MMed and DCH Lectures

Weekly by Zoom

Prof Trevor Duke

MMed and DCH Lectures

COVID-19 in children

May 2, 2020

Prof Trevor Duke

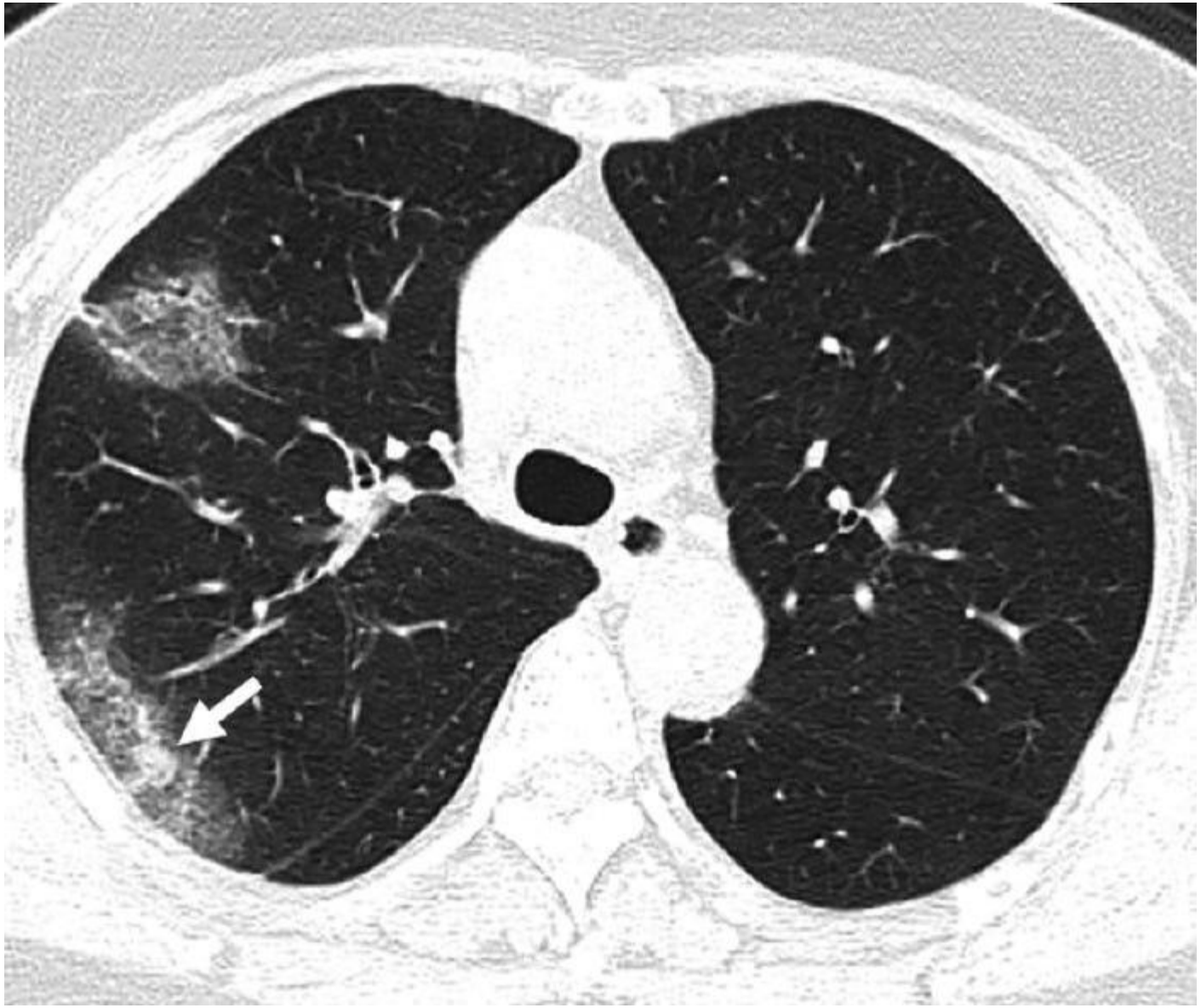
- Preparation and knowledge makes all the difference

Aims of today’s session

- Learn about COVID-19 in children
- Put it in perspective
- Innate vs acquired immunity
- Toxic shock syndrome
- Understand the stages in the care of all sick children
- Hypoxia and oxygen treatment

Covid-19

- Day 0-4: Ground glass opacities on CT (peripheral)
- Days 5-10: progression into more lobes
- 11-13: clinically most severe
- 14+ resolution and clinical improvement



Epidemiology

- China 2143 children
  - Severe 112 (5%) hospitalised: fever, cough, diarrhoea, hypoxaemia
  - Critical 13 (0.6%), 9/13 (69%) under 5 years of age. ARDS, respiratory failure, shock, encephalopathy, myocardial failure, coagulopathy
- USA 2572 children (1.7%)
  - 5-20% hospitalized
  - 0.6-2% of children need ICU
- Spain, Italy, UK similar, very low risk of severe disease in children
- 10 paediatric / adolescent deaths

Yuanyuan Dong, et al. Pediatrics 2020. Chinese Centre for Disease Control and Prevention, 2020
Guan W. New Eng J Med 2020. Clinical Characteristics of Coronavirus Disease 2019 in China
CDC COVID-19 Response Team. MMW Coronavirus Disease 2019 in Children - United States 2020

Covid-19 manifestations in children

Most children asymptomatic

Mild illness

- URTI, cough, runny nose, most common (70-80%), very mild illness
- Average age in other countries of COVID-19 proven cases in children is 7 years in China and 11 years in USA. Infants and young children under 5 are more commonly hospitalised.

Moderate-severe illness

- Pneumonia: 5% of infected children are hypoxic; most just need oxygen for a few days
- Severe illness is rare in children: only 0.6% are critical and need intensive care.

COVID-19 related paediatric multisystem inflammatory syndrome

- Acute viral syndrome: high fever (T>39 C), red skin rash, diarrhoea and vomiting.
- *Rarely* associated with shock (hypotension), myocarditis, encephalitis, coagulopathy.
- Lymphopenia, high ferritin and D-dimers, echo shows myocardial dysfunction
- Can look like toxic shock syndrome from Staph or Streptococcal infection, or Kawasaki disease or macrophage activation syndrome
- Most are not very unwell, just have fever, vomiting and diarrhoea

* Signs of shock are: capillary refill >3 seconds, low volume pulses, hypotension (see table below), fast breathing, lethargic or poor conscious state.


MAXP

COVID-19 related paediatric multisystem inflammatory syndrome

- Delayed by *one month* after peak of acute viral infection
- Most patients positive for antibody, not PCR, therefore late inflammatory *post-viral* illness – acquired immunity
  - Antibody-antigen complex activation of macrophages, neutrophils, complement
  - Antibody-antigen complex facilitate viral infection into cells (such as in dengue)
  - T-cell immunity in 2-3 week after viral infection – injury to tissues that mimic virus
  - May be genetically determined

Outcomes in COVID-19 infected children

- Very few paediatric deaths (10 child and adolescent deaths globally), and most are adolescent patients.
- Children with chronic underlying conditions, such as cerebral palsy, chronic lung disease, heart disease, type 1 diabetes, immune problems, are more likely to be hospitalised (but this is similar to other viruses).

COVID-19 Testing

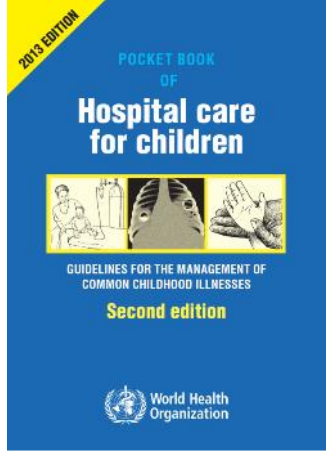
- PCR on nasal swab
- Serology IgG, IgM, IgA
- PCR on stool
- Role of repeat testing
- FBE – look for lymphopenia
- Blood culture
- D-dimer
- Ferritin

Treatment

Mild disease

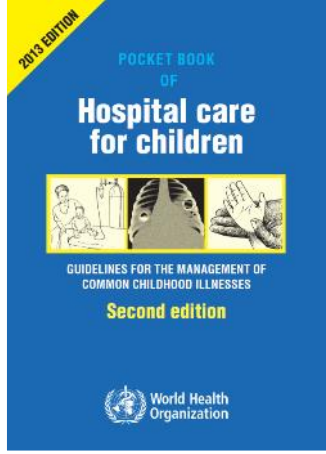
- If no signs of severe disease, manage at home, and instruct the family to isolate as best as they can for 14 days.
- Check immunization status and update if needed.

Treatment: If the child is unwell



- Check oxygen saturation, triage emergency signs and examine for signs of respiratory distress. Follow standard treatment and Hospital Care for Children.
- **Admit to hospitalise a suspected case if the child is hypoxic, or has any other signs of severe pneumonia or any danger signs (inability to feed, severe respiratory distress, obstructed breathing, cyanosis, shock)**
- Give oxygen therapy, other standard therapies for pneumonia (standard antibiotics for moderate or severe pneumonia).

COVID-19 related paediatric multisystem inflammatory syndrome



Children with fever, rash, vomiting, diarrhoea, dehydration or shock: manage according to standard treatment and according to Hospital Care for Children guidelines:

- **Triage:** Assess for emergency signs.
- **Emergency treatment**: give oxygen, intravenous fluid to correct dehydration if present
  - If the child still has clinical signs of shock after commence an adrenaline infusion. Put 6mg adrenaline in 1000 ml normal saline and run at 0.5ml/kg/hour (0.05 mcg/kg/min).
- **Admit** to a ward where the child can be **isolated and monitored**. Reassess regularly.
- **Treatment**: give antibiotic treatment for sepsis. Give aspirin if the child has rash and shock.
- **Monitor** vital signs, SpO_2, hydration state, and blood pressure.
- **Supportive care**: avoid over-hydration, check blood glucose, nutrition.

Potential risks

Host susceptibility

- HIV, tuberculosis, malnutrition

Environmental

- Overcrowding and social congregation
- Poor sanitation and income insecurity
- Faecal-oral spread in children

Health services

- Numbers of health care workers
  - Germany 42 Italy 40 Australia 37
  - UK 28 USA 26 Singapore 23
  - South Africa 9 Kenya 1.6 PNG 0.7

In perspective:

- Thousands of children will die of pneumonia this year…from causes *other than* COVID-19

- Disruption to health services, social isolation and economic stress will kill more children in low-income countries than Covid-19

- Hospitals should do what they do well…
  1. Protection for staff and infection control
  2. Oxygen supplies for the 5% of children who are hypoxic
  3. Maintain good quality routine health services

Risk to staff

- **SARS in Hong Kong:** 1300 health care workers infected
  - Bed space <1m
  - Lack of washing facilities for staff
  - **Intubation / resuscitation performed on the ward**
  - Staff worked while experiencing symptoms

Yu IT. Why did outbreaks of severe acute respiratory syndrome occur in some hospital wards but not in others? Clin Infect Dis, 2007;44:1017-25
Hui D. Severe acute respiratory syndrome (SARS): lessons learnt in Hong Kong. J Thorac Dis 2013;5:S122-S126

- 105 nurses and doctors provided care for 20 **adults** with SARS on mask NIV: none seroconverted or became unwell.

Cheung TM. Effectiveness of non-invasive positive pressure ventilation in the treatment of acute respiratory failure in severe acute respiratory syndrome. Chest. 2004 Sep;126(3):845-50.

Infection risk from **paediatric patients** with SARS

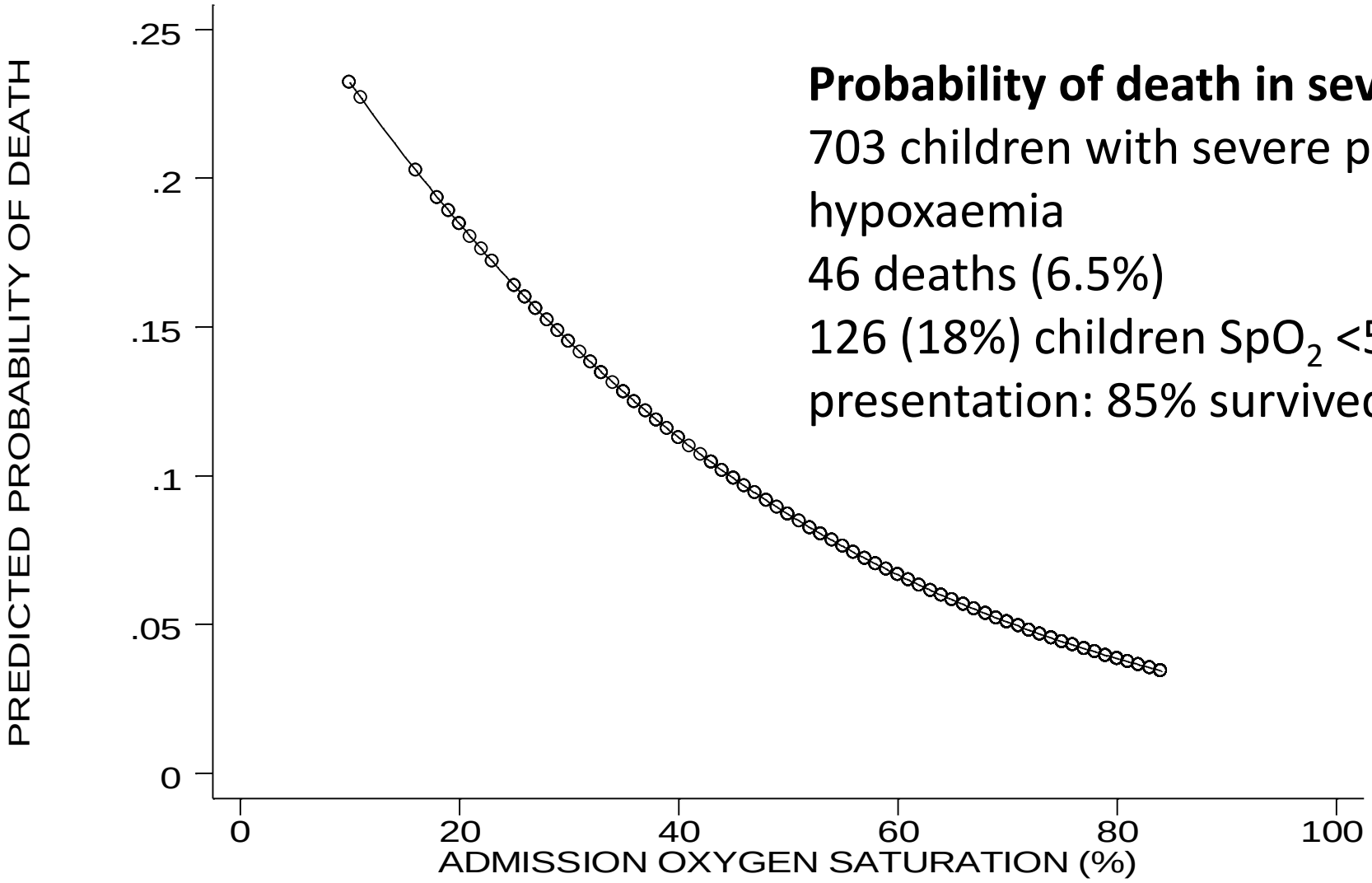
- 38 children with SARS: 26 HCWs worked in the ‘ultra high-risk area’ caring for SARS patients. No HCWs developed clinical features suggestive of SARS. No nosocomial spread of SARS-associated coronavirus to other patients or visitors during the 4 month period

Leung TF. Infection control for SARS in a tertiary paediatric centre in Hong Kong. J Hosp Infect. 2004 Mar;56:215-22

Intubation is the biggest risk to staff

No documented cases of transmission of SARS-1 (or Covid-19) from paediatric patients to health care workers (in the context of full precautions used in HK).

If a country has 1000 new (adult) infections per week, 17 will be children, of which 5 will require oxygen in hospital, and 1 child every 3 weeks will need ICU



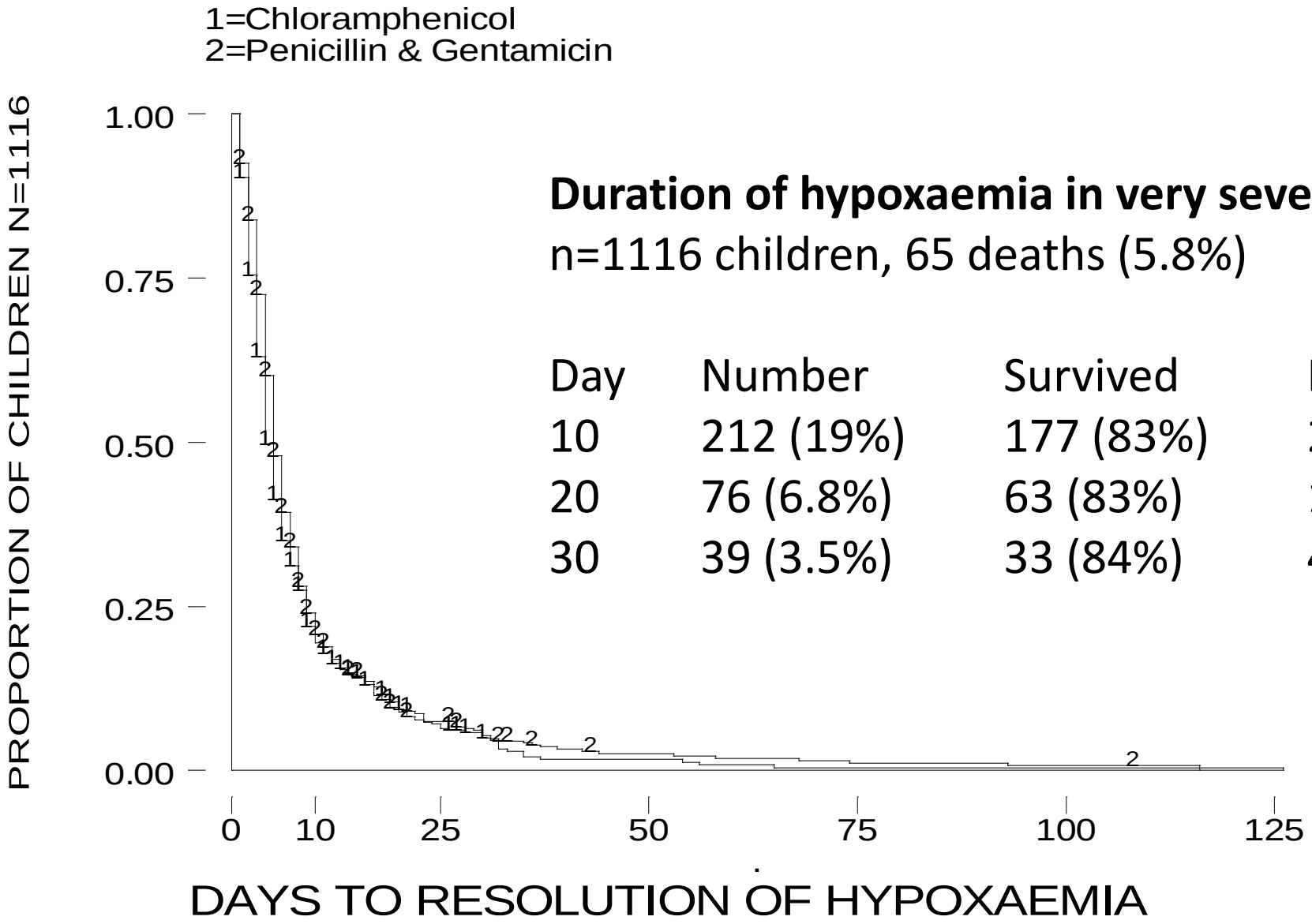
Probability of death in severe pneumonia

703 children with severe pneumonia and hypoxaemia

46 deaths (6.5%)

126 (18%) children SpO_2 <50% at presentation: 85% survived

Duke T. et al. Int J Tuberc Lung Dis 2001; 5:511-519



Duration of hypoxaemia in very severe pneumonia

n=1116 children, 65 deaths (5.8%)

Day	Number	Survived	Died
10	212 (19%)	177 (83%)	28
20	76 (6.8%)	63 (83%)	10
30	39 (3.5%)	33 (84%)	4

Duke T. et al. Lancet 2002;359:474-480

What to do if a child is still hypoxic?

CPAP, with high FiO_2 or Higher flow O_2

Maintain routine services

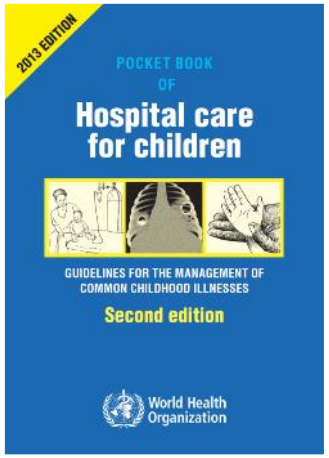
- Children with HIV, tuberculosis and other chronic conditions still need their medications and their conditions monitored, acute infections still need to be treated, high-risk newborns still need special care, and immunization programs still need to function so as to not lose ground in the control of many diseases

Maintain routine services: e.g. immunization

- Redirection of health care workers to “COVID-19 priorities”
- Social distancing means parents not bringing children to clinics
- Transport disruptions, border closures and supply chains
- Mistrust and stigma directed against health care workers

- Measles outbreaks and deaths, global polio eradication in jeopardy

Summary: in the time of COVID-19



Children are much less affected than adults, but important to be prepared

Hospitals should do what they do well…

1. Protection for staff and infection control
2. Oxygen supplies for the 5% of children who are hypoxic
3. Maintain good quality routine health services