PNG Department of Health

Child Morbidity and Mortality

12th Annual Report, 2021

PNG National Department of Health

Paediatric Society of Papua New Guinea

2021 Annual Report on Child Morbidity and Mortality

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

Acknowledgements:
We gratefully acknowledge all paediatricians, nurses and other health care workers in all participating hospitals who reported their hospital's data.

Data compiled by Edilson Yano, Paediatric Surveillance Officer and PHR coordinator
Edited by Prof Trevor Duke
Graphs by Eleanor Neale
Forward by Dr James Amini, Chief Paediatrician

We are grateful to the Australian Department of Foreign Affairs and Trade for their support to this program.

May 2022

2021 Annual Report on Child Morbidity and Mortality

FORWORD by the Chief Paediatrician

It gives me great pleasure to write the forward for this excellent Annual Report for 2021.

The Annual Reports on Child Morbidity and Mortality have been produced since 2009 and this report marks 12 years of this reporting through many versions to what we are up to now.

Twelve years gives a lot of useful data of trends in morbidity and mortality and helps us in planning for areas for improvement.

We have improved over these years in reporting, with a handful of Provincial Hospitals reporting in 2009, this year with 18 health facilities participating, a bit less than last year with 24.

Overall, our admissions have been increasing and our mortality rates have decreased gradually. Our case fatality rates for most diseases have generally improved with special mention of some neonatal conditions, and severe malnutrition. In 2021 our severe pneumonia mortality rates are a little higher, and this may be because of the disruptions from COVID, which we have to respond to.

Over the years, our plans for improvement have been guided by this data and the results in this report show that. The Paediatric Society of PNG has initiated programs to improve our outcomes, and these are proving successful.

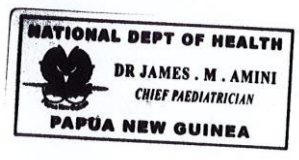
As a way forward, the Paediatric Society will achieve further improvement in our outcomes with a **National Paediatric Quality Improvement Program** and the many initiatives described in the **Child and Adolescent Health Policy and Plan 2021-2030**. As a Society, we want to ensure that quality care is given even in resource limited settings to all children of this country.

Let me acknowledge all my fellow Paediatricians and colleague health workers who contribute to the data collection. Edilson Yano has been our constant worker helping to put together the data. Lastly but not the least, Prof Trevor Duke who edits and produces this report – our deepest appreciation for the service you provide this country of ours.

I hope this report gives useful information to all health workers and administrators both in the province and nationally to improve child health services together with our second and revised Child Health Plan 2021-2030, that we hope to launch before the end of the year. In our last NHP 2011-2020 KRA 4, I believe we have achieved much and as we go forward with the new NHP 2021-2030 that the recommendations from this report can be the cornerstone for child health services in PNG.

In 2022 we are dealing with the ongoing COVID-19 pandemic and its aftermath, but we will get through it if everyone works together, supports each other, and gets vaccinated.

Dr James M Amini
Chief Paediatrician
President, Paediatric Society of Papua New Guinea



2021 Annual Report on Child Morbidity and Mortality

Executive summary

This report covers admissions and outcomes for children in 2021 from 18 hospitals.

The COVID-19 pandemic and effect on health services

2021 was the second year of the pandemic, where health services, especially in the second half of the year, were overwhelmed by COVID cases, and ran short of basic treatments, especially oxygen. This has an impact on child health outcomes and may account for the higher-than-expected case fatality rate for pneumonia in 2021.

These data were compiled in this difficult environment, and it is a credit to the paediatricians, nurses, and HEOs in charge of wards that they have kept these records at this time.

In 2022 it remains important to **get routine health services for children back on track**, including childhood immunisations, and all Maternal and Child Health (MCH) services.

Children have not been as directly affected by Covid-19 infection as adults, but the newer variants, especially Omicron has led to many children, adolescents and young adults becoming unwell with Covid-19. Guidelines for health care workers on Covid-19 in children are available at www.pngpaediatricsociety.org scroll down to the bottom of the page. A link to other useful WHO resources on COVID-19 can also be downloaded there.

Report main points

- In 2021 there were 29,485 admissions and 1582 deaths recorded (mortality rate 5.4%). This is a continuation of improvement in mortality rates, compared with a decade ago.
- In 2021 there were 858 post-neonatal deaths out of a total of 17,193 patients (CFR 4.9%) and 726 neonatal deaths out of 12292 patients (neonatal CFR 5.9%).
- Pneumonia was again the most common reason for admission (4967, 16.8% of admissions). Pneumonia case fatality rates were 4.2% overall and 9.2% for severe pneumonia. These are slightly higher than in 2020 and 2019 and may reflect the effect of the Covid-19 pandemic, especially the jeopardisation of oxygen supplies during the worst months of the Covid-19 surge.
- 41% of all admissions were in the neonatal period and accounted for 46% of all childhood deaths. The leading causes in neonates were combinations of neonatal sepsis, birth asphyxia, and very low birth weight.
- Severe malnutrition was present in 2514 admissions (8.5% of admissions). Malnutrition caused or contributed to 256 deaths (16% of all deaths). Case fatality rates (overall 10.2%) for severe malnutrition shows a sustained improving trend over the last 6 years. This is close to the World Health Organization target of under 10%. Many additional children had moderate malnutrition.
- This year there were 1235 children admitted with chronic non-communicable illnesses – asthma, chronic lung disease, rheumatic and congenital heart disease, epilepsy and cerebral palsy, and cancer. There were 158 deaths; these conditions, although making up only 4% of all admissions, caused 10% of all

paediatric deaths. More awareness of how to care for such children in hospitals and in communities is needed.

In response to the PHR results for 2021, the Child Health Advisory Committee of the National Department of Health has made the following recommendations:

To achieve further improvements, The Paediatric Society has initiated a **National Paediatric Quality Improvement Program**. 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.
- More paediatric nurses being trained
- Training on the care of seriously ill children, through the WHO Hospital Care for Children program
- Continuing medical education (CME) for paediatricians and paediatric nurses
- Establishment of intensive care areas in the paediatric wards for the care of the sickest children
- Paediatric monitoring and response charts with early warning indicators and escalation processes
- Infection control and antibiotic stewardship
- Improved systems for managing children with chronic conditions
- Improved diagnostics, especially diagnostics to guide antibiotic use

Tools for Quality Improvement are available at:
https://pngpaediatricsociety.org/quality-improvement/

Decreases in deaths from **severe pneumonia** requires both 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* 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, newborns should have 4% chlorhexidine applied to the umbilical cord.

Better care for very low birth weight babies, those with 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 partographs 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. 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. By addressing these steps, the CFR for severe malnutrition has come down from 18-24% to just over 10%, a big improvement in the last decade.

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. Third generation cephalosporins - ceftriaxone or cefotaxime - are effective antibiotic to treat meningitis.

Tuberculosis caused 6.6% of all admissions in 2021. 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.

In the last 3 years there has been an encouraging decrease in the number of admissions of **children living with HIV**. This may reflect the improved treatments available with Dolutegravir-based antiretroviral therapy. More children living with HIV are remaining healthy and being treated as outpatients. And it may reflect better prevention of parent to child transmission of HIV. However, the persisting deaths from malnutrition are a reminder to always think of HIV in any malnourished child and do an HIV test.

There are more children with **chronic diseases**, including asthma, chronic lung disease, epilepsy, rheumatic and congenital heart diseases, cerebral palsy and neurodevelopmental problems, thalassaemia, 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. Increasingly important is adolescent health, including preventative and mental health issues.

The National Child Health Plan outlines a plan for improving child health up to 2021, and a revised plan is completed for 2021-2030. 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

2021 Annual Report on Child Morbidity and Mortality

Introduction

The Child Health Advisory Committee of the National Department of Health releases the 12th Annual Report on Child Morbidity and Mortality in Papua New Guinea, for 2021. 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 2021, with some comparisons to data collected in the previous 11 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.

There have been several versions of the PHR, we are now up to V12.2, but not all hospitals were using the latest version in 2021. That is not a problem as the data for the common diagnoses are consistent between versions and therefore comparable. However, some less-common diagnoses only included in V12.2 are not reported by all hospitals.

Version 12.2 has a maternal component. In future years labour obstetric departments may report summary data from their labour and maternity wards on outcomes for mothers and deliveries.

A note on the method of the graphs in this report: the graphs of case fatality rates per year are *weighted averages*, rather than proportions of the aggregate raw data for all hospitals combined for each condition. The use of weighted averages is more valid for looking at time trends in outcomes, as different hospitals report different numbers of cases and deaths, and different numbers of hospitals have reported data each year. Weighted averages take this into account and enables year-on-year comparison as smaller district hospitals or health facilities contribute PHR data in the future.

Mortality rates for common diseases

Despite the disruption from the pandemic the overall case fatality rate (CFR) in 2021 of 5.4% continues the lower trend from last year (5.8%), and lower than in the previous 10 years, see figure 1 and table 1.

Case fatality rates vary widely, often related to the level of the health facility (smaller rural hospitals have much lower CFR, larger referral hospitals have higher CFR, related to referral bias and complexity). Differences in CFR can reflect many factors, including case mix (the types of illnesses seen in different hospitals), the severity of illness at the time of presentation (if children with severe illness present late, they have a higher risk of death), 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 falls in overall CFR and the CFRs for pneumonia and malnutrition in the last 5 years are real progress.

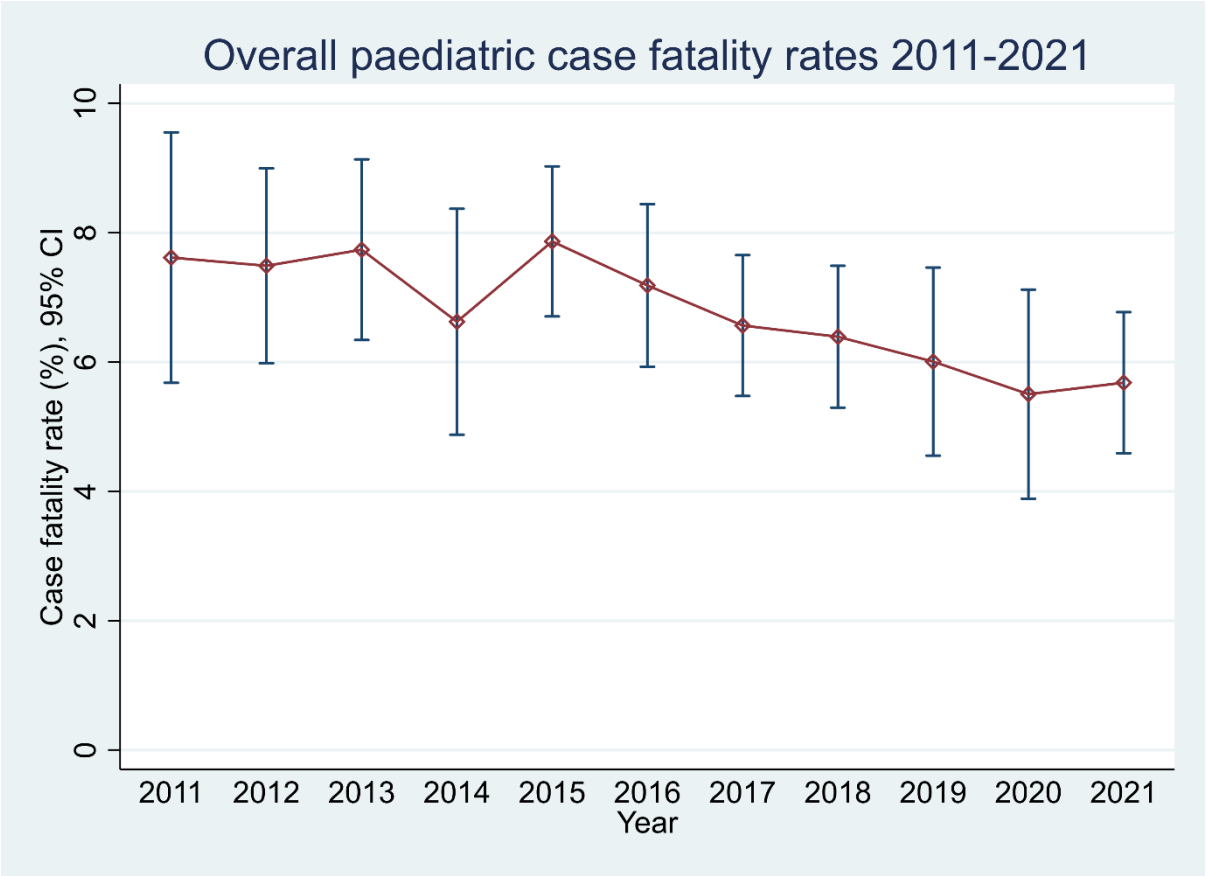


Figure 1. Overall paediatric case fatality rates 2011-2021

2020	**Paediatric admissions**	**Paediatric deaths**	**Case fatality rate**
Alotau	977	20	2.05
Angau	3072	193	6.28
Buka	468	29	6.20
Chuave			
Daru			
Gembogl			
Gerehu	854	7	0.82
Goroka	1745	138	7.91
Kainantu			
Gumine			
Kavieng	608	32	5.26
Kimbe	1079	102	9.45
Kerema			
Kerowagi			
Koge			
Kompiam	743	35	4.71
Kundiawa	1349	71	5.26
Kudjip			
Mabisanda			
Lorengau			
Mendi	1449	128	8.83
Mingendi			
Modilon	1863	131	7.03
Mt Hagen	4284	175	4.10
Nonga	991	77	7.77
Popendetta			
Port Moresby	6593	268	4.06
Rumginae	53	1	1.89
Tari	1012	67	6.62
Vanimo	359	17	4.74
Wabag	1009	71	7.03
Wewak			
Yampu			
Total	**29,485**	**1582**	**5.37**

Table 1. Summary of admission, death, and case fatality rates in participating hospitals in 2021

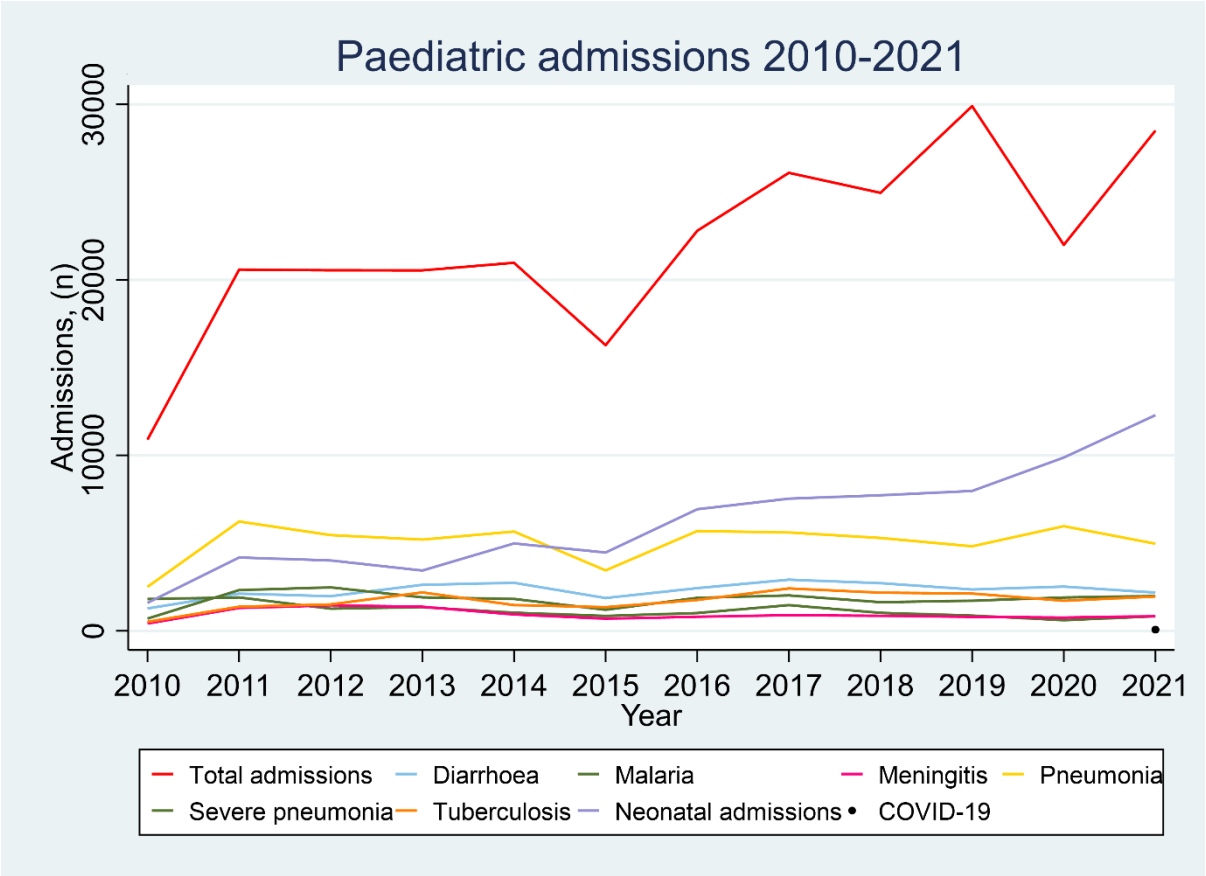


Figure 2. Admissions per year overall and for common acute infections

Despite more hospitals participating in the PHR and more patients being reported the number of cases of common infections has remained static or in some cases declined. This indicates partly the effectiveness of measures to reduce pneumonia, malaria and diarrhoea, the increased proportion of neonatal admissions, and the increase in chronic conditions.

Diagnoses	Admissions 2021	Deaths 2021	Case fatality rate 2021	Average CFR 2009-2021
All paediatric admissions	29485	1582	5.4	6.83
Pneumonia	4967	211	4.2	4.40
Severe pneumonia	1984	183	9.2	10.38
Neonatal conditions	12292	726	5.9	8.23
Diarrhoea	2179	91	4.2	4.31
Malaria	829	34	4.1	4.43
Severe malnutrition	2514	256	10.2	15.43
Tuberculosis	1953	156	8.0	10.09
Meningitis	836	104	12.4	16.91
HIV	384	61	15.9	15.23
Anaemia	2184	277	12.7	12.71
Rheumatic heart disease	170	15	8.8	10.52
Congenital heart disease	466	64	13.7	17.30
Measles	3	0	0.0	2.95
Cancer	138	39	28.3	30.80
Tetanus	10	2	20.0	17.57
Acute flaccid paralysis	21	4	19.0	4.96
Whooping cough	33	0	0.0	0.84
Child protection	127	30	23.6	17.93
Trauma and injuries	331	3	0.9	1.06

Table 2. Most common causes of hospital admission and case fatality rates in children for 2021

Note: some diagnoses added recently, so CFRs do not reflect the complete 10 years of reporting.

Pneumonia

In 2021 as in all years, pneumonia was the most common reason for admission (4967 cases: 16.8% of all admissions). Pneumonia case fatality rates in 2021 were 4.2% overall (Figure 3), and 9.2% for severe pneumonia (Figure 4).

These CFRs are higher in 2021 than in the previous year (3.1% and 7.7% respectively in 2020) and the increase in pneumonia mortality in 2021 is possibly influenced by the Covid pandemic. There were 68 known cases of Covid pneumonia and 6 deaths, but many hospitals were not able to test regularly, so many cases may have been missed.

Previously the case fatality rate for severe pneumonia was higher than 10%, and up to 20% or more in many hospitals.

This improvement over time is due to many things: better clinical care, use of oxygen concentrators and pulse oximetry, vaccines against *Haemophilus influenzae* type b and *Streptococcus pneumoniae*, and changes in epidemiology with more viral bronchiolitis.

Using the current version of the PHR in 2021 many hospitals reported bronchiolitis separate to pneumonia. In 2021 there were 699 cases of bronchiolitis and 9 deaths reported (CFR 1.3%). So, the reduction in pneumonia CFR remains significant, as previously these cases of bronchiolitis would have been included in pneumonia numbers.

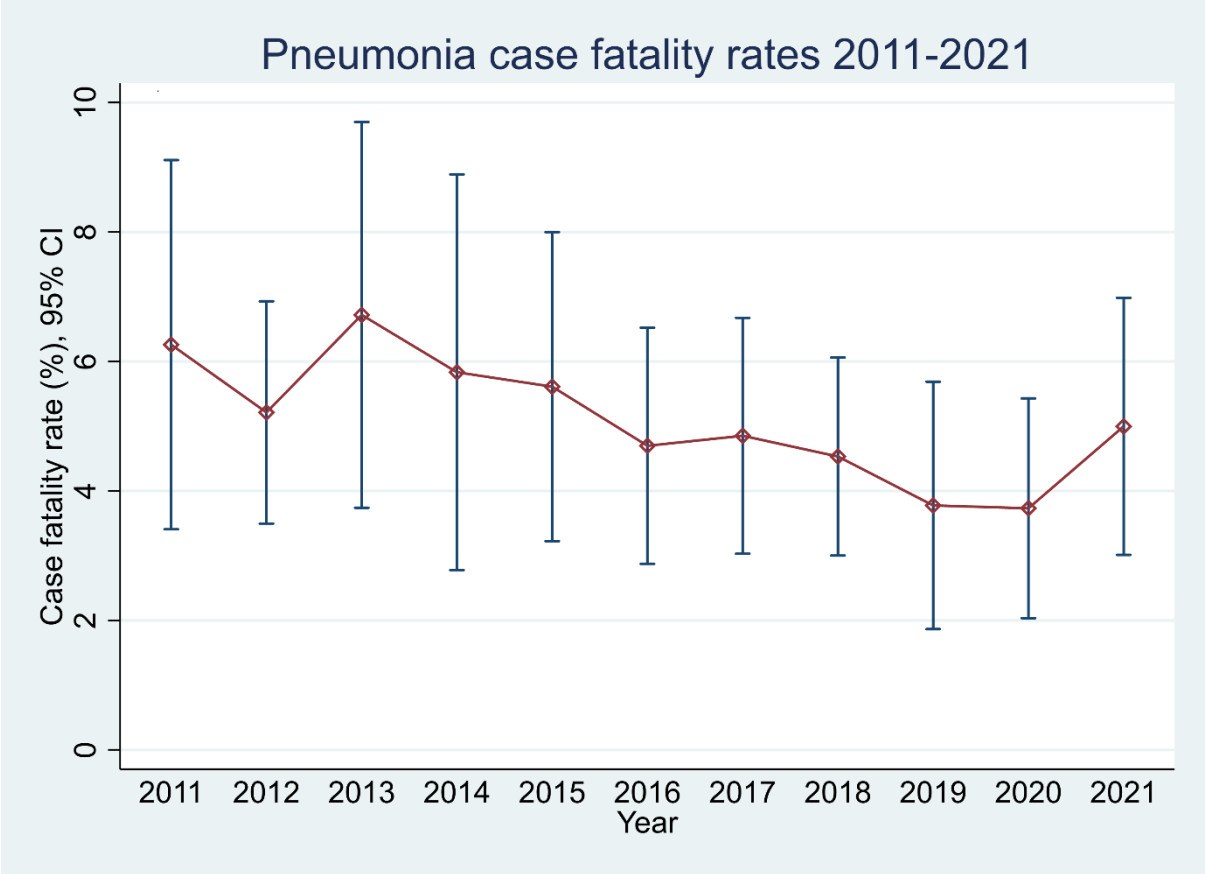


Figure 3. Pneumonia case fatality rates 2011-2021

Severe pneumonia case fatality rates, which 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.

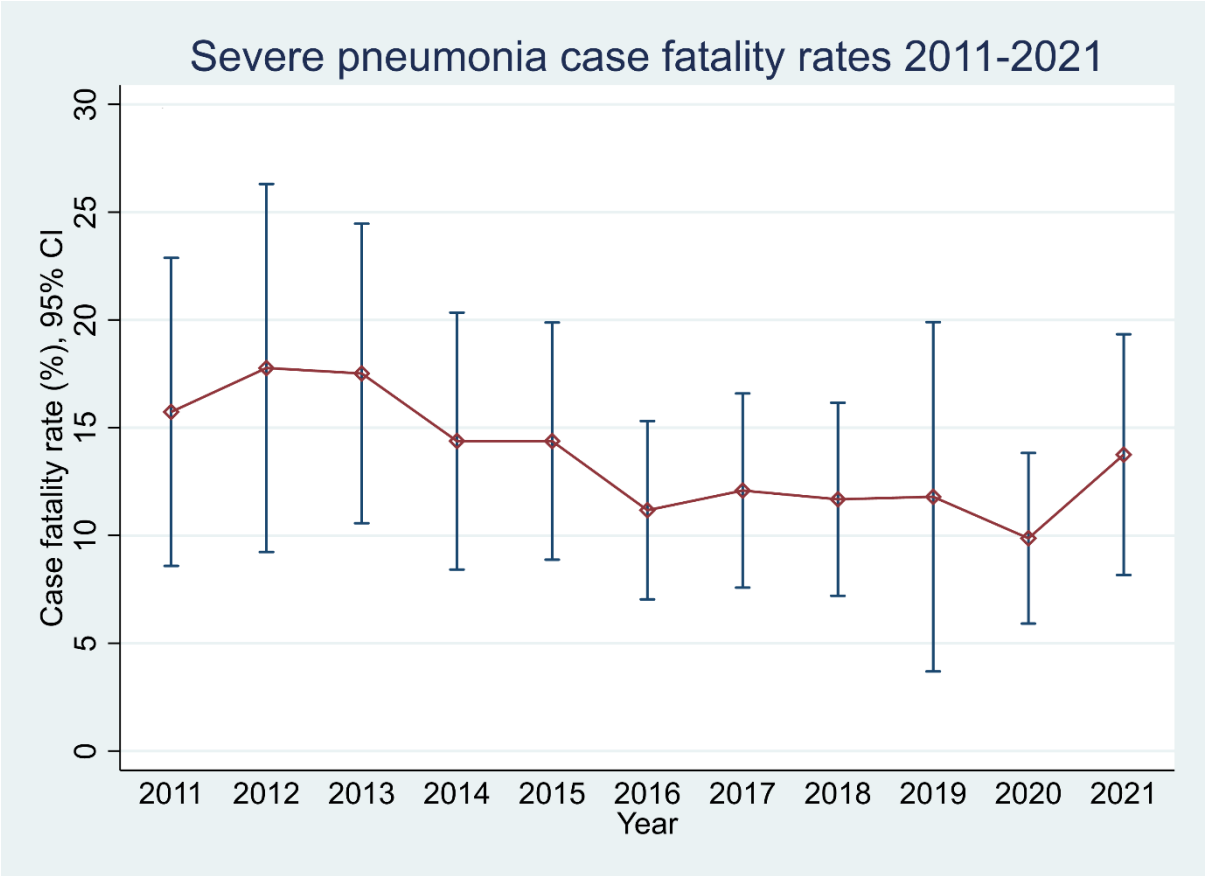


Figure 4. Severe pneumonia case fatality rates 2011-2021

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 always provide clinical care
- supervision of nursing and medical care by senior clinicians

Deaths from pneumonia (211 – higher than in 2020) and meningitis (104 – lower than in previous years) combined account for 19.8% of all deaths. This emphasises the importance of *Hemophilus influenzae* type b vaccine (Hib) – given as part of Pentavalent vaccine, and the pneumococcal conjugate vaccine (PCV); both vaccines

given at 1, 2 and 3 months. These vaccines are preventing deaths and disability from bacterial meningitis and are reducing cases of pneumonia. So, coverage needs to be strengthened. And improving BCG coverage will reduce pneumonia and meningitis from tuberculosis.

However, there are other common causes of pneumonia, including viruses (particularly respiratory syncytial virus - RSV, influenza, and COVID-19) and bacteria (such as Group A streptococcus, *Staphylococcus aureus*, Chlamydia, Mycoplasma), and other causes of meningitis (enterovirus, dengue and other mosquito-borne viruses), which are not all currently prevented by vaccines.

This means that these pneumonia and meningitis will continue to be a major cause of hospital admission for children in PNG.

The best way to address this with a comprehensive approach. The PNG Child Health Plan 2021-2030 outlines a comprehensive approach to 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.
- Handwashing
- Vaccines: measles, Hib, PCV, BCG, COVID-19

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.

Keeping the paediatric service going in Manus

In Lorengau General Hospital where there are no paediatricians - the nurses, HEOs, and registrar keep the paediatric service going. This picture was taken after their morning ward round. In the picture is the sister-in-charge of COPD and Children's ward, Dr Waine the paediatric registrar, a nurse, and two HEOs.

Diarrhoea

2179 cases and 91 deaths (case fatality rate of 4.2%) due to diarrhoea were reported in the 18 hospitals in 2021. Diarrhoea mortality rates are dependent on many factors - like 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, the appropriate use of antibiotics in bloody diarrhoea, and by reducing undernutrition.

Most watery diarrhoea in otherwise well children is due to viruses and does not require antibiotics. These children need ORS, zinc and nutrition (breast feeding in infants). 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 (Septrin) 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).

In 2021 there were 286 children admitted with dysentery, and 7 deaths, which means most diarrhoea deaths (84/91) are not due to bloody diarrhoea.

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.

Typhoid

Many typhoid cases were reported in 2021: 567 in total, with 3 reported deaths from typhoid. Most of these cases were from major highlands hospitals: Mt Hagen (301 cases), Goroka (87) and Kundiawa (54).

Multi-drug resistant typhoid has increased in countries throughout Asia in the last 10 years. Although there is limited resistance data from PNG, the recommended treatment for proven or suspected typhoid is fluroquinolones (ciprofloxacin). Third generation cephalosporins, and azithromycin are also options.

Malaria

In 2021 malaria accounted for 829 admissions and 34 deaths (case fatality rate of 4.1%). This is an increase on last year, but still less than malaria case numbers that were reported in years before 2018. Cases of malaria may be increasing again, because of waning use of insecticide-treated bed nets and other public health protective measures.

Year	Cases	Deaths	CFR
2021	829	34	4.1
2020	617	32	5.2
2019	872	42	4.8
2018	1026	43	4.2
2017	1465	56	3.8
2016	1015	46	4.5
2015	852	44	5.2
2014	1033	67	6.5
2013	1347	70	5.2
2012	1263	69	5.5
2011	1904	61	3.2
2010	1814	50	2.8

Table 3. Malaria admissions and case fatality rates 2010-2021

PNG 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, 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 2021 in the 18 hospitals that reported using the PHR, 2514 children were admitted with severe malnutrition

(weight for age <3 SD below the median), or with severe wasting or kwashiorkor. This represented 8.5% of all admissions, stable on previous years.

The case fatality rate for severe malnutrition was 10.1%, comparable to 2019 (10.4%) and 2020 (10.8%), and lower than in earlier years of the PHR reporting where CFR was 15-20% or above (Figure 5 and Table 3).

This shows that there has been a sustained 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.

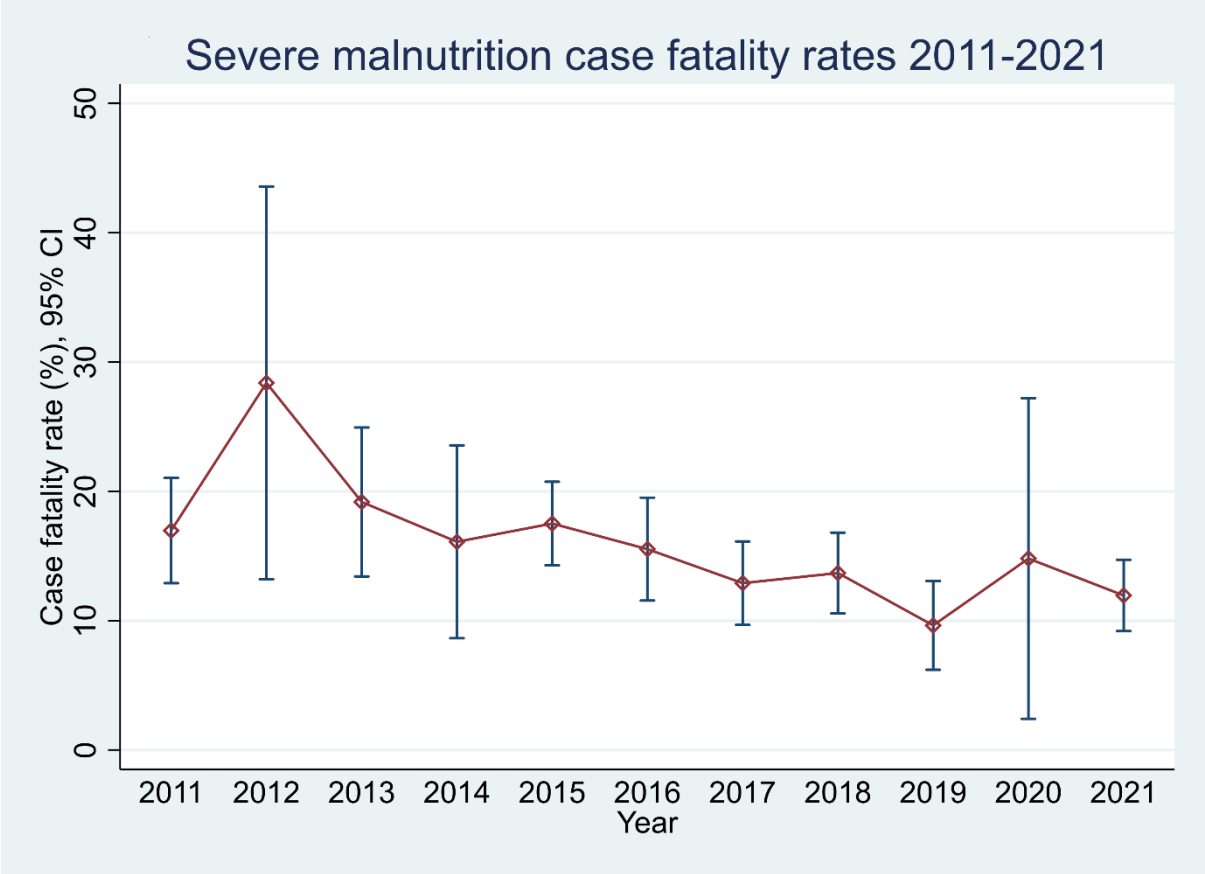


Figure 5. Severe malnutrition case fatality rate 2011-2021

Year	Number admissions	Percentage of all admissions	Deaths	CFR	Number of hospitals with CFR >20%
2011	1544	7.50	287	18.6	3
2012	2590	12.61	604	23.3	4
2013	3379	16.50	524	15.5	4
2014	2861	13.64	455	15.9	4
2015	2338	14.36	438	18.7	4
2016	2635	11.56	438	16.7	4
2017	3049	14.0	483	15.8	2
2018	2548	10.21	315	12.4	3
2019	2411	8.06	250	10.4	1
2020	2377	7.27	257	10.8	1
2021	2514	8.52	256	10.1	0

Table 4. Cases and outcomes of children with severe malnutrition 2011-2021

In the last 3 years we also report moderate malnutrition, because as improvements occur, a greater focus is needed on other types of under-nutrition, including moderate malnutrition, under-nutrition in adolescents, nutritional anaemia.

In 2021 1759 children were reported with moderate malnutrition, and there were 118 deaths (CFR 6.7%), which is just higher than the death rate overall for children (5.3%). This will be an underestimate of the numbers of cases of moderate malnutrition, as only 13 of the 18 hospitals were using the PHR version which includes moderate malnutrition, and moderate malnutrition will be an under-recognised condition because it is so common. However, recording a problem is a start to improving the recognition of it. Better approaches to children with moderate malnutrition will prevent more children developing severe malnutrition.

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). If F75 and F100 are not available, there are **recipes for making equivalent formula** at https://pngpaediatricsociety.org/treatment/ in the section: **Undernutrition – guidelines and tools for management**.

- 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 used in all wards. 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 should have the highest priority. This requires improved rates of breast feeding and complementary (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 836 admissions and 104 deaths. The case fatality rate for meningitis was 12.4%.

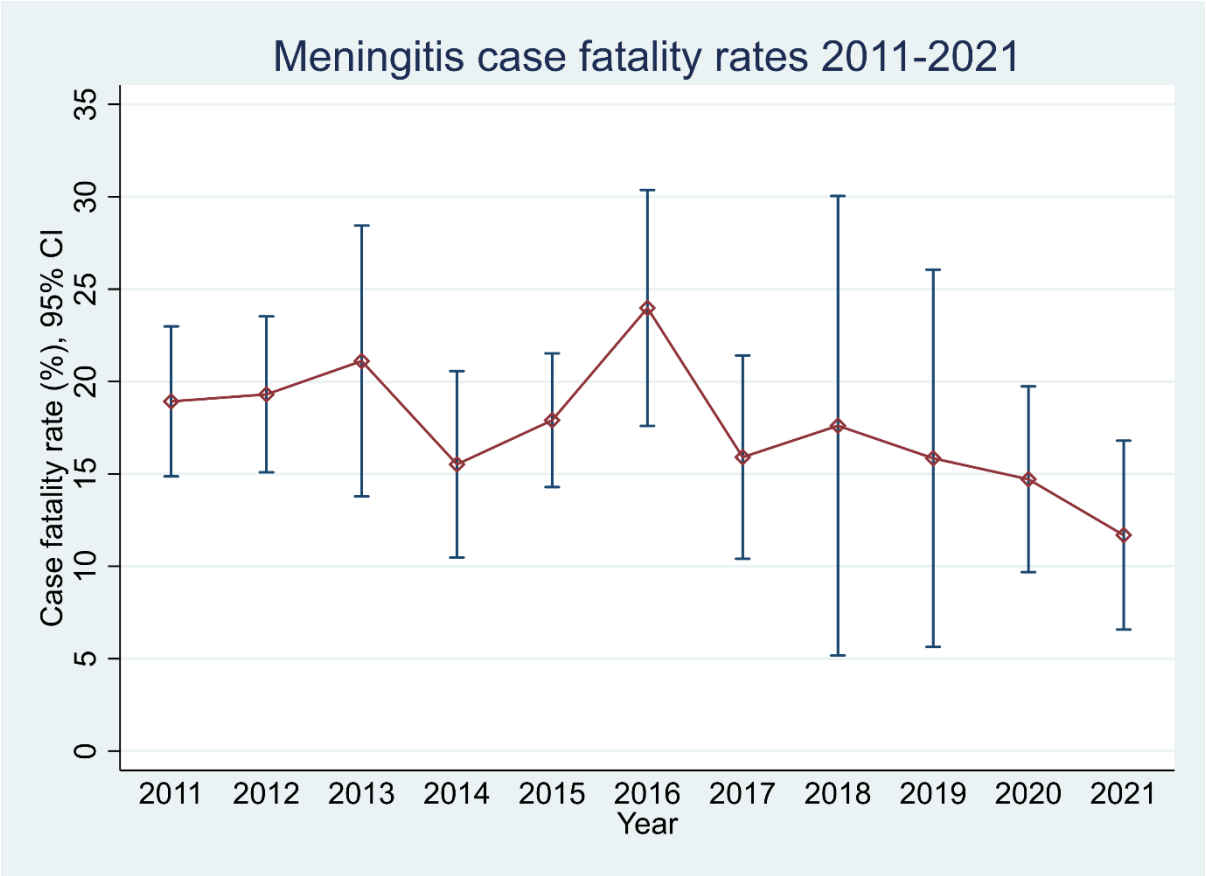


Figure 6. Meningitis case fatality rates

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 (Pentavalent) and pneumococcal (PCV) vaccines. Cases of Haemophilus influenza and pneumococcal meningitis are still being reported in 2021, which indicates that the vaccines are not yet reaching all children.

Most Hib and *Streptococcus pneumoniae* 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 enterovirus, dengue, Japanese encephalitis, herpes viruses, and 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 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 to 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 children with meningitis. 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.
- Consider the diagnosis of TB meningitis if a child is not improving, or if the history is suggestive (prolonged history, malnutrition, contact with a case of active TB). If uncertain, refer, or commence TB treatment.
- Do a CT scan if you can if the child remains poorly conscious after 48 hours of treatment for bacterial meningitis.

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 outpatient 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 <92%
- 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 Hartmann solution, 20ml/kg, then reassess.

- Promptly give IV or IM antibiotics: ceftriaxone plus flucloxacillin
- 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 blood sugar level (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.

Tuberculosis

In the 18 hospitals in 2021 there were 1953 children admitted with tuberculosis, and 156 deaths and a case fatality rate of 8.1%. The number of admissions for TB is higher than in 2020, especially considering that fewer hospitals reported (24 in 2020) (Figure 7).

Year	Cases of TB	Total admissions	% of admissions
2017	2417	23272	10.4%
2018	2175	24960	8.7%
2019	2125	29901	7.1%
2020	1819	32755	5.6%
2021	1953	29485	6.6%

Table 5. Cases of TB as a proportion of all admissions 2017-2021

Whether this represents a reduction of this magnitude or is related to other ascertainment or confounding factors is hard to determine. The apparent reduction may relate to more accurate diagnoses in 2019-2021, or more children being managed in the community and not being admitted, or the inclusion in the PHR program of smaller hospitals less likely to diagnose TB. However, it could represent a true better control of endemic TB in the community, thanks to the work of the National TB Program, the adult TB health workers, communities mobilised to identify and treat TB and partners.

The case fatality rate for both paediatric pulmonary and extra-pulmonary TB is stable, with extrapulmonary TB having more than twice the case fatality rate as pulmonary TB.

Pulmonary TB made up 54% of all TB diagnoses. 359 children (18% of all cases of TB, and 42% of the extra-pulmonary tuberculosis) had central nervous system TB, which has the highest case fatality rate (15.3%). There were 23 cases of MDR TB reported, again an underestimate as not all hospitals are testing or reporting, but it is important in the future we record this accurately.

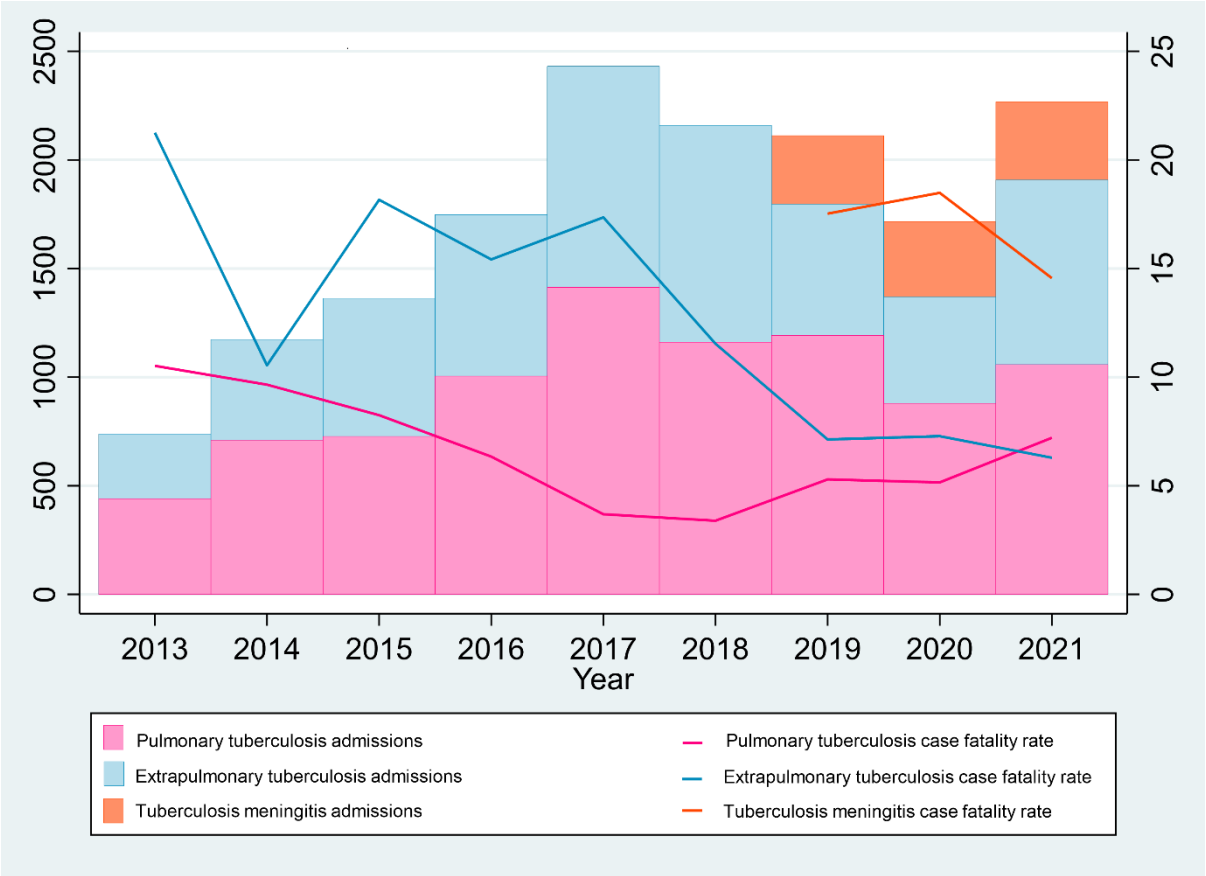


Figure 7. Pulmonary and extra-pulmonary tuberculosis admissions and case fatality rates 2013-2021

This numbers represented in this report may be a 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.

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 x-ray 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 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 2021 there were 384 children with HIV admitted to the hospitals, and 61 known HIV-related deaths (case fatality rate of 15.8%). This may be a trend pointing to better treatment of children living with HIV.

Year	Admission of children with HIV	Deaths in children with HIV
2016	532	86
2017	545	89
2018	547	87
2019	389	48
2020	479	82
2021	384	61

Table 6. Cases and deaths of paediatric HIV 2016-2021

The numbers represent only cases that were admitted to hospitals 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.

In the past children living with HIV were failing anti-retroviral (ART) therapy because they are still on Nevirapine-Lamivudine-Zidovudine (NVP/3TC/AZT) combination therapy. In PNG as in many countries there are high levels of drug-resistance to non-nucleoside reverse transcriptase inhibitors (NNRTIs), such as Nevirapine. This leads to poor treatment outcomes on NNRTI-based ART among infants and young children.

Now most children living with HIV will be on Dolutegravir (DGV)-based therapy, and this may account for the fall in HIV-related deaths in 2021.

Recommendations

- **Effective therapy using Dolutegravir (DGV)-based therapy is available, and other recommended drugs Lopinavir (LPV)/ritonavir, Abacavir and Lamivudine are now also available.**
- **All children living with HIV should be on DGV-based or LPV-based regimens. This is described in the new HIV care and treatment guidelines:** https://pngpaediatricsociety.org/wp-content/uploads/2020/03/PNG-HIV-care-and-treatment-guidelines-2019.pdf
- Mothers who are diagnosed with HIV during or after pregnancy are now treated with three antiretroviral drugs for life, not just for shorter periods to prevent transmission to the baby.

- Early infant diagnosis of HIV with PCR testing is now available (including rapid point-of-care testing using GeneXpert in some hospitals).
- Children who have HIV confirmed by early infant diagnosis and start on effective 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 living with HIV should see a paediatrician regularly, for starting on antiretroviral therapy and follow-up.
- **Children on ART need to have their treatment monitored, with regular testing of viral load, or CD4 count.**
- All children living with HIV need prophylaxis with cotrimoxazole (Septrin or Bactrim) and isoniazid, treatment of other infections and good nutrition.

Teach children who are living 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.

Chronic non-communicable diseases in children

There are increasingly children with **chronic diseases**, involving respiratory, cardiac, neurological systems, and cancer. These are under-estimates of the true burden of these conditions. The PHR has just started reporting these conditions, and more awareness on the care of these patients is needed. Individually the conditions are less common than acute problems, for example, pneumonia, diarrhoea or malaria. However 1235 patients with these chronic conditions have been admitted to these 18 hospitals in 2021 (Table 4).

Chronic condition	Admissions	Deaths
Asthma	140	0
Rheumatic heart disease	170	15
Congenital heart disease *	528	89
Cerebral palsy / developmental disability	140	13
Epilepsy	119	2
Cancer	138	39

Table 7. Common chronic diseases reported in 2021.

* Includes paediatric admissions plus babies born with congenital heart disease.

Children with chronic diseases, regardless of the type, have some common health care 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 must 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. These children are most at risk of dying from acute infections and malnutrition, so preventative measures are vital.

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 127 child protection cases and 30 deaths reported in 2021. These under-estimates the true burden of child abuse, maltreatment, and neglect, 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 awareness of child protection is needed, and more resources, including a child social worker in each hospital to deal with the range of common social issues.

Vaccine preventable diseases

There were 21 cases of acute flaccid paralysis (AFP) in 2021 (Figure 8) and 2 deaths. There were 10 cases of tetanus (2 deaths), and 33 cases of whooping cough, and 3 reported case of measles and 1 of rubella in 2021.

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 do not come to get vaccines, so we have to go to their homes and communities to immunise them.

Report any suspected case of acute flaccid paralysis, acute fever and rash, tetanus, or whooping cough to the Provincial or National Disease Control Officer for evaluation and specimen collection for laboratory confirmation.

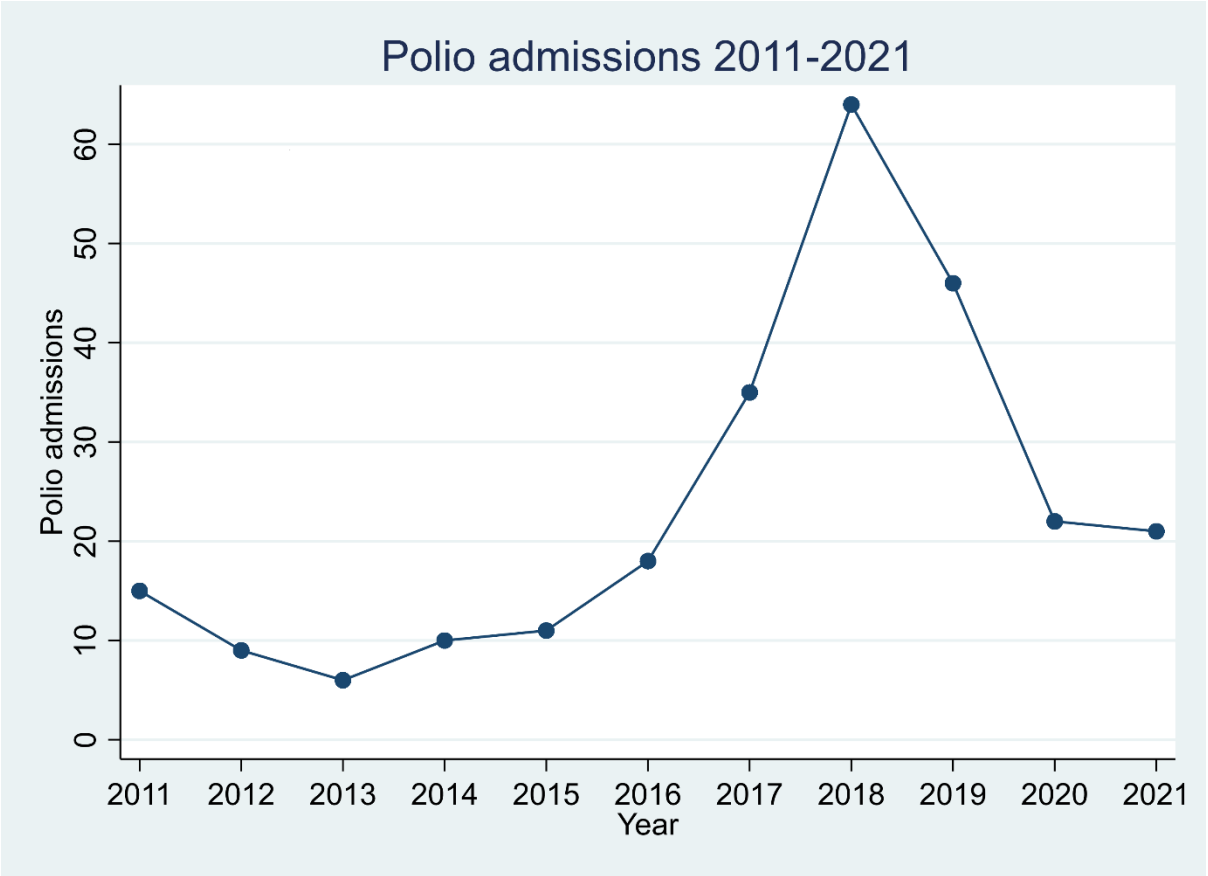


Figure 8. Cases of acute flaccid paralysis reported in 2011-2021

Neonatal care

Neonatal admissions made up 12292 (41.0%) of all 29485 paediatric admissions to the 18 hospitals in 2021. There were 726 neonatal deaths reported (mortality rate 5.0), continuing a lower trend than has been seen previously (Table 8).

Year	Neonates admitted	Neonatal deaths	Mortality rate
2015	4461	394	8.8
2016	6930	556	8.0
2017	7534	687	9.1
2018	7725	643	8.3
2019	7971	679	8.5
2020	10024	534	5.3
2021	12292	726	5.9

Table 8. Neonatal admissions and deaths 2015-2021

There has been rise in neonatal admissions reported in 2020 and 2021 (Table 8 and Figure 1) and continuing downward trend in neonatal mortality rates (Figure 9).

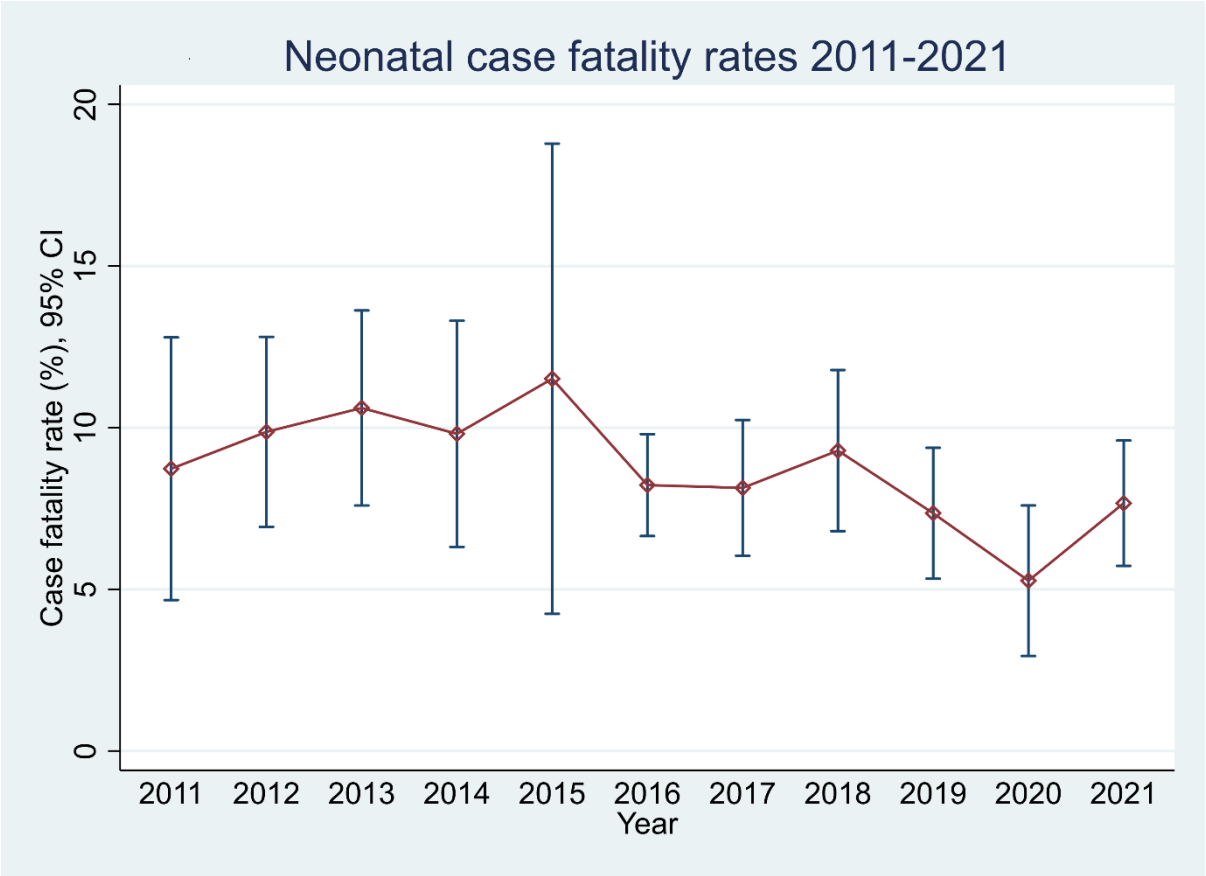


Figure 9. Overall neonatal mortality rates in Special Care Nurseries 2011-2019

Neonatal infections

Fifty-four percent of all neonatal admissions were associated with infections (n=6666). 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.

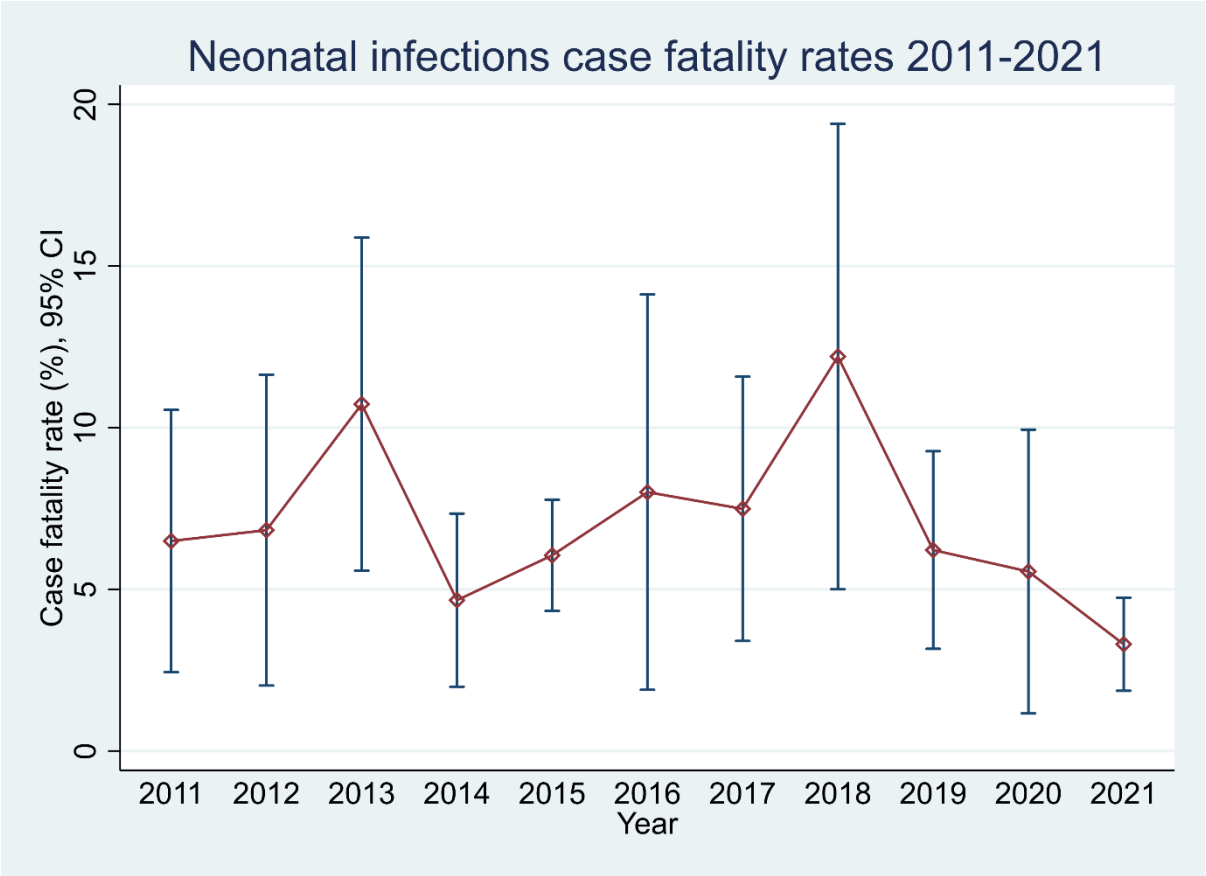


Figure 10. Neonatal infection case fatality rates in Special Care Nurseries 2011-2021

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. In 2021 there were 1909 cases reported of birth asphyxia, and 240 babies died (case fatality rate 4.8%). 33% of neonatal deaths were due to perinatal asphyxia or associated with it. The number of deaths from birth asphyxia (more than 4 per week) is unchanged over the last 6 years suggesting that the problem is not adequately addressed by current interventions.

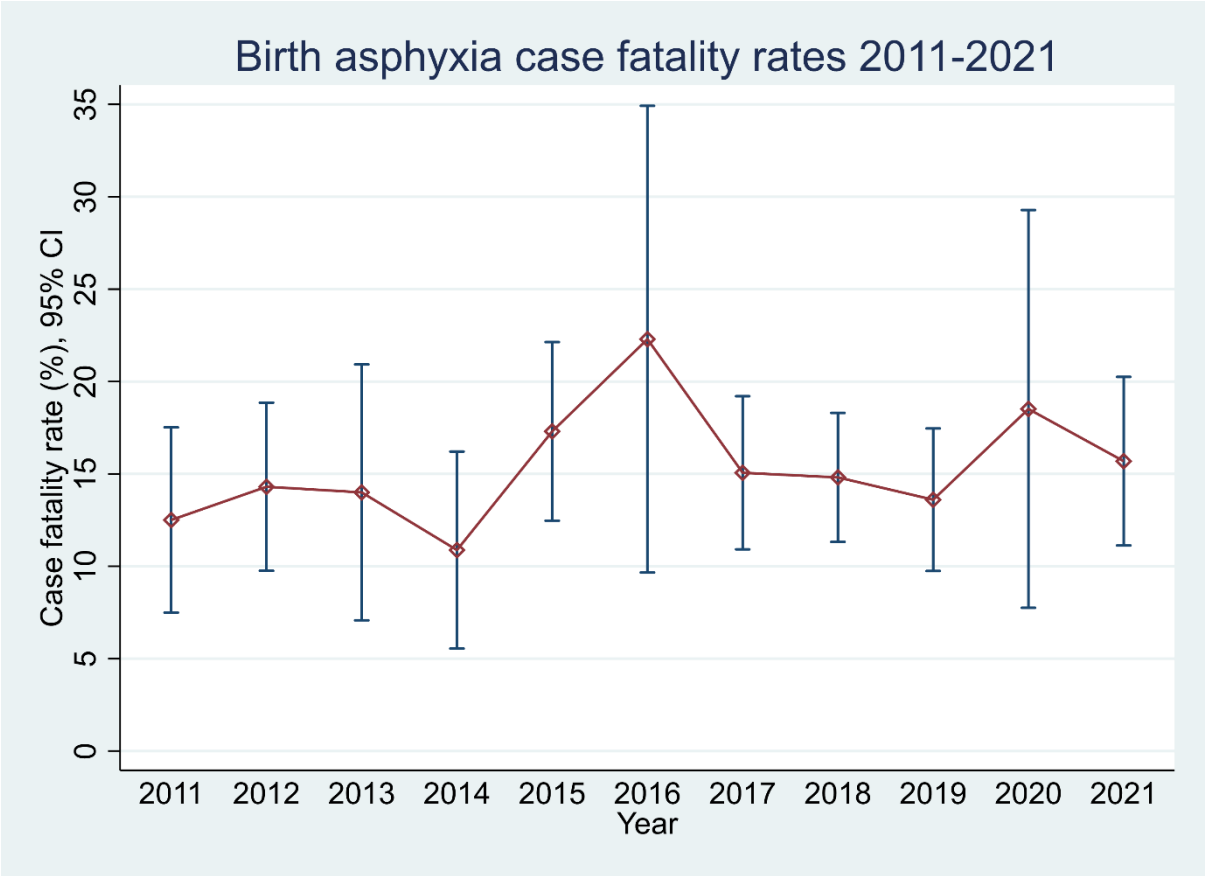


Figure 11. Case fatality rates for newborns with birth asphyxia

Year	Birth asphyxia	Birth asphyxia as a percentage of all newborn admissions	Deaths caused by birth asphyxia (% of all newborn deaths)	Case fatality rate
2015	1335	29.9%	198 (50%)	14.8%
2016	1478	21.3	285 (51%)	19.2%
2017	1892	25.15	280 (41%)	14.8%
2018	1812	23.5%	245 (38.1%)	13.5%
2019	1473	18.5%	218 (32.1)	14.8%
2020	2134	21.3%	204 (38.2%)	9.5%
2021	1909	15.5%	240 (33.1%)	12.6%

Table 9. Birth asphyxia cases as a proportion of all newborn admissions and deaths

The developmental implications for many surviving children are significant: cerebral palsy, intellectual disability, blindness, and seizures are common. Even mild or moderate forms of birth asphyxia can have long-term developmental consequences.

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 459 very low birth weight admissions in the 18 hospitals. In 2021, 113, or 24.6% of VLBW newborns died, which is lower than in recent years.

Year	VLBW cases	VLBW deaths	Case fatality rate
2015	267	100	37.5
2016	356	120	33.7
2017	491	198	40.3
2018	536	217	40.5
2019	419	140	33.4
2020	262	79	30.2
2021	459	113	24.6

Table 10. Very low birth weight cases and deaths 2015-2020

These surviving babies are at high risk of complications and need close follow-up and care in the first year of life.

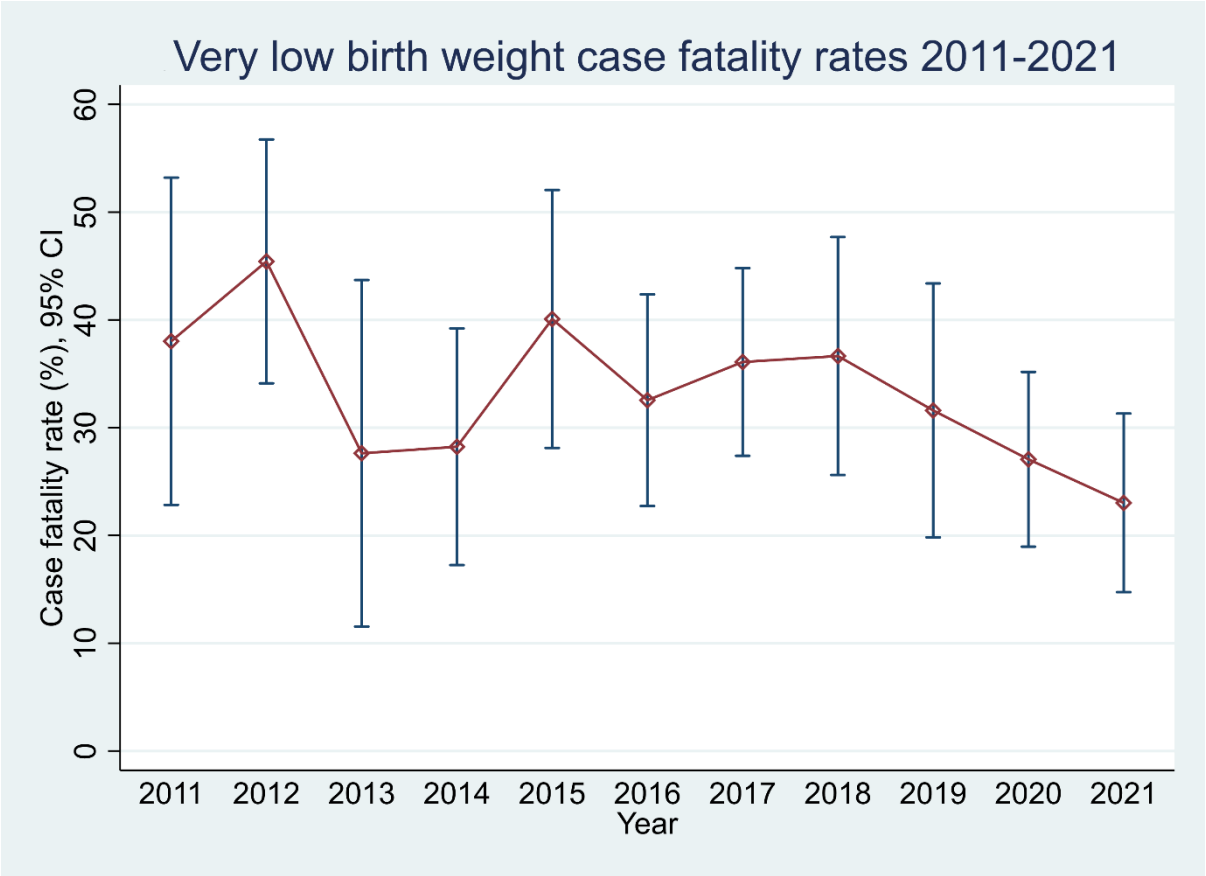


Figure 12. Case fatality rates for very low birthweight newborns

In 2021, prematurity (gestational age <37 weeks) was reported also in some hospitals that used up to date versions of the PHR. There were 2716 admissions for prematurity, and 52 deaths (case fatality rate 1.9%).

Congenital malformations

453 newborns were reported to have congenital malformations, of 81 died (case fatality rate 17.8%). Cases included 62 newborns with congenital heart disease, 44 with congenital gastrointestinal anomalies (including anorectal malformations / imperforate anus, diaphragmatic hernia, and gastroschisis), and 11 newborns were reported with microcephaly.

Congenital or intrauterine infections

There were 50 cases of congenital syphilis, 12 cases of congenital malaria and 5 cases of congenital rubella.

Recommendations for improving neonatal care

Provision of early essential newborn care and keeping newborns with their mothers has 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, hypoglycaemia, 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 babies who are not breathing within 1 minute 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 are not separated from 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, expressed breast milk by a nasogastric tube is ideal. However large volumes of enteral feeding in the first day or two of life is often not well tolerated. 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 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.
- Birthing facilities, nurseries, and post-natal wards can be involved in educating mothers on warning signs for newborns e.g. poor feeding, fits or twitching, yellow discoloration, fever, too sleepy, wet cord, etc. Such education on warning signs can help improve health seeking for sepsis, where it is not uncommon for symptoms to have been present for a couple of days.
- 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

Summary

This Annual Report and the Paediatric Hospital Reporting System in 2021 has highlighted sustained progress in several areas, but also some conditions where the outcomes in 2021 were adversely affected by the pandemic, including pneumonia. The Paediatric Society asks that all health workers and hospital administrators play their part to address ongoing problems, adopt the recommendations in this report, and see these results improve further in the coming years.

Appendix table 1. Pneumonia (all types of severity)

Hospitals	Pneumonia admissions	Pneumonia deaths	Pneumonia CFR
Alotau	186	3	1.6
Angau	406	22	5.4
Buka	56	2	3.6
Chuave			
Daru			
Gembogl			
Gerehu	184	5	2.72
Goroka	378	14	3.70
Kainantu			
Gumine			
Kavieng	57	11	19.3
Kimbe	164	16	9.8
Kerema			
Kerowagi			
Koge			
Kompiam	161	5	3.1
Kundiawa	407	19	4.7
Kudjip			
Mabisanda			
Lorengau			
Mendi	485	22	4.5
Mingendi			
Modilon	384	6	1.6
Mt Hagen	843	13	1.5
Nonga	157	15	9.6
Popendetta			
Port Moresby	376	29	7.7
Rumginae	7	0	0.0
Tari	312	10	3.2
Vanimo	74	5	6.8
Wabag	330	14	4.2
Wewak			
Yampu			
TOTAL	**4967**	**198**	**4.25**

Appendix table 2. Severe pneumonia

2020	Severe pneumonia admissions	Severe pneumonia deaths	Severe pneumonia CFR
Alotau	18	3	16.7
Angau	116	20	17.2
Buka	9	2	22.2
Chuave			
Daru			
Gembogl			
Gerehu	70	5	7.1
Goroka	251	11	4.4
Kainantu			
Gumine			
Kavieng	28	11	39.3
Kimbe	38	10	26.3
Kerema			
Kerowagi			
Koge			
Kompiam	64	5	7.8
Kundiawa	299	17	5.7
Kudjip			
Mabisanda			
Lorengau			
Mendi	40	15	37.5
Mingendi			
Modilon	76	5	6.6
Mt Hagen	418	13	3.1
Nonga	60	13	21.7
Popendetta			
Port Moresby	173	26	15.0
Rumginae	2	0	0.0
Tari	216	10	4.6
Vanimo	25	5	20.0
Wabag	81	12	14.8
Wewak			
Yampu			
TOTAL	1984	183	9.22

Appendix Table 3. Diarrhoea

Hospital	Diarrhoea admissions	Diarrhoea deaths	Diarrhoea CFR
Alotau	91	2	2.2
Angau	246	19	7.7
Buka	27	1	3.7
Chuave			
Daru			
Gembogl			
Gerehu	140	0	0.0
Goroka	165	5	3.0
Kainantu			
Gumine			
Kavieng	30	1	3.3
Kimbe	69	1	1.4
Kerema			
Kerowagi			
Koge			
Kompiam	133	3	2.3
Kundiawa	146	11	7.5
Kudjip			
Mabisanda			
Lorengau			
Mendi	150	8	5.3
Mingendi			
Modilon	103	1	1.0
Mt Hagen	207	1	0.5
Nonga	84	4	4.8
Popendetta			
Port Moresby	352	12	3.4
Rumginae	6	0	0.0
Tari	89	5	5.6
Vanimo	26	1	3.8
Wabag	115	16	13.9
Wewak			
Yampu			
TOTAL	**2179**	**91**	**4.18**

Appendix Table 4. Malaria

Hospitals	Malaria admissions	Malaria deaths	Malaria CFR
Alotau	2	0	0.0
Angau	180	9	5.0
Buka	3	0	0.0
Chuave			
Daru			
Gembogl			
Gerehu	22	0	0.0
Goroka	15	0	0.0
Kainantu			
Gumine			
Kavieng	45	2	4.4
Kimbe	150	7	4.7
Kerema			
Kerowagi			
Koge			
Kompiam	12	1	8.3
Kundiawa	15	1	6.7
Kudjip			
Mabisanda			
Lorengau			
Mendi	2	0	0.0
Mingendi			
Modilon	202	6	3.0
Mt Hagen	4	0	0.0
Nonga	65	2	3.1
Popendetta			
Port Moresby	75	4	5.3
Rumginae	3	0	0.0
Tari	0	0	0.0
Vanimo	26	1	3.8
Wabag	8	1	12.5
Wewak			
Yampu			
TOTAL	829	34	4.10

Appendix table 5. Severe malnutrition

Hospitals	Severe malnutrition admission	Severe malnutrition deaths	Severe malnutrition CFR
Alotau	76	3	3.9
Angau	324	23	7.1
Buka	24	2	8.3
Chuave			
Daru			
Gembogl			
Gerehu	184	3	1.6
Goroka	231	31	13.4
Kainantu			
Gumine			
Kavieng	28	5	17.9
Kimbe	194	24	12.4
Kerema			
Kerowagi			
Koge			
Kompiam	64	9	14.1
Kundiawa	180		0.0
Kudjip			
Mabisanda			
Lorengau			
Mendi	86	14	16.3
Mingendi			
Modilon	250	24	9.6
Mt Hagen	166	27	16.3
Nonga	79	12	15.2
Popendetta			
Port Moresby	437	53	12.1
Rumginae	5	0	0.0
Tari	70	12	17.1
Vanimo	47	4	8.5
Wabag	69	10	14.5
Wewak			
Yampu			
TOTAL	2514	256	10.18

Appendix Table 6. Meningitis

Hospitals	Meningitis admissions	Meningitis deaths	Meningitis CFR
Alotau	12	0	0.0
Angau	66	9	13.6
Buka	22	7	31.8
Chuave			
Daru			
Gembogl			
Gerehu	25	1	4.0
Goroka	86	8	9.3
Kainantu			
Gumine			
Kavieng	16	4	25.0
Kimbe	40	9	22.5
Kerema			
Kerowagi			
Koge			
Kompiam	15	2	13.3
Kundiawa	65	10	15.4
Kudjip			
Mabisanda			
Lorengau			
Mendi	35	13	37.1
Mingendi			
Modilon	67	5	7.5
Mt Hagen	91	13	14.3
Nonga	18	3	16.7
Popendetta			
Port Moresby	216	16	7.4
Rumginae	2	0	0.0
Tari	36	1	2.8
Vanimo	5	0	0.0
Wabag	19	3	15.8
Wewak			
Yampu			
TOTAL	836	104	12.44

Appendix Table 7. Tuberculosis

Hospitals	TB admissions	TB deaths	TB CFR
Alotau	48	3	6.3
Angau	192	18	9.4
Buka	60	1	1.7
Chuave			
Daru			
Gembogl			
Gerehu	38	0	0.0
Goroka	153	10	6.5
Kainantu			
Gumine			
Kavieng	23	2	8.7
Kimbe	163	19	11.7
Kerema			
Kerowagi			
Koge			
Kompiam	29	1	3.4
Kundiawa	172	15	8.7
Kudjip			
Mabisanda			
Lorengau			
Mendi	186	18	9.7
Mingendi			
Modilon	133	17	12.8
Mt Hagen	87	5	5.7
Nonga	37	3	8.1
Popendetta			
Port Moresby	461	29	6.3
Rumginae	7	0	0.0
Tari	65	8	12.3
Vanimo	20	1	5.0
Wabag	79	6	7.6
Wewak			
Yampu			
TOTAL	1953	156	7.99

Appendix Table 8. HIV

Hospitals	HIV admissions	HIV deaths	HIV CFR
Alotau	13	2	15.4
Angau	39	8	20.5
Buka	9	1	11.1
Chuave			
Daru			
Gembogl			
Gerehu	40	2	5.0
Goroka	54	11	20.4
Kainantu			
Gumine			
Kavieng	5	0	0.0
Kimbe	11	1	9.1
Kerema			
Kerowagi			
Koge			
Kompiam	16	3	18.8
Kundiawa	0	0	0.0
Kudjip			
Mabisanda			
Lorengau			
Mendi	4	1	25.0
Mingendi			
Modilon	28	5	17.9
Mt Hagen	33	11	33.3
Nonga	3	2	66.7
Popendetta			
Port Moresby	95	0	0.0
Rumginae	1	0	0.0
Tari	0	0	0.0
Vanimo	0	0	0.0
Wabag	33	14	42.4
Wewak			
Yampu			
TOTAL	384	61	15.89

Appendix Table 9. Total neonatal admissions

Hospitals	Neonatal admissions	Neonatal deaths	Neonatal CFR
Alotau	337	9	2.7
Angau	1651	113	6.8
Buka	66	5	7.6
Chuave			
Daru			
Gembogl			
Gerehu	120	0	0.0
Goroka	593	72	12.1
Kainantu			
Gumine			
Kavieng	312	10	3.2
Kimbe	417	47	11.3
Kerema			
Kerowagi			
Koge			
Kompiam	79	13	16.5
Kundiawa	267	6	2.2
Kudjip			
Mabisanda			
Lorengau			
Mendi	488	54	11.1
Mingendi			
Modilon	753	66	8.8
Mt Hagen	1409	92	6.5
Nonga	560	41	7.3
Popendetta			
Port Moresby	4496	134	3.0
Rumginae			
Tari	337	27	8.0
Vanimo	140	9	6.4
Wabag	267	28	10.5
Wewak			
Yampu			
TOTAL	12292	726	5.91

Appendix Table 10. Neonatal infections

Hospitals	Neonatal sepsis admissions	Neonatal sepsis deaths	Neonatal sepsis CFR
Alotau	191	2	1.0
Angau	1294	59	4.6
Buka	58	2	3.4
Chuave			
Daru			
Gembogl			
Gerehu	92	0	0.0
Goroka	185	23	12.4
Kainantu			
Gumine			
Kavieng	231	7	3.0
Kimbe	243	12	4.9
Kerema			
Kerowagi			
Koge			
Kompiam	645	6	0.9
Kundiawa			
Kudjip			
Mabisanda			
Lorengau			
Mendi	314	14	4.5
Mingendi			
Modilon	380	9	2.4
Mt Hagen	660	21	3.2
Nonga	416	14	3.4
Popendetta			
Port Moresby	1483	41	2.8
Rumginae			
Tari	225	4	1.8
Vanimo	100	0	0.0
Wabag	149	11	7.4
Wewak			
Yampu			
TOTAL	6666	225	3.38

Appendix Table 11. Very low birth weight (1000-1499g)

Hospitals	Very low birth weight admissions	Very low birth weight deaths	Very low birth weight CFR
Alotau	8	2	25.0
Angau	51	26	51.0
Buka			
Chuave			
Daru			
Gembogl			
Gerehu	0	0	0.0
Goroka	60	21	35.0
Kainantu			0.0
Gumine			
Kavieng	13	5	38.5
Kimbe	24	11	45.8
Kerema			
Kerowagi			
Koge			
Kompiam	0	0	0.0
Kundiawa	30	0	0.0
Kudjip			
Mabisanda			
Lorengau			
Mendi	23	9	39.1
Mingendi			
Modilon	47	7	14.9
Mt Hagen	47	7	14.9
Nonga	26	5	19.2
Popendetta			
Port Moresby	101	13	12.9
Rumginae			
Tari	9	4	44.4
Vanimo	6	1	16.7
Wabag	14	2	14.3
Wewak			
Yampu			
TOTAL	459	113	24.62

Appendix Table 13. Perinatal asphyxia

Hospitals	Birth asphyxia admission	Birth asphyxia death	Birth asphyxia CFR
Alotau	50	7	14.0
Angau	378	53	14.0
Buka	8	0	0.0
Chuave			
Daru			
Gembogl			
Gerehu	0	0	0.0
Goroka	154	25	16.2
Kainantu			
Gumine			
Kavieng	53	1	1.9
Kimbe	76	15	19.7
Kerema			
Kerowagi			
Koge			
Kompiam	17	6	35.3
Kundiawa			
Kudjip			
Mabisanda			
Lorengau			
Mendi	101	25	24.8
Mingendi			
Modilon	147	18	12.2
Mt Hagen	341	23	6.8
Nonga	95	18	18.9
Popendetta			
Port Moresby	371	30	8.1
Rumginae			
Tari	36	8	22.2
Vanimo	34	6	17.6
Wabag	48	5	10.4
Wewak			
Yampu			
TOTAL	4969	240	4.83

Appendix Table 14. Paediatric cancer

Hospitals	Cancer admission	Cancer death	Cancer CFR
Alotau	3	0	0.0
Angau	3	2	66.7
Buka	5	0	0.0
Chuave			
Daru			
Gembogl			
Gerehu	1	0	0.0
Goroka	2	2	100.0
Kainantu			0.0
Gumine			
Kavieng	14	2	14.3
Kimbe	8	2	25.0
Kerema			
Kerowagi			
Koge			
Kompiam	3	1	33.3
Kundiawa	11	0	0.0
Kudjip			
Mabisanda			
Lorengau			
Mendi	1	0	0.0
Mingendi			
Modilon	9	2	22.2
Mt Hagen	7	4	57.1
Nonga	13	5	38.5
Popendetta			
Port Moresby	49	19	38.8
Rumginae	0	0	0.0
Tari	9	0	0.0
Vanimo	0	0	0.0
Wabag	0	0	0.0
Wewak			
Yampu			
TOTAL	138	39	28.3

Appendix Table 15. Acute rheumatic fever / Rheumatic heart disease

Hospitals	Rheumatic heart disease admissions	Rheumatic heart disease deaths	Rheumatic heart disease CFR
Alotau	4	0	0.0
Angau	3	1	33.3
Buka	6	0	0.0
Chuave			
Daru			
Gembogl			
Gerehu	1	0	0.0
Goroka	9	0	0.0
Kainantu			0.0
Gumine			
Kavieng	12	1	0.0
Kimbe	3	0	0.0
Kerema			
Kerowagi			
Koge			
Kompiam	2	1	50.0
Kundiawa	15	0	0.0
Kudjip			
Mabisanda			
Lorengau			
Mendi	15	1	6.7
Mingendi			
Modilon	5	0	0.0
Mt Hagen	20	0	0.0
Nonga	8	2	25.0
Popendetta			
Port Moresby	59	9	15.3
Rumginae	0	0	0.0
Tari	3	0	0.0
Vanimo	0	0	0.0
Wabag	5	0	0.0
Wewak			
Yampu			
TOTAL	170	15	8.82

Appendix Table 16. Congenital heart disease (admissions outside the newborn period)

Hospitals	Congenital heart disease admissions	Congenital heart disease deaths	Congenital heart disease CFR
Alotau	18	0	0.0
Angau	30	4	13.3
Buka	8	0	0.0
Chuave			
Daru			
Gembogl			
Gerehu	5	0	0.0
Goroka	98	8	8.2
Kainantu			0.0
Gumine			
Kavieng	18	7	38.9
Kimbe	29	8	27.6
Kerema			
Kerowagi			
Koge			
Kompiam	3	2	66.7
Kundiawa	7		0.0
Kudjip			
Mabisanda			
Lorengau			
Mendi	23	4	17.4
Mingendi			
Modilon	38	5	13.2
Mt Hagen	42	5	11.9
Nonga	24	5	20.8
Popendetta			
Port Moresby	78	12	15.4
Rumginae	0	0	0.0
Tari	8	1	12.5
Vanimo	16	2	12.5
Wabag	21	1	4.8
Wewak			
Yampu			
TOTAL	466	64	13.7

Appendix Table 17. Child protection admissions (physical abuse, neglect, or sexual abuse)

Hospitals	Child protection admission	Child protection death	Child protection CFR
Alotau	12	2	16.7
Angau	0	0	0.0
Buka	2	0	0.0
Chuave			
Daru			
Gembogl			
Gerehu	2	0	0.0
Goroka	2	0	0.0
Kainantu			
Gumine			
Kavieng	1	0	0.0
Kimbe	9	2	22.2
Kerema			
Kerowagi			
Koge			
Kompiam	26	6	23.1
Kundiawa	0	0	0.0
Kudjip			
Mabisanda			
Lorengau			
Mendi	0	0	0.0
Mingendi			
Modilon	29	5	17.2
Mt Hagen	0	0	0.0
Nonga	10	4	40.0
Popendetta			
Port Moresby	23	5	21.7
Rumginae	0	0	0.0
Tari			
Vanimo	1	0	0.0
Wabag	10	6	60.0
Wewak			
Yampu			
TOTAL	127	30	23.62