process than occurs with bacterial or viral meningitis, and TB should be considered early.

All patients with febrile encephalopathy or meningitis require very good supportive care and monitoring.

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, pertussis (whooping cough) and hepatitis B (a liver infection which eventually can cause liver cancer in adults). PCV protects against the other most common cause of meningitis.

All children with suspected meningitis should have a lumbar puncture if it is safe to do so. If the CSF is cloudy or has cells on microscopy, treat with ceftriaxone 50mg/kg twice daily IV or IM for 10 days.

Supportive care of all children with febrile encephalopathy (seizures and / or acute coma) includes attention to the following:

- Nurse all children with meningitis or unconsciousness in a high dependency or intensive care section of the ward
- Nurse the child 30° head up (elevate the head of the bed, or nurse on a pillow) to reduce the risk of aspiration and reduce intracranial pressure
- Monitor with pulse oximetry to detect hypoxaemia, and give oxygen if SpO_2<92%
- Monitor the blood glucose and prevent hypoglycaemia
- Monitor the Glasgow Coma Scale
- Monitor the blood pressure and ensure it is in the normal range (avoid both severe hypertension and hypotension, both are bad for injured brains). Monitor the pulses and peripheral circulation.
- Close observation for convulsions, and prompt treatment with a preventative anticonvulsant if the child has convulsions
- Do not give too much IV fluids, this leads to body and brain swelling and results in poor outcomes, maintain enteral nutrition via a nasogastric tube
- Change position to prevent pressure sores
- Physiotherapy to prevent limb contractures

Recommendations on identification and treatment of severe infections [NEXT]

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
- slow capillary refill
- pallor
- lethargy or unconsciousness

There may be **localising signs suggesting meningitis**

- severe headache
- neck stiffness
- severe vomiting
- repeated convulsions
- bulging fontanelle
- extreme irritability or high-pitched cry

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.
- Promptly give IV or IM antibiotics: ceftriaxone, (plus flucloxacillin if signs of Staph infection are present)
- Monitor in a high dependency or ICU section of the ward. 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.

Dr Fiona Kupe and the team at NCD health – contributions to urban and public child health

Figure 5. Sr Lillian Abady, Dr Fiona Kupe, HEO Christine Mapya and Sr Judith Pangali from Gerehu Hospital

Dr Fiona Kupe is a paediatrician who comes from Manus Province. She completed her Master's Degree in Child Health in 2013 and took up post with the National Capital District Health Services in January 2014.

Since taking up this post, Dr Kupe became heavily involved for the first time in provincial child public health. In NCD, Dr Kupe coordinated the "Switch from Trivalent OPV to Bivalent OPV", the introduction of SIREP strategy and the introduction of new vaccines: injectable polio vaccine, pneumococcal conjugate vaccine (PCV-13) and measles-rubella vaccine in 2016.

Dr Kupe became heavily involved in the measles outbreak responses in 2014-2015 and the polio outbreak responses in 2018-2019. Dr Kupe says: "Surveillance for Vaccine Preventable Diseases is really important". As the Paediatric Society Focal Person for Immunisation and Vaccine Preventable Disease Surveillance, she contributes to this through being a link with provincial paediatric colleagues and the National Department of Health, to fill gaps in communication and timely information flow from the National to Provincial levels.

When the severe acute malnutrition (SAM) program was introduced NCD was not included in the initial training. Upon realising this, Dr Kupe contacted UNICEF to seek assistance to set up the program. She worked with the Provincial Family Health Coordinator and conducted two SAM trainings in NCD in 2017. Staff are now actively screening and identifying cases of SAM early, resulting in early intervention. 15 of the 25 urban clinics in NCD are now successfully implementing the SAM program.

Gerehu General Hospital has been recently upgraded from an urban clinic. To enable a skilled workforce, Dr Kupe has worked closely with Dr Kunera Kiromat, Sr Veronica Lausi and Sr Serah Gaiyowa and their nursing team, in training nursing officers and community health workers on the daily clinical ward round, setting up the Paediatric Hospital Reporting (PHR) program, making HIV testing available every day, establishing inpatient SAM management, and installing oxygen concentrators in the paediatric ward in 2018. This has reduced referrals of pneumonia cases requiring oxygen therapy to Port Moresby General Hospital, and lead to Gerehu having the lowest case fatality rate of any hospital in the country in 2018.

Dr Kupe's work in NCD emphasises that there are many things a provincial paediatrician can contribute toward reducing childhood morbidity and mortality, and not just in the curative setting, but importantly in upskilling lower cadre health workers and getting involved with the provincial health team and the Family Health Coordinator to improve child public health programs as well. To do this Dr Kupe says it is important to get to know the key child health program officers at the National Level and the WHO/UNICEF technical officers in child health as this has greatly assisted her in implementing childhood programs in NCD.

Neonatal admissions

Neonatal admissions made up 7725 (30.9%) of all 24,960 paediatric admissions to the 18 hospitals in 2018. There were 643 neonatal deaths reported, meaning that 38% of all deaths in children were in the neonatal period. There has been a steady downward trend in neonatal mortality rates in participating hospitals (Figure 6).

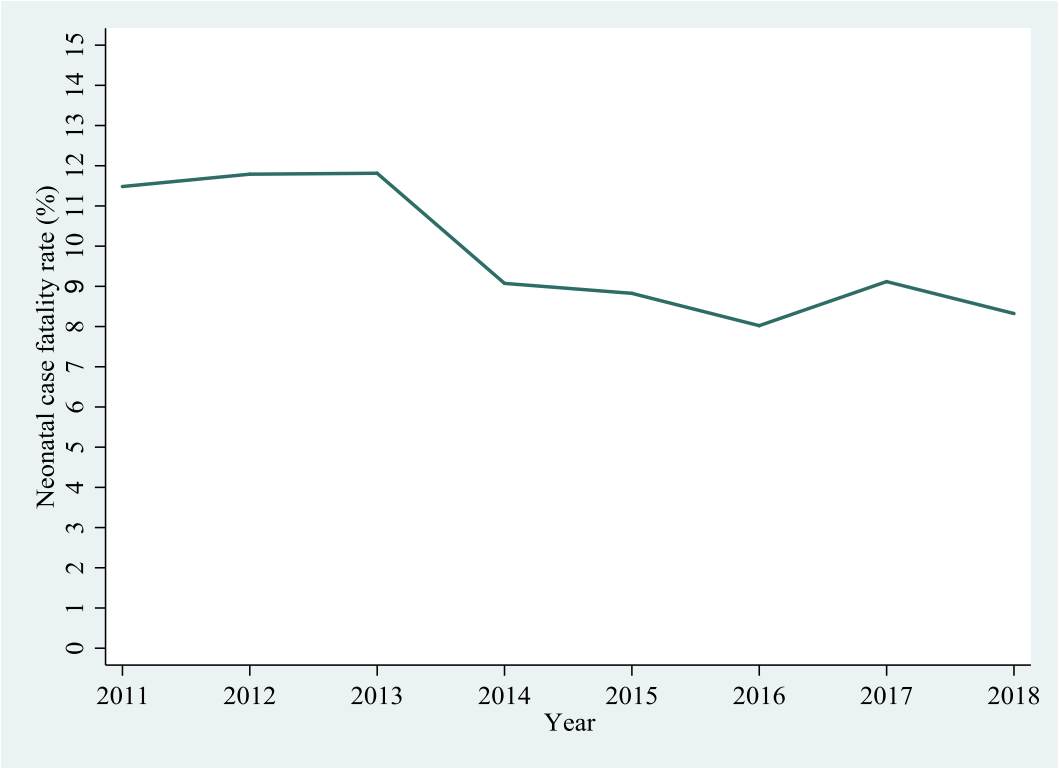

Figure 6. Overall neonatal mortality rates in Special Care Nurseries 2011-2018

Neonatal infections

Two-thirds (66%) of all neonatal admissions were associated with infections (n=5071). Neonatal infections included pneumonia, meningitis, cord sepsis, skin sepsis and diarrhoea. Because of comorbidity, infections may occur in babies with other diagnoses, including low birth weight.

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 1812 hospital admissions due to birth asphyxia, and the CFR was 13.5%, the same as in previous years. 38% of neonatal deaths were due to perinatal asphyxia or associated with it.

The developmental implications for many surviving children are significant: cerebral palsy, intellectual disability, blindness, and seizures are common. Perinatal asphyxia can be reduced with supervision with supervision by a skilled midwife, identification of delays in labour, active management of labour, and close communication between

obstetric / midwifery services and paediatric services. Providing immediate newborn care - described below - can also prevent some cases of asphyxia, as babies are stimulated to initiate breathing early by drying. Training in neonatal resuscitation for nurses and doctors can also reduce the number of babies with birth asphyxia.

Very low birth weight

Very low birth weight is a birth weight between 1000 and 1499g. There were 536 very low birth weight admissions in the 18 hospitals. In 2018, 217, or 40.5% of VLBW newborns died in hospital, but nearly 60% survived hospitalisation, and these babies are at high risk of complications and need close follow-up and care in the first year of life.

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 with the mother*** 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 after birth, reduces the risk of anaemia and the risk of intraventricular haemorrhages in preterm infants.
- ***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 that babies will breast feed successfully and means they are less likely to receive colostrum, which contains antibodies that protect against infection.

Babies who require resuscitation or special care

Despite thorough drying, 2-3% of newborns do not breathe at birth. ***Bag and mask resuscitation*** for all babies who are not breathing within X minutes of 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 non-invasive and as 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 infection

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 many neonates do not have clinical signs of hypoxaemia, 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, aminophylline 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. Hypoglycaemia occurs because neonates have 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. Ensure 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.
- 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 [IS THIS WISE?] 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 strongly 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 is very important 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 be 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 18 hospitals in 2018 there were 2175 children admitted with tuberculosis, with189 known deaths, and a case fatality rate of 8.69%. This is probably only a very small proportion 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 emphasise that TB causes many childhood deaths.

Pulmonary TB made up 53% (1161) of all TB diagnoses. Extra-pulmonary tuberculosis (TB meningitis, lymph node TB, spinal TB, abdominal TB, miliary TB) made up 47% of children diagnosed with TB (998 reported cases). EPTB has a much higher hospital mortality rate than PTB (13.5% compared with 4.7%), this is consistently seen over years, reflecting the multi-system nature of many cases of EPTB treated as in-patients in hospitals. Case fatality rates for both pulmonary and extra-pulmonary TB are improving over the years (Figure 7).

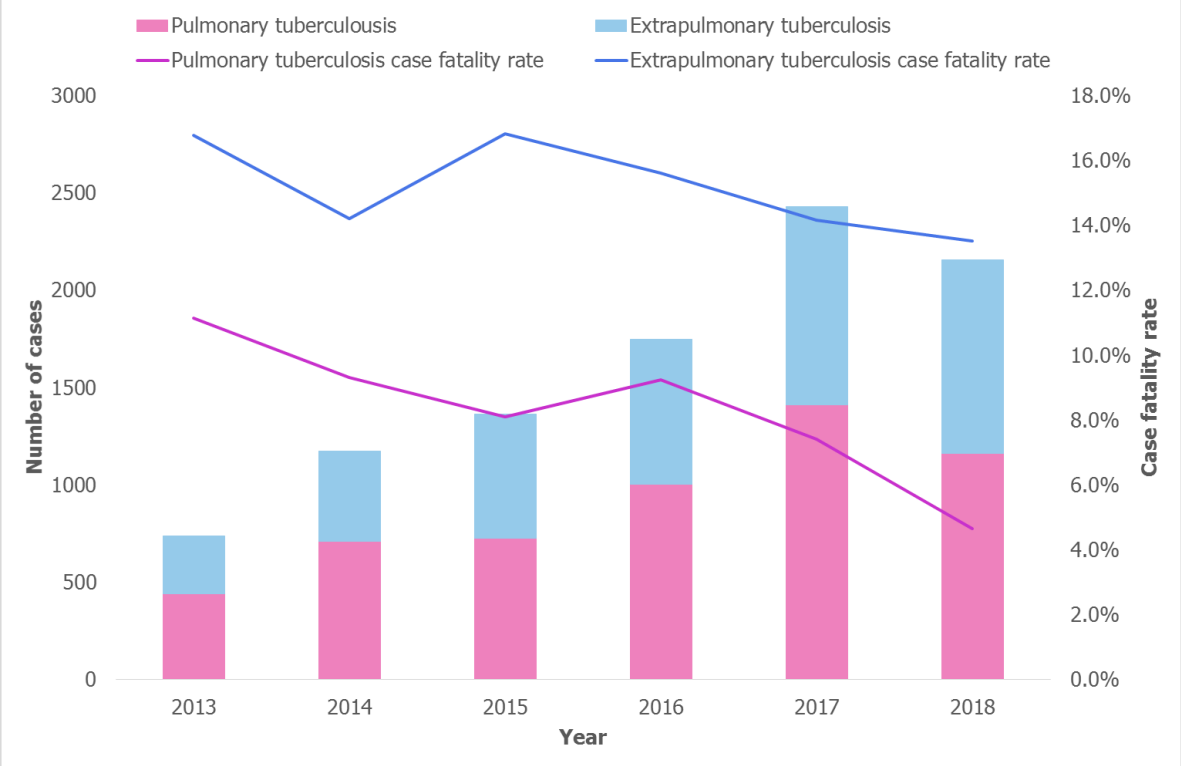

Figure 7. Pulmonary and extra-pulmonary tuberculosis admissions and case fatality rates 2011-2018

Malnutrition contributes substantially to high case fatality rates for children with PTB and EPTB.

Recommendations

Every effort should be made to help children complete TB 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 have 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 (see paediatric Standard Treatment Manual). 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, 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 children in hospital for the duration of their intensive phase treatment (2 months) if 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 proper family screening and treatment themselves if they have TB.

TB programs that are successful in achieving good treatment completion rates have nurse outreach services for identification and supervision of DOTs providers, checking of adherence, nutritional, social and economic support, and follow-up in the home.

HIV

In 2018 there were 547 new cases of HIV admitted to the 18 hospitals, and 87 known HIV-related deaths. This represents only 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 almost always 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 anti-retroviral therapy (ART) before they become symptomatic have a much better chance of healthy life than children diagnosed later because they have AIDS-defining infections.
- All children diagnosed with HIV should see a paediatrician regularly, for starting on antiretroviral therapy and follow-up.
- All children with HIV need prophylaxis with cotrimoxazole and INAH, treatment of intercurrent infections and good nutrition.
- **Teach children with HIV about their condition. They are more likely to take their ART reliably if they understand more, and even young children have a right to this knowledge. Educational resources are available to teach children who are living with HIV about their condition in ways that are age-appropriate.**

Vaccine preventable diseases

There were 64 cases of acute flaccid paralysis in 2018 (Figure 8) and there were 3 deaths. There were 6 cases of tetanus (5 deaths), 24 cases of whooping cough, and 1 reported case of measles in 2018.

The polio outbreak in 2018

On June 22, 2018, the National Department of Health confirmed an outbreak of poliomyelitis caused by circulating vaccine-derived poliovirus type 1 (cVDPV1). After the initial cVDPV1 case was detected, active AFP case-finding at health facilities was intensified. The outbreak of vaccine-derived polio has occurred because of low vaccination coverage, and poor sanitation and hygiene. Five rounds of mass polio vaccination campaigns conducted in 2018, enhanced surveillance including environmental surveillance, and social mobilisation were conducted in response.

The polio outbreak in PNG means that every child health care worker should promote vaccination, hygiene and sanitation, and report cases of AFP.

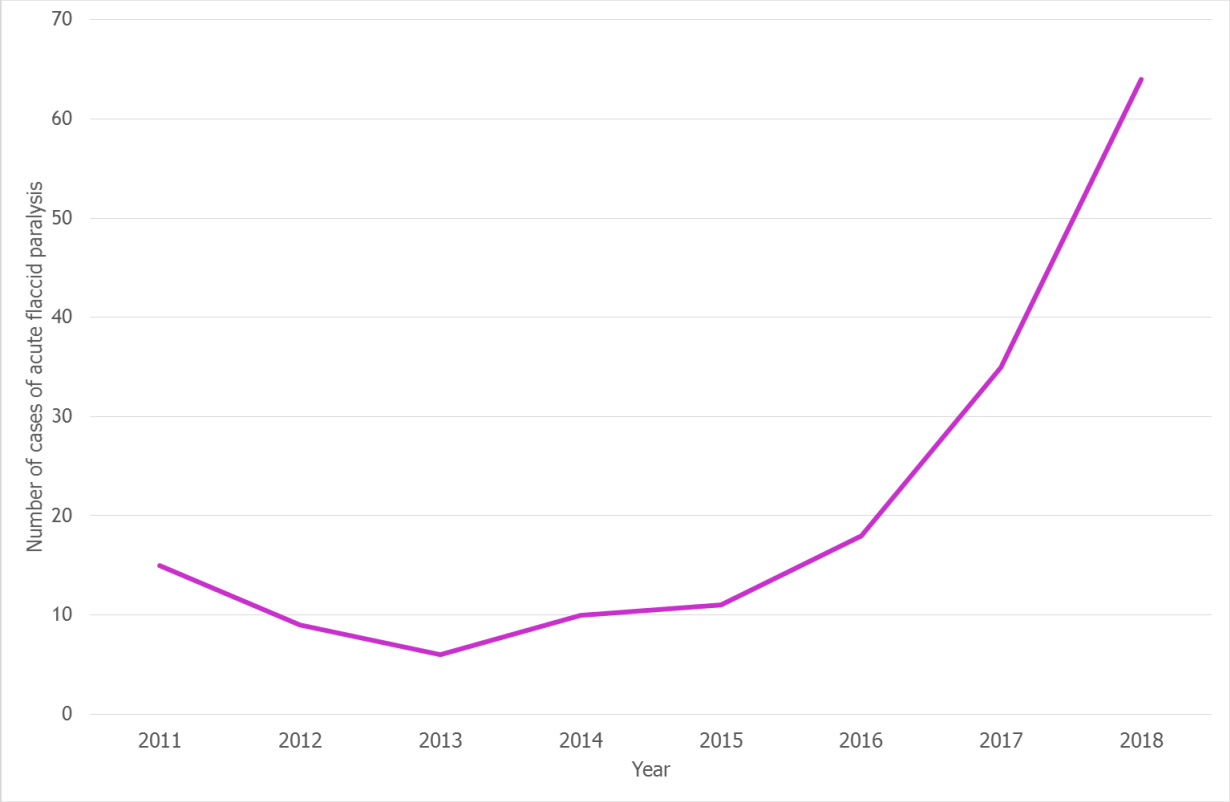

Figure 7. Cases of acute flaccid paralysis 2011-2018

10 facts about polio that all health workers need to know:

1. Polio is a disease caused by a virus that causes acute flaccid paralysis (AFP)
2. Polio virus is spread by contact with faeces, through poor hygiene and sanitation
3. Polio vaccine prevents polio
4. Every child needs at least 3 doses of polio vaccine
5. PNG has switched so that now 2 doses of oral polio vaccine is given at 1 and 2 months, followed by 1 dose of injectable polio vaccine at 3 months. This new schedule is important in eradicating polio
6. Because of the polio outbreak in PNG, mass vaccination is being done. With every round of mass vaccination for the polio outbreak, all children should be vaccinated, even if they have received 3 or more doses of polio vaccine before.
7. It is very important that health facilities have adequate stocks of both oral (OPV or Sabin) and injectable polio vaccines (IPV).
8. Polio vaccines need to be kept in the refrigerator

9. Handwashing and good hygiene and sanitation prevents the spread of polio virus
10. Vaccination prevents the spread of polio virus

Vaccination coverage in PNG is still far too low, and it is inevitable that there will be another measles epidemic in the next few years unless action is taken.

The coverage rate for measles vaccine throughout PNG is about 60%. At least 90% coverage is needed to prevent outbreaks of measles. Every child we vaccinate is another child protected. The most at risk children are those who don't come to get vaccines, so we have to go to their homes and communities to immunise them.

No.	Vaccine	Age Group	Dose	Route	Disease Protects
1.	BCG	At Birth	0.05 ml (only one dose)	Intradermal	Tuberculosis
2.	OPV	Under 2 years old	2 drops (in 1 month, 2 months, 3 months)	Oral	Poliomyelitis
3.	Hepatitis B	At Birth	0.5 ml	Intramuscular	Hepatitis B
4.	IPV (inactivated Polio vaccine)	At 3 months	0.5 ml (one dose with 3rd dose of OPV	Intramuscular	Poliomyelitis
5.	Pentavalent	Under 2 years	0.5ml (3 doses in 1st ,2nd and 3rd months)	Intramuscular	Diphtheria, Whooping Cough, pneumonia and meningitis due to H. Influenzae, tetanus, Hepatitis B
6.	PCV-13 Pneumococcal Conjugate Vaccine)	Under 2 years	0.5ml (3 doses at 1st, 2nd and 3rd months)	Intramuscular	Pneumonia and meningitis due to Streptococcus pneumoniae
7	MR (Measles, Rubella)	Under 2 years	0.5ml (3 doses at 6,9 and 18 months)	Subcutaneous	Measles and Rubella
8	Tetanus Toxoid	Pregnant Mother, School Entry. School Leaving	0.5ml (2 doses in one month apart	Intramuscular	Tetanus
9.	Vitamin A	06 months - 2 years	3 doses (6 months, 9 months blue capsule 100,000 IU and 18 months Red capsules 200,000 IU)	Oral	Protects from night blindness

Table 4. The vaccines and diseases prevented

Chronic diseases in children

There are increasingly children with **chronic diseases**, including rheumatic heart disease (92 cases and 6 deaths in 2018), congenital heart diseases (476 cases and 70 deaths), cerebral palsy (150 cases and 50 deaths), epilepsy (59 cases), and cancer (92 cases and 25 deaths).

Children with chronic diseases have many needs, including

- **a long-term treatment plan**
- **good follow-up by a trusted doctor or paediatric nurse**
- **going to school regularly and having schools informed about their condition**
- **a regular supply of medicines on time, and good adherence**
- **optimal nutrition**

Children with chronic illnesses have to understand their condition well. Children as young as 4 or 5 years can start to understand. This is empowering and helps them manage their illness as they get older.

Some children with chronic illness have problems with hearing and vision, which can be addressed to make their lives better, and some have motor and mobility problems that can be addressed with physiotherapy, regular exercise and aids such as wheelchairs or walking frames. Programs are needed in every province that better support children with chronic illness.

Guidelines for the management of common cancers are available at www.pngpaediatricsociety.org (under Treatment Guidelines, Cancer Protocols), and assistance is available from Dr Gwenda Anga, oncology paediatrician at Port Moresby General Hospital.

Child protection

Data on child physical, sexual and other forms of abuse are now being collected by the PHR. There were 195 child protection cases and 29 deaths reported in 2018. This under-estimates the true burden of child abuse and maltreatment, but it is a start at systematic gathering of data on this problem. Social issues are also a frequent root cause of malnutrition and its disease risks.

More emphasis on child protection is needed, and more resources, including a child social worker in each hospital to deal with the range of common social issues.

Summary

This Annual Report and the Paediatric Hospital Reporting System in 2018 has highlighted significant progress in several areas: overall paediatric mortality rates, and case fatality rates for pneumonia, tuberculosis and neonates. The report also highlights problems. Addressing these in a systematic way will further 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	Admissions 2018	Deaths 2018	CFR 2018	Admissions 2009-2018	Deaths 2009-2018	CFR 2009-2018
All paediatric admissions	24,960	1676	6.7	182,707	13348	7.31
Pneumonia	5292	185	3.5	45422	2133	4.70
Severe pneumonia	1632	157	9.6	16068	1793	11.16
Neonatal conditions	7725	643	8.3	44340	4202	9.48
Diarrhoea	2716	113	4.2	20464	881	4.31
Malaria	1026	43	4.2	11866	520	4.38
Severe malnutrition	2548	315	12.4	22027	3762	17.08
Tuberculosis	2175	189	8.7	14613	1587	10.86
Meningitis	859	133	15.5	8880	1563	17.60
HIV	547	87	15.9	3600	548	15.22
Anaemia *	2553	280	11.0	12341	1592	12.90
Rheumatic heart disease *	92	6	6.5	458	42	9.17
Congenital heart disease *	476	70	14.7	1199	228	19.02
Measles	1	0	0.0	2158	64	2.97
Cancer *	92	25	27.2	593	189	31.87
Tetanus	6	5	83.3	119	18	15.13
Acute flaccid paralysis	64	2	3.1	172	6	3.49
Whooping cough	24	1	4.2	158	2	1.27
Child protection *	195	29	23.3	422	71	16.82

Table 5: Admissions, deaths and case fatality rates for common diagnoses in 2018, and comparison with 2009-2018

* 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 2018.

Hospital	Admissions	Deaths	Case fatality rate
Alotau	615	28	4.6
Angau	2611	204	7.8
Buka	807	61	7.6
Daru			
Gerehu	981	7	0.7
Goroka	2527	178	7.0
Kavieng			
Kimbe	1216	123	8.1
Kerema			
Kompiam	221	12	5.4
Kundiawa	1684	99	5.9
Mabisanda	149	7	4.7
Manus	288	16	5.6
Mendi	1191	64	5.4
Modilon	1324	119	9.0
Mt Hagen	3027	107	3.5
Nonga	1070	77	7.2
Popendetta	828	62	7.5
Port Moresby	4893	415	8.5
Vanimo	655	23	3.5
Wabag	873	74	8.5
Wewak			
Total	**24960**	**1676**	**6.71**

Table 6. Total paediatric and neonatal admissions, deaths and case fatality rate for 2018

Hospital	Pneumonia Admissions	Pneumonia Deaths	Pneumonia Case fatality rate	Severe pneumonia admissions	Severe pneumonia deaths	Severe pneumonia CFR
Alotau	138	1	0.7	13	1	7.7
Angau	391	19	4.9	107	17	15.9
Buka	201	10	5.0	90	10	11.1
Daru						
Gerehu	336	1	0.3	69	1	1.4
Goroka	670	22	3.3	262	22	8.4
Kavieng						
Kimbe	194	16	4.4	74	16	21.6
Kerema						
Kompiam	43	2	4.7	7	2	3.7
Kundiawa	323	6	1.8	126	6	4.7
Mabisanda	25	1	4.0	9	1	11.1
Manus	58	4	6.9	13	2	15.4
Mendi	341	7	2.1	71	6	8.5
Modilon	213	9	4.2	55	5	9.1
Mt Hagen	878	23	2.6	235	14	6.0
Nonga	143	18	12.6	51	17	33.3
Popendetta	166	11	6.6	68	8	11.8
Port Moresby	782	23	2.9	226	21	9.3
Vanimo	86	2	2.3	31	1	3.2
Wabag	304	10	3.3	125	7	5.6
Wewak						
Total	**5292**	**185**	**3.50**	**1632**	**157**	**9.62**

Table 7. Pneumonia admissions and outcomes in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	33	0	0.0
Angau	205	9	4.4
Buka	137	15	10.9
Daru			
Gerehu	161	1	0.6
Goroka	269	4	1.5
Kavieng			
Kimbe	120	6	5.0
Kerema			
Kompiam	27	1	3.7
Kundiawa	211	2	0.9
Mabisanda	50	4	8.0
Manus	44	1	2.3
Mendi	220	6	2.7
Modilon	72	6	8.3
Mt Hagen	405	9	2.2
Nonga	124	8	6.5
Popendetta	85	5	5.9
Port Moresby	375	19	5.1
Vanimo	41	2	4.9
Wabag	137	15	10.9
Wewak			
Total	2716	113	4.16

Table 8. Diarrhoea admissions and outcomes in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	16	1	6.3
Angau	123	7	5.7
Buka	24	3	12.5
Daru			
Gerehu	20	0	0.0
Goroka	24	2	8.3
Kavieng			
Kimbe	99	3	3.0
Kerema			
Kompiam	2	0	0.0
Kundiawa	8	1	12.5
Mabisanda	0	0	0.0
Manus	18	1	5.6
Mendi	2	0	0.0
Modilon	276	10	3.6
Mt Hagen	82	2	2.4
Nonga	57	4	7.0
Popendetta	134	6	4.5
Port Moresby	52	1	1.9
Vanimo	88	2	2.3
Wabag	1	0	0.0
Wewak			
Total	**1026**	**43**	**4.19**

Table 9. Malaria admissions and outcomes in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	17	3	17.6
Angau	362	56	15.5
Buka	125	24	19.2
Daru			
Gerehu	137	5	3.6
Goroka	199	22	11.1
Kavieng			
Kimbe	167	40	24.0
Kerema			
Kompiam	20	4	20.0
Kundiawa	58	6	10.3
Mabisanda	7	2	28.5
Manus	31	6	19.4
Mendi	107	15	14.0
Modilon	198	18	9.1
Mt Hagen	257	32	12.5
Nonga	113	9	16.8
Popendetta	178	18	10.1
Port Moresby	410	32	7.8
Vanimo	74	7	9.5
Wabag	88	16	18.2
Wewak			
Total	**2548**	**315**	**12.36**

Table 10. Severe malnutrition admissions and outcomes in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	17	2	11.8
Angau	95	20	21.1
Buka	29	5	17.2
Daru			
Gerehu	23	0	0.0
Goroka	127	28	22.1
Kavieng			
Kimbe	27	7	25.9
Kerema			
Kompiam	4	0	0.0
Kundiawa	59	3	5.1
Mabisanda	5	0	0.0
Manus	1	1	100.0
Mendi	32	5	15.6
Modilon	66	21	31.8
Mt Hagen	36	4	11.1
Nonga	40	15	37.5
Popendetta	36	4	11.1
Port Moresby	218	17	7.8
Vanimo	11	0	0.0
Wabag	33	1	3.0
Wewak			
Total	**859**	**133**	**15.48**

Table 11. Meningitis admissions and outcomes in 2018

Hospital	Admissions	Deaths	Case fatality rate	PTB admissions	PTB deaths	PTB CFR	EPTB admissions	EPTB deaths	EPTB CFR
Alotau	23	1	4.3	5	0	0.0	18	1	5.6
Angau	258	29	11.2	151	8	5.3	106	21	19.8
Buka	74	4	5.4	36	1	2.8	38	3	7.8
Daru									
Gerehu	26	0	0.0	20	0	0.0	0	0	0.0
Goroka	198	22	11.1	95	9	9.5	103	13	12.6
Kavieng									
Kimbe	154	19	12.3	104	5	4.8	50	14	28.0
Kerema									
Kompiam	9	0	0.0	2	0	0.0	7	0	0.0
Kundiawa	178	8	4.5	73	0	0.0	105	8	7.6
Mabisanda	2	0	0.0	0	0	0.0	2	0	0.0
Manus	1	0	0.0	0	0	0.0	1	0	0.0
Mendi	48	2	4.2	17	0	0.0	31	2	6.5
Modilon	116	13	11.2	53	7	13.2	63	6	9.5
Mt Hagen	197	15	7.6	85	1	1.2	112	14	12.5
Nonga	53	5	9.4	21	1	4.8	32	4	12.5
Popendetta	133	13	9.8	48	2	4.2	85	11	12.9
Port Moresby	597	48	8.0	392	19	4.8	196	29	14.8
Vanimo	46	5	10.9	24	0	0.0	22	5	22.7
Wabag	62	5	8.1	35	1	2.9	27	4	14.8
Wewak									
Total	**2175**	**189**	**8.69**	**1161**	**54**	**4.65**	**998**	**135**	**13.53**

Table 12. TB admissions and outcomes in 2018

PTB = Pulmonary tuberculosis EPTB = Extra-pulmonary tuberculosis

Hospital	Admissions	Deaths	Case fatality rate
Alotau	12	2	16.7
Angau	43	6	14.0
Buka	8	3	37.5
Daru			
Gerehu	13	0	0.0
Goroka	60	8	13.3
Kavieng			
Kimbe	5	2	40.0
Kerema			
Kompiam	5	1	20.0
Kundiawa	10	3	30.0
Mabisanda	1	0	0.0
Manus	9	2	22.2
Mendi	3	1	33.3
Modilon	32	5	15.6
Mt Hagen	136	10	7.4
Nonga	3	1	33.3
Popendetta	9	2	22.2
Port Moresby	172	35	20.3
Vanimo	0	0	0.0
Wabag	26	6	23.1
Wewak			
Total	**547**	**87**	**15.90**

Table 13. HIV admissions and outcomes in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	112	6	5.4
Angau	1245	100	8.0
Buka	118	16	13.6
Daru			
Gerehu	137	1	0.7
Goroka	702	61	9.0
Kavieng			
Kimbe	385	28	7.3
Kerema			
Kompiam	37	5	13.5
Kundiawa	581	45	7.7
Mabisanda	6	1	16.7
Manus	92	5	5.4
Mendi	337	18	5.3
Modilon	346	30	8.7
Mt Hagen	722	36	5.0
Nonga	361	25	6.8
Popendetta	200	25	12.5
Port Moresby	1938	203	10.5
Vanimo	252	9	3.6
Wabag	154	29	18.8
Wewak			
Total	**7725**	**643**	**8.32**

Table 14. Total neonatal admissions and outcomes in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	85	1	1.2
Angau	1119	71	6.3
Buka	93	66	71.0
Daru			
Gerehu	137	1	0.7
Goroka	253	23	9.1
Kavieng			
Kimbe	252	13	5.2
Kerema			
Kompiam	29	1	3.4
Kundiawa	351	8	2.3
Mabisanda	6	1	16.7
Manus	80	45	56.3
Mendi	283	8	2.8
Modilon	432	39	9.0
Mt Hagen	431	12	2.8
Nonga	320	16	5.0
Popendetta	154	19	12.3
Port Moresby	735	53	7.2
Vanimo	206	30	14.6
Wabag	105	16	15.2
Wewak			
Total	**5071**	**423**	**8.34**

Table 15. Neonatal infections in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	9	2	22.2
Angau	30	17	56.7
Buka	9	6	66.7
Daru			
Gerehu	0	0	0.0
Goroka	56	28	50.0
Kavieng			
Kimbe	161	62	39.8
Kerema			
Kompiam	0	0	0.0
Kundiawa	13	7	54.0
Mabisanda	0	0	0.0
Manus	3	0	0.0
Mendi	15	3	20.0
Modilon	30	8	26.7
Mt Hagen	16	4	25.0
Nonga	25	6	24.0
Popendetta	14	8	57.1
Port Moresby	127	52	40.9
Vanimo	12	3	25.0
Wabag	16	11	68.8
Wewak			
Total	**536**	**217**	**40.49**

Table 16. Very low birth weight (1000-1499g) admissions and deaths in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	18	5	27.8
Angau	226	39	17.3
Buka	22	9	4.9
Daru			
Gerehu	0	0	0.0
Goroka	459	36	7.8
Kavieng			
Kimbe	134	15	11.2
Kerema			
Kompiam	14	4	28.6
Kundiawa	62	9	14.5
Mabisanda	0	0	0.0
Manus	14	1	7.1
Mendi	50	11	22.0
Modilon	100	17	17.0
Mt Hagen	254	21	8.3
Nonga	68	8	12.9
Popendetta	52	6	11.5
Port Moresby	262	54	20.6
Vanimo	39	4	10.3
Wabag	38	6	15.8
Wewak			
Total	**1812**	**245**	**13.52**

Table 17. Perinatal asphyxia admissions and deaths in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	7	1	14.3
Angau	11	1	9.1
Buka	4	0	0.0
Daru			
Gerehu	0	0	0.0
Goroka	7	1	14.3
Kavieng			
Kimbe	1	1	100.0
Kerema			
Kompiam	1	0	0.0
Kundiawa	15	6	40.0
Mabisanda	0	0	0.0
Manus	1	1	100.0
Mendi	5	3	60.0
Modilon	3	0	0.0
Mt Hagen	2	0	0.0
Nonga	7	3	42.9
Popendetta	1	1	100.0
Port Moresby	24	6	25.0
Vanimo	0	0	0.0
Wabag	3	1	33.3
Wewak			
Total	**92**	**25**	**27.2**

Table 18. Cancer admissions and deaths in 2018

Hospital	RHD Admissions	RHD Deaths	RHD Case fatality rate	CHD admissions	CHD deaths	CHD case fatality rate
Alotau	7	2	28.6	16	2	12.5
Angau	2	0	0.0	33	2	6.1
Buka	6	1	16.7	22	3	13.6
Daru						
Gerehu	1	0	0.0	8	0	0.0
Goroka	13	0	0.0	9	3	33.3
Kavieng						
Kimbe	2	0	0.0	20	4	20.0
Kerema						
Kompiam	0	0	0.0	1	1	100.0
Kundiawa	4	0	0.0	14	1	7.0
Mabisanda	0	0	0.0	0	0	0.0
Manus	1	0	0.0	11	2	18.2
Mendi	2	0	0.0	3	2	66.7
Modilon	2	0	0.0	43	8	18.6
Mt Hagen	8	1	12.5	49	4	8.2
Nonga	3	0	0.0	40	15	37.5
Popendetta	5	0	0.0	25	3	12.0
Port Moresby	32	1	3.1	136	15	47.6
Vanimo	1	0	0.0	9	2	22.2
Wabag	3	1	33.3	37	3	8.1
Wewak						
Total	92	6	6.5	476	70	14.71

Table 19. Rheumatic and congenital heart admissions and deaths in 2018

Hospital	Admissions	Deaths	Case fatality rate
Alotau	0	0	0.0
Angau	18	4	22.2
Buka	0	0	0.0
Daru			
Gerehu	2	0	0.0
Goroka	2	0	0.0
Kavieng			
Kimbe	4	0	0.0
Kerema			
Kompiam	14	3	21.4
Kundiawa	21	0	0.0
Mabisanda	0	0	0.0
Manus	0	0	0.0
Mendi	1	1	100.0
Modilon	54	2	3.7
Mt Hagen	0	0	0.0
Nonga	0	0	0.0
Popendetta	59	12	20.0
Port Moresby	5	0	0.0
Vanimo	0	0	0.0
Wabag	15	7	46.7
Wewak			
Total	**195**	**29**	**14.9**

Table 20. Child protection admissions (physical abuse, sexual abuse or neglect) in 2018

Summaries of paediatric registrar research projects 2018

Cancer at Port Moresby General Hospital (Dr Benjamin Daur)

At Port Moresby General Hospital, between 2016 and 2018, 61 children with cancer were diagnosed. The mean time of diagnosis from first symptoms was 8 months, and the mean time from presentation to diagnosis was 9 days. Compared with earlier studies from 1998-2001 there has been an increase in retinoblastoma diagnoses and a decrease in the number of children diagnosed with lymphoma. The late presentation is a concern, and messages need to get out to health workers about the signs that could indicate childhood cancer: severe pallor, a lump, swelling of the abdomen, easy bleeding and progressive malnutrition. For retinoblastoma the early signs are leukocoria (white pupillary reflex), strabismus (squint) and eye inflammation or swelling which does not resolve with antibiotics.

Care seeking for children with pneumonia in Mendi (Dr Rose Hosea)

In Mendi, care seeking behaviour of the parents of 100 patients with pneumonia (53) or diarrhoea (43) or both (4) was assessed. 70% were infants. Many parents sought hospital treatment more than 24 hours after onset of illness despite the fact that most of them reside within an hour from the hospital. Most parents who delayed care did so thinking that the symptoms were not serious, and waited at home for them to subside. The presence of more than one symptom of illness seemed to be a motivating factor to seek care, believing that indicated increased severity of illness. Some parents had false beliefs about the cause of diarrhoea, believing it was normal phase in child development, rather than an infection or illness.

Waiting times in the Emergency Department (Dr Heagi Lovai)

At Port Moresby General Hospital Children's Emergency Department waiting times for 164 patients was assessed. A 5-tier classification of triage category is used, but there is not consistency of classification between health care workers. Average overall waiting time was 119 mins, 96% of patients in category 1 (the most severe) and 2 waited longer than specified by the Australasian Triage criteria. There is a need to use a triage classification system that is easy to understand, such as WHO's triage system, and a need to improve staffing in the children's emergency department, including more nurses and specialist paediatric cover to support the registrars.

Nebulised saline for bronchiolitis (Dr Gordon Pukai)

In a randomised trial in the Port Moresby General Hospital Emergency Department, children under 2 years of age with bronchiolitis were given either nebulisation with normal saline (x 3 over 4 hours) in addition to standard treatment (oxygen if SpO2<90%, antibiotics, minimal handling) or standard treatment alone. A change in Respiratory Distress Score, hypoxaemia and admission were the main outcomes. The 2 groups were similar to begin with, in terms of RDS and oxygen saturation. There was a significant difference in the change in RDS at 4 hours between the 2 groups. Among the 100 that received Normal saline, the mean RDS fell by 3.41 (95% CI 3.0-3.8), where in the Standard group the RDS fell by only 1.96 (95% CI 1.5-2.4). P-value <0.0001. There was a significant difference in the change in SpO2 between the 2 groups. Among the 99 children who received standard therapy the SpO2 increased by 4% (95% CI 2.8-5.2) to a mean SpO2 of 87.5% at 4 hours, and among the 100 who received normal saline the SpO2 increased by 7% (6.0-7.9) to a mean SpO2 of 90.7% at 4 hours. There was a significantly higher discharge rate in those who received Normal saline. 58 of 100 (58%) were discharged, whereas only 24 of 99 (24.2%) who received Standard care were discharged (p<0.001)

Rheumatic heart disease (Dr Veronica Kalit)

48 children with rheumatic heart disease were involved in a longitudinal cohort study, using quantitative and qualitative methods to understand the child's and the family's perceptions of their condition, and secondary prophylaxis. These children had quite severe RHD, with 31 having moderate-severe mitral regurgitation, 20 having moderate-severe aortic regurgitation, and 31 on anti-heart failure medications. There were 4 deaths in the follow-up period, including 2 sudden deaths immediately after injections of benzathine penicillin in children with severe heart failure. The deaths lead to a change in secondary prophylaxis at Port Moresby General Hospital: from predominantly benzathine penicillin to daily oral penicillin V.

Follow-up of low birth weight babies (Dr Maylin Kariko) **[NEXT PAGE]**

A follow-up study was conducted for 81 low birth weight babies recruited from the Special Care Nursery at Port Moresby General Hospital. The mean birth weight was 1495 g, and the mean gestational age was 34 weeks, meaning these babies were significantly small for gestational age, as well as being preterm. The median length of stay was 19 days, and discharge weight was 1.54kg. There were 16 known deaths: 13 while in hospital and 3 after discharge. Many were lost to follow up. 39 were followed up at a median of 9 months chronological age. The majority of the babies followed up were very well nourished with a weight-for-length z-score of -0.3, and good head growth. 47% had some degree of gross motor developmental delay. 15 (38%) had admissions to the children's ward, mostly for respiratory and gastrointestinal infections, which highlights the increased vulnerability to community acquired infections in this population.

Anaemia in children in Kimbe (Dr Elizabeth Longe)

In Kimbe 214 children with anaemia (median Hb 6.72 g/dL) were studied. 14 children had a history of chronic illness, including pulmonary tuberculosis (6 cases previously diagnosed), HIV, hypothyroidism and cerebral palsy (1 each). Rapid diagnostic tests for malaria were done in 213 children: 133 were negative, 33 were positive for plasmodium falciparum, 43 were mixed, and 4 were plasmodium vivax. 179 children were followed up and had a repeat Hb 5 months after first presentation. The mean change in Hb for the 179 children was 4.07 (SD 2.51) g/dL. Five children died from malignancies (AML and retinoblastoma), severe malaria, HIV and severe malnutrition and meningitis. The mortality rate for severe anaemia can be low if Standard Treatment is followed and comorbidities are identified and treated.

Epilepsy in children in Port Moresby (Dr Casparia Mond)

47 children with epilepsy were studied over nearly 2 years at Port Moresby General Hospital, the median age was 6.5 years. 21 (45%) had normal development, and 26 (55%) had some developmental delay. Most children had generalised tonic-clonic seizures or complex partial seizures. Over 20 months of close follow up and adjustment of medications, the proportion of children with good control (less than 4 seizures per month) increased (73% at baseline and 92% good control at 20 months). Frequent stock-out of phenobarbitone and financial challenges faced by parents affected the child's seizure control. For the children with epilepsy, stigma and discrimination affected the quality of their lives.

Multi-drug resistant tuberculosis in children (Dr Vela Solomon)

50 children with multi-drug resistant TB were described at Port Moresby General Hospital. The numbers of children diagnosed from 2004 have increased each year. These children came from National Capital District, Central and Gulf Provinces, and Daru. 38 (76%) had previously undergone treatment for drug-sensitive TB, and 31 had completed this treatment. A contact source for drug-resistant TB was identified in 25 children, and in 10 children the contact was the child's mother. The median length of illness until diagnosis was 7 months, but many children had received multiple courses of DS TB and other treatments, either complete or partial. 35 children had confirmation of rifampicin resistance on GeneXpert testing, and 15 were diagnosed on clinical grounds alone. 16 were TB culture positive, and drug resistance patterns were identified in 15 of these.

Prevention of parent to child transmission (Dr Paul Wari)

A descriptive study was done to assess the outcomes of children exposed to HIV in the Prevention of Parent to Child Transmission Programme at the Well Baby Clinic of Port Moresby General Hospital. 135 children were followed. All received zidovudine for the first 6 weeks of life, and 118 received nevirapine. 58 were exclusively breast fed, 25 formula fed, 40 mixed fed, and in 12 the feeding method was unascertained. 95 received isoniazid prophylactic therapy. 14 (10%) had a positive HIV-PCR test at 6-8 weeks of age. Two thirds (90/135) did not have any follow-up testing at 6 or 18 months and nearly 2/3 were lost to follow-up by 18 months (85/135). 6 were known to have died. There has been a deterioration in PPTCT and HIV services for children since the loss of funding and coordination by the CHAI PNG, leading to high rates of loss to follow up and inadequate testing being done.

Paediatric monitoring and response chart

Name

UR Number | Age: | Weight: | Length / height

Diagnoses: | Frequency of observations:

Date			
Time			
	Temp °C	≥ 39	>39
		38-38.9	38-38.9
		36-37.9	36-37.9
		<36	<36
AIRWAY / BREATHING	Respiratory Rate (bpm)	≥ 80	≥ 80
		70	70
		60	60
		50	50
		40	40
		30	30
		20	20
		10	10
		0	0
	SpO_2 (%)	95-100	95-100
		90-95	90-95
		80-90	80-90
		70-80	70-80
		<70	<70
	Oxygen	L/min	L/min
	Respirat distress	Severe	Severe
		Mod.	Mod.
		Mild	Mild
		Normal	Normal
CIRCULATION	Heart rate (bpm)	≥ 200	≥ 200
		190	190
		180	180
		170	170
		160	160
		150	150
		140	140
		130	130
		120	120
		100	100
		90	90
		80	80
		70	70
		60	60
		<60	<60
	Cap refill	≥ 3 secs	≥ 3 secs
		< 3 secs	< 3 secs
	BP	Systolic	Systolic
		Diastolic	Diastolic
		Mean	Mean
DISABILITY	AVPU response to stimuli	Alert	Alert
		Verbal	Verbal
		Pain	Pain
		None	None
	Pain score (/10)		Pain
Blood sugar level			
Treatments given Actions taken			