IN-12 Measles, whooping cough, diphtheria and the childhood killers

HEALING after the FALL, research library, IN-12

Researched 10 October 2026 by Claude Opus agent for THRIVING after the FALL, Book Four. Library document, unverified.

Findings by section

1. Scope and the three voices

This report covers measles, whooping cough (pertussis) and diphtheria in unvaccinated children, with scarlet fever, mumps, rubella and chickenpox briefly. Tradition, record and modern inference are kept apart. My own inferences carry [VERIFY].

Case fatality in vaccinated, well-fed populations (CDC: 1 to 3 measles deaths per 1,000 cases) is not the post-Fall baseline. 'Natural immunity' to measles was bought in England in 1871 to 1880 with 91,948 measles deaths, 92% under age 5 (THRIVING library, IN-01).

2. How fast a susceptible cohort builds up

The record. Measles has a basic reproduction number (R0, the number one case infects in a fully susceptible group) of 12 to 18 in most settings (Guerra 2017). The immune share needed to stop spread is 1 minus 1/R0, or 92 to 94% (my arithmetic). Bartlett (1957) and Black (1966) showed that measles cannot persist in a population below about 250,000 to 500,000: it burns out and must be reimported. A district of 3,000 will meet measles as the Faroe Islands did, as an import striking everyone born since the last visit.

Maternal antibody does not bridge the gap. In 207 Belgian mother and infant pairs, infants of vaccinated mothers lost measles antibody at a median of 0.97 months and those of naturally immune mothers at 3.78 months, and by 6 months 95 to 99% had none (Leuridan 2010). For a generation after the Fall the mothers will be vaccinated women, so their babies will be unprotected almost from birth.

The inference [VERIFY]. At the birth rate of 35 per 1,000 used in IN-01, a village of 300 has about 10 births a year and a district of 3,000 about 105.

Years after vaccination stops	Susceptible children, village	Susceptible children, district	Share of district
1	about 9	about 95	3%
2	about 18	about 190	6%
5	about 45	about 450	15%
10	about 90	about 850	28%

An epidemic can take off once R0 times the susceptible share exceeds 1: at R0 of 15 that is 6.7%, about 200 children in the district, reached in roughly 2 years. Dispersed living lowers the effective R0 and markets and schools raise it, so

this is uncertain by a factor of two. The standard final-size equation gives the size: with 450 susceptibles (15%) and R0 of 15, the effective number is 2.25 and about 85% of susceptibles, some 380 children, are infected. At 3% case fatality that is 11 deaths, at 10% about 38. A village with 45 susceptibles would see about 38 cases and 1 to 4 deaths. The longer the gap between imports, the larger and older the epidemic, and after 20 years young adults are susceptible too. Panum found adults over 30 died at rates second only to infants.

3. Measles

Virgin soil. Peter Ludvig Panum was sent to the Faroe Islands in 1846. Measles had been absent since 1781. Of 7,782 inhabitants about 6,000 fell ill and at least 102 died (Panum 1847, via the University of Pittsburgh summary). Other secondary accounts give 170 deaths, 2.8% [VERIFY]. Panum fixed the incubation at 13 to 14 days and showed that those who had had measles in 1781 did not catch it again. Deaths were highest under age 1 and over 30.

Shanks and colleagues (2015) compared isolated populations. The Faroes lost about 2,300 per 100,000 population, Iceland 3,173 per 100,000, and Fiji in 1875 and Rotuma in 1911 up to a fifth of the population. Highland Scottish recruits in the First World War died at over 10%, while US Army case fatality fell from 2.0% to 0.004% over the period. Shanks attributes the gap to the host, chiefly prior exposure to the respiratory germs that cause the secondary pneumonias, rather than to the virus.

Case fatality by age and nutrition. Portnoy and colleagues (2019) pooled studies from low- and middle-income countries for 1990 to 2015. Overall case fatality was 2.2% (community 1.5%, hospital 2.9%), 3.3% under 5 and 0.9% at 5 and over. Where under-5 mortality was 150 per 1,000 or more, under-5 case fatality was 11.8% (range 0 to 41.7%). Refugee settings were excluded. Wolfson found 0 to 40.1%, outbreak median 5.2% (THRIVING library, IN-01). In the US in 1920 there were 7,712 measles deaths, 78% under 5, and children nursed at home died at 2 to 3% against 6 to 10% in institutions (Weaver 1924).

Famine and displacement push these higher. Toole and colleagues (1989) reported "extremely high" camp measles mortality without a figure. At Gode, Ethiopia, in the 2000 famine, measles contributed to about a fifth to a quarter of 159 deaths under 5, under-5 deaths reached 6.7 per 10,000 per day, and malnutrition contributed to 72.3% of all deaths (CDC 2001, Salama 2001). The brief's 25% fits Portnoy's range, but I found no single camp study giving it [VERIFY].

Crowding counts as much as hunger. Peter Aaby's work in Guinea-Bissau showed that secondary cases within a household, infected by long close contact, die more often than index cases, and that crowding predicted death better than nutrition (Aaby 1986, abstract only). Keeping siblings apart lowers the dose.

Complications. About 8% of cases get diarrhoea, 7% ear infection, 6% pneumonia and 0.1% encephalitis (CDC). Pneumonia and dehydration are the commonest immediate causes of death (MSF measles guideline). Among 130 Tanzanian children with corneal ulcers, 37% of ulcers followed measles, vitamin A deficiency was the main cause of ulcers in both eyes, and traditional eye medicines caused others (Foster and Sommer 1987, search summary only).

Immune amnesia. Mina and colleagues (2015) used records from England and Wales, the US and Denmark to show that measles lowers resistance to other infections for 2 to 3 years, and that it may have lain behind up to half of all childhood infectious deaths before vaccine. In 2019 they measured 77 unvaccinated Dutch children before and after a 2013 outbreak: they lost 11 to 73% of their antibody repertoire, about 40% in severe and 33% in mild cases, while controls kept about 90% (Mina 2019). The village should expect two years of excess diarrhoea and pneumonia deaths after a measles year, and should mark in the register which children had measles.

Vitamin A. Barclay, Foster and Sommer (1987) randomised 180 children admitted with measles to routine care with or without 200,000 IU by mouth on two days. Six of 88 treated children died (7%) against 12 of 92 controls (13%), p = 0.13. Under age 2, 1 of 46 died against 7 of 42, a significant difference. The page I read did not name the hospital, which other sources place in Tanzania [VERIFY]. Hussey and Klein (1990) randomised 189 children with severe

measles in Cape Town, median age 10 months, to 400,000 IU over two days or placebo, within 5 days of the rash. Of 12 deaths, 10 were on placebo (p = 0.05), and death or major complication fell by half (RR 0.51, 95% CI 0.35 to 0.74) (abstract only).

The Cochrane review by Yang, Mao and Wan (first version Huiming 2005) pooled 8 trials with 2,574 children. Across all regimens deaths did not fall significantly (RR 0.70, 95% CI 0.42 to 1.15). Two doses of 200,000 IU under age 2 cut deaths by about 80% (RR 0.21, 95% CI 0.07 to 0.66). A single dose showed no benefit and no adverse effects were reported (Yang 2011). IN-01's 62% fall (95% CI 19 to 82%) is the earlier two-dose estimate across ages (THRIVING library, IN-01). I agree two doses are the rule, but the benefit sits in children under 2 and in deficient populations, and one dose is not enough.

WHO doses: 50,000 IU under 6 months, 100,000 IU at 6 to 11 months, 200,000 IU from 12 months, once a day on two consecutive days, with a third dose 2 to 4 weeks later for eye signs or severe malnutrition (WHO 2005). MSF gives the third dose on day 8 when the cornea is affected (MSF measles guideline). IN-01's Protocol 4 names only eye signs as the trigger. I would add severe malnutrition, following WHO.

Overdose. Acute toxicity in infants shows as a bulging fontanelle, vomiting and irritability, settling in 24 to 72 hours. Three Indian infants had a bulging fontanelle after 100,000 IU, and a Bangladesh newborn trial of 25,000 IU found bulging in 10.5% against 2.5% (Indian Pediatrics 1996 reports, search summary only [VERIFY]). The UK Committee on Toxicity puts the threshold at about 800 µg retinol equivalents per kg per day (COT). HY-08 gives the chronic limits: 600 µg a day under age 4 and 3,000 µg in adults, with chronic toxicity at 8,000 to 10,000 µg a day (THRIVING library, HY-08). In Assam in November 2001 a campaign used 5 mL cups in place of 2 mL spoons and 14 to 17 child deaths were reported, with overdose, coincidence and mass panic all argued since [VERIFY]. The lesson is the measure: the card must name capsules or drops, never "a spoonful". Intakes over 10,000 IU a day in early pregnancy were associated with malformations (Rothman 1995, prevalence ratio 4.8, secondary), so no girl or woman who could be pregnant may receive the measles dose. A daily vitamin A 'tonic' is the usual route to chronic poisoning.

Food is the long answer: liver, red palm oil (*Elaeis guineensis*, fruit), orange sweet potato (*Ipomoea batatas*, root), carrot (*Daucus carota*, root) and amaranth leaves (*Amaranthus* spp.) (THRIVING library, HY-08). Wild carrot has deadly lookalikes, poison hemlock (*Conium maculatum*) and water hemlock (*Cicuta* spp.), so only the garden carrot belongs here.

Nursing. WHO and MSF agree (WHO 2005, MSF measles guideline): feed small meals every 2 to 3 hours and keep breastfeeding, because many children lose weight for weeks. Give fluids and oral rehydration for diarrhoea. Treat fever over 39°C for comfort only. Clean the eyes with boiled, cooled water twice a day, use tetracycline eye ointment three times a day for 7 days if infected, and never steroid drops. Rinse the mouth with a pinch of salt in a cup of water four times a day. Count breaths and treat pneumonia as in IN-03 (THRIVING library, IN-03). Weaver (1924) added a darkened room, petroleum jelly on the lid margins, and urgent help for growing hoarseness, which could be diphtheria grafted onto measles.

The tradition. Red cloth runs from John of Gaddesden's *Rosa Anglica* (early 14th century) to Niels Finsen's red room of 1893 (secondary accounts [VERIFY]). It is harmless, and a dimmed room does as much. Many cultures heat or sweat the child to 'bring out' the rash. In India measles is linked to the goddess Mata and some foods are withheld while she is present (Indian Pediatrics 1994, ethnographic summary [VERIFY]). Vatsonga mothers in Limpopo combine isolation, special foods and herbal washes (Lebese 2004, abstract only). The useful core is isolation and rest. The harms are withholding food, overheating a feverish child and putting plant juices into damaged eyes. Neem leaves (*Azadirachta indica*) hung by beds are harmless, but neem seed oil given to infants has caused encephalopathy and death, reported from Malaysia in the 1980s [VERIFY].

4. Whooping cough

The disease. Chao Yuanfang described a 'cough of a hundred days' in China around 610 CE, saying only one or two in ten recovered (secondary history [VERIFY]). Thomas Sydenham named it pertussis in 1679. Incubation is 7 to 10 days. A cold-like catarrhal stage of 1 to 2 weeks is the most infectious. The paroxysmal stage lasts 1 to 6 weeks, averaging 15 fits in 24 hours, each a run of coughs on one breath, a whoop and often vomiting. Convalescence takes weeks to months. Young infants may never whoop: they go blue, stop breathing (apnoea) or fit, and apnoea may be the only sign. Untreated patients are infectious for about 21 days from the start of the fits, or until 5 days of an effective antibiotic (MSF pertussis guideline, CDC).

Who dies. Chow and colleagues (2016) found that in the US in 1900 to 1919 two thirds of pertussis deaths came before 12 months and about 15% before 2 months, with 3,530 infant deaths per million each year. Infant pertussis deaths reached 5,110 per million in Machakos, Kenya, and 6,900 per million at 0 to 5 months in Niakhar, Senegal, where pertussis caused 9% of under-5 deaths. In Chicago in 1911 to 1922, 1,630 of 39,233 cases died, 1 in 24, three times the measles rate (Weaver 1924).

Where infants catch it. Wendelboe and colleagues (2007) found a source in 48% of infant cases: parents in 55% of these, siblings in 16%, household members in 76 to 83% overall (secondary summary). The baby is protected by keeping coughing people away from it.

What antibiotics do. The Cochrane review by Altunaiji and colleagues (2007) found that azithromycin for 3 days or clarithromycin or erythromycin for 7 days cleared the germ as well as 14 days of erythromycin (RR 1.02) with fewer side effects (RR 0.66), but that no antibiotic changed the course of the illness. Prophylaxis for contacts over 6 months was not significantly protective (abstract only). WHO says erythromycin "does not shorten the illness but reduces the period of infectiousness" (WHO 2005). After the Fall the antibiotic's job is to stop an older child infecting a baby. MSF doses are given in Protocol 4 (MSF pertussis guideline). Erythromycin under 1 month risks pyloric stenosis, so azithromycin is preferred at that age (CDC).

What nursing does. No trial tests nursing, but WHO and MSF agree and the advice follows the mechanism of death: apnoea, exhaustion, pneumonia and starvation (WHO 2005, MSF pertussis guideline). Watch every infant under 3 to 6 months closely. Keep the child semi-reclining at about 30°. During a fit, turn it prone or on its side, head slightly down. Wipe secretions gently and avoid deep suction, throat examination and nasogastric tubes, which trigger fits. Stimulate a baby that stops breathing. Give oxygen at 0.5 L/min by nasal prongs where it exists. Feed small amounts often, soon after a fit, and refeed after vomiting, as Weaver (1924) also advised. Check every 3 hours and teach the mother to recognise apnoea.

Why sedatives kill. WHO is explicit: "Do not give cough suppressants, sedatives, mucolytic agents or antihistamines" (WHO 2005). A Cochrane review found no benefit for antihistamines (49 children), salbutamol (42) or steroids (11) (Wang 2014, abstract only). Opiates suppress the drive to breathe in an infant whose danger is already apnoea. Weaver's 1924 pamphlet still advised paregoric, an opium tincture (Weaver 1924). Mrs Winslow's Soothing Syrup held about 65 mg of morphine per fluid ounce and was called a 'baby killer' by the American Medical Association in 1911, and codeine has caused child deaths through fast conversion to morphine (secondary sources [VERIFY]).

The tradition. Sundew (*Drosera rotundifolia*, whole plant) and thyme (*Thymus vulgaris*, leaf) are European herbal standards for coughs, untested in pertussis [VERIFY]. Thyme tea is safe for older children. Honey eases coughs in children over 1 year (THRIVING library, IN-03) and must never be given under 12 months because of infant botulism.

5. Diphtheria

The disease. Toxin-making *Corynebacterium diphtheriae* grows in the throat, nose, larynx and skin sores. Incubation is 2 to 5 days (MSF diphtheria guideline). Within 2 to 3 days of a mild sore throat a grey-white membrane forms, stuck fast and bleeding when scraped, and neck swelling gives the 'bull neck' of severe disease (CDC). In the larynx it causes hoarseness, stridor and obstruction. Toxin damages the heart muscle (myocarditis) in 10 to 20%, mostly in week 2 but from week 1 to week 6, and the nerves of palate, eyes, limbs and breathing from week 2 to week 8. At least a third of adult deaths are cardiac (CDC, MSF). Weaver wrote that with heart damage "perfect quiet in a horizontal position is imperative", since sitting up could be "quickly fatal", most often between day 5 and day 14 (Weaver 1924).

Without and with antitoxin. Before antitoxin a quarter to a third of patients died, and 60 to 80% of hospital cases (Weaver 1924). Emil von Behring and Shibasaburo Kitasato described antitoxin in 1890 and it was first used in Berlin in 1891 [VERIFY: Behring's paper not read]. Émile Roux reported in Paris in 1894 that 109 of 448 serum-treated children died (24%), against 51% of 3,971 in the same hospital from 1890 to 1893 and 60% at the Hôpital Trousseau without serum (James Lind Library, secondary). Johannes Fibiger's trial at the Blegdam Hospital, Copenhagen, from May 1896 to May 1897, allocated by alternate day: 8 of 239 treated patients died (3.3%) against 30 of 245 controls (12.2%), and 60.7% of treated patients had serum sickness (James Lind Library). Weaver gave deaths by day of antitoxin: about 1% on day 1, 3% on day 2, 6% on day 3, 11% on day 4 and 15% on day 5. Bound toxin cannot be neutralised, so every day counts. Modern case fatality, often without antitoxin, is 5 to 10%, up to 20% under 5 and over 40 (CDC).

Nome, 1925. Dr Curtis Welch diagnosed diphtheria in Nome, Alaska, on 21 January 1925, with the town's antitoxin expired. 300,000 units, enough for about 30 patients, travelled 674 miles by dog sled from Nenana, relayed by 20 mushers and about 150 dogs from 27 January to 2 February,. The official toll was 5 deaths and 29 cases (secondary accounts [VERIFY]). One expired box nearly cost a town its children.

The post-Soviet epidemic. Vitek and Wharton (1998) traced diphtheria's return to the former Soviet Union as coverage fell and adult immunity waned. Cases rose from 1,431 in 1990 to 50,412 in 1994 and 50,425 in 1995. There were more than 140,000 cases and 4,000 deaths, about 3% by my arithmetic, three quarters of them in Russia, where adults aged 40 to 49 had the highest death rates. Azerbaijan's case fatality was 13.1%. Vaccinating about 70 million adults in 1993 to 1995 ended it. Adults lose immunity when boosters stop.

Antibiotics. These stop toxin production and spread, not the toxin already made. MSF and the 2024 WHO guideline prefer a macrolide for 14 days, with penicillin as the alternative, and give contacts a macrolide for 7 days or one injection of benzathine penicillin (MSF diphtheria guideline, WHO 2024 summary). Doses are in Protocol 5. No trial has measured antibiotics without antitoxin. My inference is that early antibiotics will prevent some severe cases and will not save a child who already has a bull neck [VERIFY].

The airway. Pierre Bretonneau named diphtheria in 1821 and performed the first successful tracheotomy for it in 1825. Armand Trousseau reported 47 survivors of 216 tracheotomies in 1855 (22%), and Joseph O'Dwyer's intubation tube saved 12 of his first 50 children in New York in 1887 (James Lind Library, secondary [VERIFY]). WHO says: "Tracheostomy should only be done by experienced staff" (WHO 2005). In children under about 10 to 12 only needle cricothyroidotomy is taught, which buys minutes and does not ventilate without pressurised oxygen (UCT atlas, Merck Manual). A tracheotomy from a book, on a choking child by lamplight, will usually kill by bleeding, a false passage or a membrane pushed deeper. An experienced hand at an equipped infirmary might save one child in three or four of those otherwise certain to die.

Can antitoxin be stockpiled or made? It is still made from hyperimmunised horses. Supply collapsed as the disease became rare. During the Rohingya outbreak in Cox's Bazar in December 2017 only about 5,000 vials existed worldwide, about 100 new cases a day were seen, and MSF could treat only about 12 patients a day with antitoxin (Reuters via Arab News 2017). I found no reliable shelf life for current products. A district might hold a few salvaged vials, kept cool and dark and used early for a spreading membrane.

It cannot be made after the Fall. Production needs toxigenic cultures, horses under veterinary control, sterile plasma processing and potency testing in animals, and each step can kill. In St Louis in 1901, antitoxin from a horse called Jim that had tetanus killed 13 children and led to the US Biologics Control Act of 1902 (widely reported, primary account not read [VERIFY]). Weaver (1924) had already abandoned local treatment: "We no longer gargle, spray and swab the throat".

6. Scarlet fever, mumps, rubella and chickenpox

Scarlet fever is streptococcal throat infection with a sandpaper rash. Case fatality was 1.5 to 10% by Weaver's time (Weaver 1924), and fell before antibiotics, probably through a change in the germ [VERIFY]. Its long shadow is rheumatic heart disease. Denny and colleagues (1950) at Warren Air Force Base gave penicillin to airmen with streptococcal throats: rheumatic fever followed in about 2% of 804 untreated and under 1% of 798 treated men, a number needed to treat of 50 to 60, with penicillin for 10 days started within about 9 days (secondary). Isolation was 4 to 5 weeks before antibiotics (Weaver 1924).

Mumps swells the salivary glands. Orchitis affects 20 to 50% of males past puberty but rarely sterilises. Permanent deafness follows about 1 in 20,000 cases and death about 2 per 10,000 (CDC summaries [VERIFY]).

Rubella is trivial for the child and catastrophic for the fetus. Miller, Cradock-Watson and Pollock (1982) found fetal infection in over 80% after maternal rubella in the first 12 weeks, 54% at 13 to 14 weeks and 25% at the end of the second trimester, with defects almost confined to infection before 16 weeks (secondary). Norman Gregg in Sydney in 1941 linked infant cataracts to maternal rubella (Gregg 1941, not read). Congenital rubella syndrome, with deafness, heart defects and cataract, follows up to 85% of first-trimester infections (CDC). Deliberate exposure of young girls is left open for MA-07, not yet in the library, since rubella also causes encephalitis in about 1 in 6,000 cases [VERIFY].

Chickenpox is mild in children and dangerous in adults, newborns and the immunosuppressed: about 1 to 1.5 deaths per 100,000 cases at ages 1 to 19, 7 in infants, 30 in adults (public health summaries [VERIFY]). A newborn whose mother develops the rash from 5 days before to 2 days after delivery may die in 20 to 30% of cases without treatment [VERIFY]. Aspirin, willow bark (*Salix alba*, bark) and meadowsweet (*Filipendula ulmaria*, flowers), all salicylates, must never be given because of Reye's syndrome. Oatmeal baths (*Avena sativa*, grain) and short nails ease itch. Isolation lasts until every spot has crusted (Weaver 1924).

7. The vaccine stockpile question

HY-10 (vaccines) is not yet in the library, so check this section against it.

Measles vaccine is live, freeze-dried, in multi-dose vials. A WHO-prequalified Serum Institute product keeps 30 months at 2 to 8°C, in the dark, with a type 14 vial monitor (a heat label that changes after about 14 days at 37°C), and must be discarded 6 hours after mixing or at the end of the session (WHO prequalification). The dried vaccine survives about 6 days at 37°C (secondary [VERIFY]). In one Nigerian survey only 16.7% of field vials were potent (secondary [VERIFY]). I found no study of potency after expiry. Efficacy is about 85% before 12 months, 95% from 12 months and 98% after two doses (THRIVING library, IN-01). Reconstituted vials kept too long grow *Staphylococcus aureus*: toxic shock deaths followed in Himachal Pradesh in 1991 to 1992 (6 deaths) and Tamil Nadu in 2008 (4 deaths) (Indian Pediatrics 2008, summary only).

DTP vaccines are destroyed silently by freezing. Shelf life is about 36 months at 2 to 8°C. The shake test compares a suspect vial with one frozen on purpose: if the suspect's sediment settles as fast or faster, discard it (cold chain training material, secondary [VERIFY]).

After exposure, measles vaccine within 72 hours or immune globulin 0.5 mL/kg within 6 days can prevent or soften measles (CDC immune globulin guidance).

After the Fall the programme is whatever salvaged vials survive: measles at 9 to 12 months, DTP as stock allows, every dose recorded by name (Protocol 7).

Evidence grades

Practice	Grade	Tradition says	Record shows	Science infers
Isolation of the sick child, keeping infants and pregnant women away	B	Keep the sick apart, many cultures	Panum and island records show spread follows contact. Secondary cases are deadlier (Aaby)	Lowers dose and delays spread, cannot stop measles once inside a house
Vitamin A, two doses by age, in measles	A	Not a tradition	Barclay 1987, Hussey and Klein 1990, Cochrane: deaths fall by about 80% under 2 with two doses	Repairs epithelial and immune damage in deficient children
Daily vitamin A tonic	X	'Strengthening'	Chronic toxicity above 8,000 to 10,000 μg a day (HY-08)	Fat-soluble, accumulates
Feeding and breastfeeding through measles	B	Some traditions withhold food	Weaver, WHO, MSF, malnutrition drives deaths (Gode)	Prevents wasting and deficiency
Withholding food in measles	X	Avoid 'hot' or fried foods (Mata)	Weight loss and deaths follow	
Heating or sweating to bring out the rash	X	Common worldwide	No benefit recorded, heat stroke and dehydration likely	
Eye care with boiled water, tetracycline ointment	B		Foster and Sommer: ulcers from traditional eye medicines	Prevents secondary infection
Macrolide antibiotic for pertussis	A (for spread), X (for course)		Cochrane: clears germ, no change in illness	
Pertussis nursing: positioning, feeding after fits, apnoea watch	B		WHO, MSF, Weaver agree	Prevents apnoea deaths and starvation
Sedatives, opiates, cough syrups in pertussis	X	Paregoric, soothing syrups	Infant deaths (Winslow, codeine)	Suppress breathing
Honey for cough over 12 months	C	Worldwide	Trials in non-specific cough (IN-03)	

Practice	Grade	Tradition says	Record shows	Science infers
Diphtheria antitoxin	A		Fibiger 1898 trial, Roux 1894, hospital series	Neutralises free toxin
Antibiotics for diphtheria	B		Clears carriage, WHO 2024	Stops toxin production, not bound toxin
Strict bed rest in diphtheria for 2 to 6 weeks	B		Weaver, pre-antitoxin wards	Rests a damaged heart
Tracheotomy by experienced surgeon	B		Trousseau 22%, pooled 39% survival in otherwise fatal cases	
Tracheotomy by an untrained hand	X		No record of success	
Swabbing or scraping the membrane	X	Caustics, silver nitrate	Weaver abandoned it	Bleeding, spread
Penicillin for streptococcal throat	A		Denny 1950	Prevents rheumatic fever
Keeping pregnant women from rash cases	B		Gregg 1941, Miller 1982	
Aspirin or willow bark for chickenpox	X	Willow for fever	Reye's syndrome	
Measles vaccine, in date and cold-chained	A		85 to 98% efficacy (IN-01)	
Making antitoxin after the Fall	X		St Louis 1901	Not feasible

Means ledger

Measles

Rung	What it can do	What it changes
Hands	Recognise the prodrome (fever, cough, runny nose, red eyes, then the rash on day 3 to 5). Isolate. Breastfeed. Count breaths	Fewer and lighter secondary cases in the house. Pneumonia noticed
Hearth	Boiled water for drinks and eye washing, salt mouthwash, home oral rehydration solution, small frequent meals, tepid sponging, a dimmed room	Fewer deaths from dehydration and wasting. Less eye infection

Rung	What it can do	What it changes
Garden and still	Red palm oil, liver, orange sweet potato, carrot and greens to prevent vitamin A deficiency before measles arrives. A scale to weigh children	Fewer blind children, probably fewer deaths [VERIFY]
Village dispensary	Vitamin A capsules by age, tetracycline eye ointment, amoxicillin for pneumonia, a register of who had measles, isolation hut	The single largest change: deaths under 2 cut by about half or more
District infirmary	Oxygen if any, feeding by tube, treatment of severe pneumonia and dehydration, measles vaccine if any stock survives, post-exposure vaccine within 72 hours	Saves some severe pneumonia. Vaccine stops the next epidemic
Pre-Fall hospital	Two-dose vaccine at 95%+ coverage, immune globulin, oxygen, intensive care	Measles case fatality 0.1 to 0.3%

Whooping cough

Rung	What it can do	What it changes
Hands	Keep coughing children and adults away from babies under 6 months. Position the baby. Stimulate when it stops breathing. Rescue breaths	Fewer infant infections. Some apnoeas reversed
Hearth	Small frequent feeds after fits, breastfeeding, refeeding after vomiting, clean cloths for secretions, a watcher at night	Prevents starvation and dehydration over the long cough
Garden and still	Thyme tea for older children. Honey for those over 1 year	Comfort only
Village dispensary	Azithromycin or erythromycin for the case and for household contacts with a baby in the house. Bulb syringe. A night rota	Shortens infectiousness, protects the baby
District infirmary	Oxygen by nasal prongs, nasogastric feeding when needed, diazepam for prolonged fits, antibiotics for pneumonia	Infants with apnoea and pneumonia survive more often
Pre-Fall hospital	Maternal vaccination in pregnancy, infant vaccine at 6 weeks, intensive care, ventilation	Infant deaths rare

Diphtheria

Rung	What it can do	What it changes
Hands	Look in the throat with a light. Recognise membrane and bull neck. Isolate. Keep the child still and upright if breathing is hard	Early recognition. Calm reduces oxygen need
Hearth	Fluids, soft food, a quiet room, the child kept lying flat once the heart is affected	Fewer sudden cardiac deaths in weeks 2 to 6
Garden and still	Nothing specific	
Village dispensary	Penicillin or a macrolide for the case and all contacts. Records of contacts. Pulse counted twice daily	Fewer secondary cases, perhaps fewer severe ones
District infirmary	Any salvaged antitoxin given early by trained staff with adrenaline at hand. Tracheotomy by an experienced person only. Monitoring for heart and nerve complications for 3 months	Antitoxin in the first 3 days cuts deaths from about a third to under 10%
Pre-Fall hospital	Antitoxin, intubation, ventilation, pacing for heart block, booster vaccination	Case fatality 5 to 10%

Harm test

Vitamin A. Kills or harms through overdose (a cup in place of a spoon, as alleged in Assam in 2001), through repeated doses within a month, through use as a daily tonic, and through giving the measles dose to a pregnant woman. Acute signs are vomiting, headache, drowsiness and in infants a bulging fontanelle. Stop further doses, give fluids, and expect recovery in 1 to 3 days. Chronic toxicity shows as dry skin, hair loss, bone pain and liver damage.

Fluids and feeding. Harm comes from overconcentrated home rehydration solution (too much salt causes high sodium, fits and death), from forced feeding of a child who is choking or coughing, and from giving fluids to a child with heart failure from diphtheria.

Fever control. Cold water or alcohol rubs cause shivering and alcohol poisoning. Paracetamol overdose damages the liver (THRIVING library, IN-02).

Pertussis care. Opiates, codeine, sedatives, antihistamines and strong alcohol kill by stopping breathing. Steam kettles cause scalds. Deep suction and throat examination provoke fits and apnoea. Erythromycin in the first month of life can cause pyloric stenosis (projectile vomiting, a lump in the upper belly), which needs surgery.

Diphtheria care. Swabbing or scraping the membrane makes it bleed. Allowing a child with myocarditis to sit up, walk or strain can cause sudden death. Feeding a child with palatal paralysis by mouth causes choking and pneumonia, so watch for fluid coming down the nose. Antitoxin causes serum sickness in up to 60% and occasionally anaphylaxis, which must be treated with adrenaline at once. A tracheotomy by an untrained hand kills by bleeding from the thyroid or great vessels, by placing the tube outside the trachea, or by pushing the membrane further down.

Isolation. Isolation harms when it means abandonment: a child left alone stops eating and drinking.

Vaccine. Harm comes from reconstituted vials kept beyond 6 hours (toxic shock), from reused needles (blood-borne infection, abscess), from frozen DTP (no protection, more local reactions) and from false confidence in vaccine of

unknown storage.

Plants. Wild carrot has deadly lookalikes. Neem oil by mouth kills infants [VERIFY]. Willow bark and meadowsweet carry the aspirin risk. Traditional eye preparations blind.

Red flags

Measles - Fast breathing or chest indrawing (pneumonia). Treat as in IN-03. - Unable to drink or breastfeed, or vomiting everything. - Drowsiness, fits or confusion (encephalitis). - Clouding of the cornea, eye pain or a child who will not open the eyes (corneal ulcer). Give the third vitamin A dose and protect the eye. - Severe wasting or swelling of both feet (severe malnutrition). - Bloody diarrhoea or signs of dehydration. - Stridor at rest, especially with hoarseness (croup, or diphtheria grafted onto measles).

Honest comfort: most children who keep drinking and feeding and get vitamin A recover. When a child with measles pneumonia is dying without oxygen, sit them up in a parent's arms, keep them warm, wet the lips, keep the room quiet and stay. The mother should know it was the virus and not her care.

Whooping cough - Any baby under 3 months with a cough. - Pauses in breathing, going blue, or a fit. - Not feeding or losing weight. - Fast breathing or fever between fits (pneumonia). - Drowsiness between fits.

Honest comfort: older children almost always survive, though the cough lasts months. For a baby dying of exhaustion or apnoea, hold the baby upright against the chest, keep it warm, and let the parents hold it. Do not give sedatives to ease the end, because they will hasten it in a way the family may never forgive.

Diphtheria - A membrane spreading beyond the tonsils, or a bull neck. - Stridor, hoarseness, indrawing of the chest. - A fast, slow or irregular pulse, pallor, cold limbs, or vomiting in week 2 (myocarditis). - Fluid returning through the nose, a nasal voice, double vision, weakness of limbs or breathing (nerve damage). - Bleeding from the nose or mouth, low urine output.

Honest comfort: the paralysis of diphtheria almost always recovers fully over weeks to months if the child is fed and kept breathing. A child with myocarditis who is kept flat and quiet through weeks 2 to 6 has a chance that walking about removes. For a child with a closing airway and no skilled operator, keep them upright and calm in a parent's arms, cool moist air may help, and the family should not be told that a cut in the neck from a book would have saved them.

Scarlet fever, mumps, rubella, chickenpox - Scarlet fever: joint pains, breathlessness or chest pain in the following weeks (rheumatic fever), dark urine and swelling (kidney inflammation). - Mumps: severe headache, stiff neck, vomiting (meningitis), sudden deafness. - Rubella: any rash illness near a woman in the first four months of pregnancy. - Chickenpox: spreading redness around a spot, breathlessness (pneumonia, especially in adults), a newborn whose mother had the rash at delivery, drowsiness.

The case against

The strongest case against the main recommendation comes from the Cochrane reviewers themselves. Yang, Mao and Wan found that across all trials vitamin A did not significantly reduce measles deaths (RR 0.70, 95% CI 0.42 to 1.15). The benefit rests on subgroups, children under 2 and two-dose regimens, in small trials with 18 deaths in Barclay's and 12 in Hussey and Klein's. Subgroups in small trials are easily overstated. I still recommend two doses for every child with measles, because the subgroups are where post-Fall deaths will fall and the harm is small, but the book should not promise a fixed halving.

The DEVTA trial in India, led by Shally Awasthi and Richard Peto, found only a 4% fall in child deaths from routine supplementation, against 34% in Alfred Sommer's Aceh trial, and Sommer, West and Martorell criticised DEVTA's conduct (THRIVING library, HY-08, IN-01). That dispute concerns routine capsules, not measles treatment, but

effects shrink where deficiency is rarer. Writers in the Indian Journal of Medical Ethics used the Assam deaths of 2001 to argue that mass vitamin A had outrun the evidence and safe measures (Indian Journal of Medical Ethics 2002, listing only [VERIFY]).

G. Dennis Shanks's work cuts another way. If measles deaths depend mainly on the host's past infections and on crowding, as his island and military comparisons and Aaby's household studies suggest, vitamin A is one lever and perhaps not the largest. Spacing, feeding and keeping infants out of crowded rooms may matter as much. Thomas McKeown argued that infectious mortality in Britain fell mainly through better nutrition, and Simon Szreter credited public health instead [VERIFY: neither read]. Measles deaths did fall long before vaccine. The record warns against crediting a remedy for what food and space did.

Antitoxin had its doubters in the 1890s, who pointed out that diphtheria mortality fluctuated from year to year and that bacteriology changed who was counted as a case. Fibiger's alternate-day trial was designed to answer them and did, but the before-and-after hospital series alone would not convince a modern reader. Tracheotomy was never tested by comparison at all.

On pertussis, a critic could argue from the Cochrane review that macrolides are wasted, since they neither change the course nor significantly protect contacts over 6 months. My answer, which is untested inference [VERIFY], is that the baby in the house is the patient.

Finally, the romance of the hospital. An infirmary without oxygen, antitoxin or intensive care will not reproduce modern outcomes, and the book must not imply that carrying a choking child 20 miles will save it. The romance of natural immunity is answered by Panum, Fiji and Gode: the lifelong immunity measles gives is real, and children paid for it.

10-line summary

1. A district of 3,000 cannot keep measles. It will arrive as an import and hit everyone born since the last epidemic.
2. Without vaccine, about 100 susceptible children a year accumulate in a district, enough for an epidemic within about 2 years and a large one by 5 [VERIFY].
3. Measles case fatality in poor settings is 2 to 12% under 5, higher in famine, crowding and secondary household cases.
4. Two doses of vitamin A by age (50,000, 100,000 or 200,000 IU) on two consecutive days cut deaths in children under 2 by about 80% in pooled trials. One dose does not work.
5. Measles damages immune memory for 2 to 3 years, so deaths from other infections follow.
6. Feeding, fluids, eye care and pneumonia treatment are the rest of measles care. Withholding food and sweating kill.
7. Pertussis kills infants. Antibiotics shorten infectiousness, not illness. Keeping coughing people away from babies is the protection.
8. Nursing (positioning, feeding after fits, watching for apnoea) keeps pertussis infants alive. Sedatives and opiates kill them.
9. Diphtheria without antitoxin killed a quarter to a third of patients. Antibiotics and strict bed rest are what remain. Antitoxin cannot be made.
10. Tracheotomy by an untrained hand will almost always fail. Say so plainly.

Open questions

- How much do antibiotics alone, without antitoxin, lower diphtheria case fatality? No trial or good cohort was found.
- What is the true measles case fatality in modern refugee camps and famines? The 25% figure in the brief could not be traced to one study.

- How long does salvaged measles vaccine keep any potency after its expiry date in a cool cellar? No study found.
- What is the shelf life of current diphtheria antitoxin products? Not found.
- Should girls be deliberately exposed to rubella before puberty when no vaccine exists? The benefit to future pregnancies must be weighed against encephalitis and the risk of exposing pregnant women. This belongs with MA-07.
- Does vitamin A from food (red palm oil, liver) before an epidemic protect as well as capsules during one? Plausible, untested [VERIFY].
- Can contact prophylaxis with azithromycin prevent infant deaths in households? The Cochrane review found no significant effect in contacts over 6 months, but infants were not separately studied.
- What will the effective R0 of measles be in a dispersed rural district after the Fall? The threshold arithmetic depends on it.

Sources to read in full

1. Panum PL. Observations made during the epidemic of measles on the Faroe Islands in the year 1846 (English translation 1940).
2. Yang H, Mao M, Wan C. Vitamin A for treating measles in children. Cochrane review, latest version.
3. WHO. Pocket book of hospital care for children (2005 and 2013 editions).
4. MSF Clinical guidelines: measles, pertussis and diphtheria chapters.
5. Vitek CR, Wharton M 1998. Diphtheria in the former Soviet Union. Emerging Infectious Diseases.
6. Weaver GH 1924. Measles, diphtheria, scarlet fever, chicken pox, and whooping cough.
7. Mina MJ et al 2019. Measles virus infection diminishes preexisting antibodies. Science.
8. Portnoy A et al 2019. Estimates of case-fatality ratios of measles. Lancet Global Health.
9. WHO 2024. Clinical management of diphtheria: guideline. Could not be read in this session.
10. Chow MYK et al 2016. Global childhood deaths from pertussis: a historical review. Clinical Infectious Diseases.

At the bedside after the Fall

Household

Minimum viable version. Know the three faces: measles (fever, cough, red eyes, then a rash from the face down), whooping cough (a cold turning into fits with a whoop or vomiting, or a baby who goes blue), diphtheria (a grey membrane and swollen neck). Keep babies away from coughing people. Isolate the sick child with one carer. Keep feeding. Never give sedatives or cough syrups to a baby, or aspirin to a child. Feed vitamin A foods in ordinary times.

What it needs to start. Clean cloths, a pot for boiling water, salt and sugar with a measured spoon, a lamp to look in the throat, a family record of who has had measles, chickenpox and whooping cough.

First failure to expect. The infant in the house catches pertussis from an older sibling before anyone recognised the sibling's cold as pertussis, because the catarrhal stage looks like any cold.

Village of 300

Minimum viable version. A trained lay healer with a stock of vitamin A capsules (at least 2 doses for every child under 5, about 100 doses [VERIFY]), tetracycline eye ointment, amoxicillin and azithromycin or erythromycin, a measles register, an isolation room or hut with a carer rota, the vitamin A card and the pertussis nursing sheet on the wall. When the first case appears, every household with a child under 5 is visited daily.

What it needs to start. Capsules and a cool dark store, a scale for weighing children, a watch with a second hand for counting breaths, a list of every child under 5 with date of birth, a messenger to the district, and someone who has seen measles before.

First failure to expect. The first case is recognised only at the rash, 4 days after it became infectious, by which time it has already been to market, church or school.

District of 3,000

Minimum viable version. An infirmary with a nurse or doctor, an isolation ward with its own entrance, oxygen if any source can be kept (a salvaged concentrator with power, or cylinders), nasogastric tubes, the antibiotic stock, any salvaged antitoxin and vaccine in the coldest store available, and a single register of all childhood epidemics. It runs the vaccine stock, the notification rules and the training of village healers.

What it needs to start. A cold store with a daily thermometer record, a map of villages and births, adrenaline and syringes, a person trained in airways, and word between villages within a day.

First failure to expect. The vaccine stock is used up or quietly spoiled by heat or freezing, and a measles epidemic arrives while the district still believes its children are protected.

Protocols

Protocol 1. Isolation for the childhood epidemics

1. A child with fever, cough and red eyes, a cough that comes in fits, or a sore throat with a membrane stays at home in one room with one carer.
2. The carer is someone who has had the disease (ask the elders: measles gives lifelong immunity). Never a pregnant woman, never someone carrying an infant.
3. Move infants under 6 months and pregnant women to relatives if possible. If not, keep them at the far end of the house and never in the same bed.
4. Open a window. Measles virus stays in the air of a closed room for up to 2 hours (CDC), so no visitor enters a room the child has just left.
5. Minimum periods:
    - Measles: until 4 days after the rash appeared, throughout the illness if malnourished or very ill. Contacts who never had measles avoid others from day 5 to day 21 after exposure.
    - Whooping cough: 21 days from the start of the fits, or 5 days after starting azithromycin or erythromycin.
    - Diphtheria: 2 negative cultures, or without a laboratory 14 days after starting antibiotics. All contacts get antibiotics.
    - Scarlet fever: 24 hours after starting penicillin [VERIFY], 3 weeks without it.
    - Mumps: 5 days after the swelling began [VERIFY].
    - Chickenpox: until every spot has crusted, usually 5 to 7 days.
    - Rubella: 7 days after the rash [VERIFY], and away from any woman who may be pregnant.
6. Tell the healer the same day. Register name, age, first symptom and rash date.
7. Never leave the child alone. The carer feeds and sleeps near the child.
8. At the end, air the room in sunshine and wash bedding in hot water.
9. Tolerance: in a one-room house isolation will fail. Concentrate on removing infants and pregnant women.

Protocol 2. The vitamin A card (measles)

1. Give to every child with measles on the day measles is recognised.
2. Dose by age, once a day on two consecutive days:

Age	Day 1	Day 2	Third dose
Under 6 months	50,000 IU	50,000 IU	Same, 2 to 4 weeks later, if eye signs or severe malnutrition
6 to 11 months	100,000 IU	100,000 IU	Same
12 months and over	200,000 IU	200,000 IU	Same

3. Read the capsule strength on the label. From a 200,000 IU capsule, a 100,000 IU dose is half its drops and a 50,000 IU dose a quarter (count the drops in one capsule first [VERIFY for the stock in hand]). Cut the capsule and squeeze into the mouth. Never measure with a spoon or cup.
4. If the child had vitamin A in the last 4 weeks, give only the day 2 dose [VERIFY].
5. Eye signs: night blindness, foamy grey patches on the white of the eye, a dry dull eye, a cloudy or ulcerated cornea. With corneal damage MSF gives the third dose on day 8.
6. Never give this dose to a girl or woman who could be pregnant. In pregnancy no more than 10,000 IU a day.
7. Overdose in the next 24 hours: vomiting, headache, drowsiness, a bulging soft spot. Give no more, give fluids, watch. Most settle in 1 to 3 days.
8. Record date, dose and age. Never give vitamin A daily. Routine capsules between epidemics follow HY-08.

Protocol 3. Measles nursing

1. Isolate (Protocol 1). Vitamin A (Protocol 2).
2. Breastfeed more often. Older children: small soft meals with oil or fat every 2 to 3 hours. Withhold no food the child will take.
3. Drinks freely. Oral rehydration solution after every loose stool (IN-01).
4. Fever over 39°C with distress: paracetamol by weight (IN-02) and lukewarm sponging. No cold water, no alcohol, no aspirin, no wrapping to sweat.
5. Eyes: wipe twice a day, inner corner outward, with boiled cooled water, a fresh cloth for each eye. Pus: tetracycline ointment 3 times a day for 7 days. Nothing else in the eyes. A dimmed room eases light pain.
6. Mouth: a pinch of salt in a cup of boiled water, rinse 4 times a day.
7. Count breaths with the child calm, morning and evening. 50 or more a minute at 2 to 11 months, 40 or more at 1 to 5 years: treat as pneumonia (IN-03).
8. Weigh weekly for 2 months. Add an extra meal a day for a month.
9. Mark 'measles, date' in the register. For 2 to 3 years treat this child's fevers and diarrhoea early.

Protocol 4. The pertussis nursing sheet

1. A baby under 3 months with a cough, or any child with coughing fits ending in a whoop, vomiting or going blue, has whooping cough until proved otherwise.
2. Antibiotic if held, within 3 weeks of cough onset (6 weeks for infants), per MSF:
    - Azithromycin under 6 months: 10 mg/kg once daily for 5 days.
    - Azithromycin from 6 months: 10 mg/kg (maximum 500 mg) on day 1, then 5 mg/kg (maximum 250 mg) on days 2 to 5.
    - Or erythromycin 15 mg/kg 3 times daily for 7 days, avoiding it under 1 month if azithromycin is held.
3. Give the same course to every member of a household with a baby under 1 or a pregnant woman.
4. Keep coughing people away from babies. A coughing mother still breastfeeds, with a cloth over her mouth, and takes the antibiotic.
5. Lay the baby at about 30° (a folded blanket under the mattress). During a fit, turn it on its side or front, head slightly down, and wipe mouth and nose gently. Nothing deep in the throat.

6. If the baby stops breathing: rub the back firmly, flick the soles. No breath within 10 seconds: 5 rescue breaths over mouth and nose, then continue.
7. Offer the breast or a small feed straight after each fit, every 2 hours if possible. Refeed within 10 minutes of vomiting.
8. Someone awake with the baby day and night for the worst 2 weeks. Check every 3 hours: colour, breathing, feeding, at least 4 wet napkins a day.
9. Never: cough syrups, opium, paregoric, codeine, sedatives, antihistamines, alcohol, or honey under 12 months.
10. To the district at once if a baby under 3 months stops breathing or turns blue, takes under half its usual feeds, fits, or breathes fast between fits.
11. Expect the cough for 6 to 10 weeks and its return with the next cold. This is not a relapse.

Protocol 5. Diphtheria without antitoxin

1. Look in every feverish sore throat with a light and a spoon handle. A grey-white membrane that bleeds when touched, or a bull neck, is diphtheria until proved otherwise.
2. Do not scrape, swab or paint the membrane. Isolate (Protocol 1).
3. Antibiotic at once for 14 days: azithromycin 10 to 12 mg/kg once daily (maximum 500 mg), or erythromycin 10 to 15 mg/kg 4 times daily (maximum 500 mg a dose), or if no macrolide, procaine penicillin 50,000 units/kg daily by injection, or oral penicillin V.
4. Send word to the district the same day. Antitoxin, if held there, is worth most in the first 3 days, and only a trained person gives it, with adrenaline drawn up.
5. Contacts: azithromycin or erythromycin for 7 days, or one injection of benzathine penicillin (600,000 IU under 30 kg, 1.2 million IU at 30 kg or more). Look in their throats daily for a week.
6. Keep the patient lying and quiet from day 1. From day 5 to at least day 21, longer if the pulse is abnormal: strict bed rest, bedpan, no sitting up.
7. Count the pulse twice daily for 6 weeks. Report a child's pulse over 140 or under 60, irregularity, pallor, vomiting or cold hands.
8. If fluid comes back through the nose or drinks cause choking, stop feeding by mouth and send for help.
9. If breathing becomes noisy and hard: upright in a parent's arms, calm, cool air. Do not lay flat, do not look in the throat, do not cut the neck unless trained and supervised before.
10. Watch for weakness of eyes, face, limbs or breathing for 3 months. It usually recovers.

Protocol 6. Rash and pregnancy

1. A woman who may be in the first 16 weeks of pregnancy avoids every person with rash and fever.
2. If a mother gets chickenpox from 5 days before to 2 days after the birth, keep the newborn warm, breastfed and watched for 3 weeks, and send to the district at the first spot.
3. No aspirin, willow bark or meadowsweet for any child or pregnant woman with a rash.

Protocol 7. Salvaged vaccine

1. Store at 2 to 8°C in the dark, in the coldest place that never freezes. Record the temperature daily.
2. Never freeze DTP. If it may have frozen, shake test it against a deliberately frozen vial and discard if it settles as fast or faster.
3. Discard if the vial monitor's inner square is as dark as the outer ring or darker.
4. Mix measles vaccine only with its own cooled diluent. Write the time on the vial. Discard after 6 hours or at session end, even with doses left.
5. One sterile needle and syringe per child.
6. Measles vaccine at 9 to 12 months, or within 72 hours of exposure from 6 months. Not in pregnancy.

7. Record name, date, batch and site. Treat vaccine of unknown storage as possibly useless: vaccinated children still follow isolation rules.

Numbers to carry

1. **Measles R0 12 to 18.** One case infects 12 to 18 others. 95% immunity stops it.
2. **About 100 new susceptible children a year in a district of 3,000.** An epidemic is possible within about 2 years of losing vaccine [VERIFY].
3. **Vitamin A: 50,000 / 100,000 / 200,000 IU by age, on two days.** Third dose at 2 to 4 weeks for eye signs or severe malnutrition. Never in pregnancy.
4. **Measles: infectious 4 days before to 4 days after the rash.** Incubation 10 to 14 days.
5. **Measles case fatality under 5 in poor settings: about 3%, up to 12% or more where child mortality is high.**
6. **Pertussis: infectious for 21 days of fits, or 5 days on azithromycin.** Antibiotics do not shorten the cough.
7. **Pertussis kills two thirds of its victims before 12 months.** Keep coughing people away from babies.
8. **Diphtheria: deaths by day antitoxin given, 1% on day 1 rising to 15% on day 5.** Without antitoxin, a quarter to a third die.
9. **Diphtheria myocarditis: weeks 1 to 6, most in week 2.** Strict bed rest for at least 3 weeks.
10. **Reconstituted measles vaccine: discard after 6 hours.**

References

1. Aaby P, Bukh J, Lisse IM, Smits AJ et al. 1986. High measles mortality in infancy related to intensity of exposure. Journal of Pediatrics. https://pubmed.ncbi.nlm.nih.gov/3723239/ (abstract only, via search summary). The Epidemiology and Infection paper on delayed mortality after early exposure was seen only as a search listing: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/9606356487F5FB4890D4B65F59EDA019/S0950268800059215a.pdf
2. Altunaiji S, Kukuruzovic R, Curtis N, Massie J. 2007. Antibiotics for whooping cough (pertussis). Cochrane Database of Systematic Reviews, CD004404. https://cochranelibrary.com/cdsr/doi/10.1002/14651858.CD004404.pub3/information (abstract and summary only)
3. Barclay AJG, Foster A, Sommer A. 1987. Vitamin A supplements and mortality related to measles: a randomised clinical trial. British Medical Journal 294:294-296. https://pmc.ncbi.nlm.nih.gov/articles/PMC1245303/ (full-text page read in summary)
4. Bartlett MS. 1957. Measles periodicity and community size. Journal of the Royal Statistical Society, Series A. No URL confirmed. Not read, known through secondary summaries in modelling papers.
5. Black FL. 1966. Measles endemicity in insular populations: critical community size and its evolutionary implication. Journal of Theoretical Biology. No URL confirmed. Not read, secondary summaries only.
6. CDC (Centers for Disease Control and Prevention). 2001. Report on mortality during the 2000 famine in Gode, Somali Region, Ethiopia [VERIFY exact title]. Morbidity and Mortality Weekly Report 50(15). https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5015a2.htm (read in summary)
7. CDC. Complications of measles. https://www.cdc.gov/measles/symptoms/complications.html (read through search summary)
8. CDC. Clinical features of pertussis. https://www.cdc.gov/pertussis/hcp/clinical-signs (read through search summary)
9. CDC. Clinical signs and symptoms of diphtheria. https://www.cdc.gov/diphtheria/hcp/clinical-signs/index.html (read in summary)
10. CDC. Measles immune globulin post-exposure prophylaxis. https://www.cdc.gov/measles/downloads/measles-immune-globulin-post-exposure-prophylaxis.pdf (search summary only)

11. Chow MYK, Khandaker G, McIntyre P. 2016. Global childhood deaths from pertussis: a historical review. Clinical Infectious Diseases 63(Suppl 4):S134-S141. https://pmc.ncbi.nlm.nih.gov/articles/PMC5106618/ (read in summary)
12. Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (UK). Vitamin A lay summary. https://cot.food.gov.uk/sites/default/files/cot/cotlaysumvita.pdf (search summary only)
13. Denny FW, Wannamaker LW, Brink WR, Rammelkamp CH, Custer EA. 1950. Prevention of rheumatic fever: treatment of the preceding streptococcic infection. Journal of the American Medical Association. No URL confirmed. Not read, secondary summaries only.
14. Foster A, Sommer A. 1987. Corneal ulceration, measles, and childhood blindness in Tanzania. British Journal of Ophthalmology. No URL confirmed. Read only through search summaries.
15. Gregg NM. 1941. Congenital cataract following German measles in the mother. Transactions of the Ophthalmological Society of Australia. No URL. Not read, secondary only.
16. Guerra FM, Bolotin S, Lim G et al. 2017. The basic reproduction number (R0) of measles: a systematic review. Lancet Infectious Diseases. Listed at https://em-consulte.com/article/1179164/the-basic-reproduction-number-r-0-of-measles-a-sys (search summary only)
17. Hussey GD, Klein M. 1990. A randomized, controlled trial of vitamin A in children with severe measles. New England Journal of Medicine 323:160-164. https://pubmed.ncbi.nlm.nih.gov/2194128/ (abstract via search summary)
18. Indian Pediatrics. 2008. Toxic shock syndrome following measles vaccination (Tamil Nadu). https://indianpediatrics.net/june2008/477.pdf (search summary only). Indian Pediatrics December 1996 reports on vitamin A and bulging fontanelle, https://indianpediatrics.net/dec1996/1053.pdf and https://indianpediatrics.net/dec1996/1065.pdf (search listings only). Indian Pediatrics March 1994 paper on beliefs about measles, https://indianpediatrics.net/mar1994/340.pdf (search listing only). Also Indian Pediatrics January 2002 commentary on the Assam vitamin A campaign, https://indianpediatrics.net/jan2002/jan-114-115.htm, and Indian Journal of Medical Ethics 2002, 'Vitamin controversy', https://ijme.in/articles/vitamin-controversy/ (search listings only)
19. James Lind Library. Danish contributions to the evaluation of serum therapy for diphtheria in the 1890s (Fibiger trial). https://www.jameslindlibrary.org/articles/danish-contributions-to-the-evaluation-of-serum-therapy-for-diphtheria-in-the-1890s/ (read in summary)
20. James Lind Library. French 19th-century contributions to the development of treatments for diphtheria (Bretonneau, Trousseau, Roux). https://www.jameslindlibrary.org/articles/french-19th-century-contributions-to-the-development-of-treatments-for-diphtheria/ (search summary only)
21. Lebese RT, Netshandama VO, Shai-Mahoko NS. 2004. Cultural health practices of South African Vatsonga people on the home care of children with measles. Curationis 27(1):52-64. https://library.aosis.co.za/index.php/record/view/7551 (record and abstract only)
22. Leuridan E, Hens N, Hutse V et al. 2010. Early waning of maternal measles antibodies in era of measles elimination: longitudinal study. British Medical Journal. https://documentserver.uhasselt.be/handle/1942/11004 (search summary of author version)
23. Miller E, Cradock-Watson JE, Pollock TM. 1982. Consequences of confirmed maternal rubella at successive stages of pregnancy. The Lancet. https://www.qxmd.com/r/6126663 (search summary only)
24. Mina MJ, Metcalf CJE, de Swart RL, Osterhaus ADME, Grenfell BT. 2015. Long-term measles-induced immunomodulation increases overall childhood infectious disease mortality. Science 348:694-699. https://repub.eur.nl/pub/87260 (secondary summaries only)
25. Mina MJ, Kula T, Leng Y et al. 2019. Measles virus infection diminishes preexisting antibodies that offer protection from other pathogens. Science 366:599-606. https://news.harvard.edu/gazette/story/2019/10/how-measles-wipes-out-the-bodys-immune-memory (secondary summaries only)
26. MSF (Médecins Sans Frontières). Clinical guidelines: Measles. https://medicalguidelines.msf.org/en/viewport/CG/english/m
16689967.html (read in summary)

27. MSF. Clinical guidelines: Pertussis (whooping cough), updated December 2024. https://medicalguidelines.msf.org/viewport/CG/english/whooping-cough-pertussis-16689506.html (read in summary)
28. MSF. Clinical guidelines: Diphtheria, updated June 2025. https://medicalguidelines.msf.org/en/viewport/CG/english/diphth 16689456.html (read in summary)
29. Panum PL. 1847 (English translation 1940). Observations made during the epidemic of measles on the Faroe Islands in the year 1846. Original not readable in this session. Figures from University of Pittsburgh Health Sciences Library exhibit, https://dec.hsls.pitt.edu/s/measles/page/measles4
30. Portnoy A, Jit M, Ferrari M et al. 2019. Estimates of case-fatality ratios of measles in low-income and middle-income countries: a systematic review and modelling analysis. Lancet Global Health. https://pmc.ncbi.nlm.nih.gov/articles/PMC6418190/ (read in summary)
31. Reuters, via Arab News. December 2017. Rohingya at risk of deadly diphtheria, face shortage of medics, antitoxins. https://www.arabnews.com/node/1215741/world (search summary only)
32. Rothman KJ, Moore LL, Singer MR et al. 1995. Teratogenicity of high vitamin A intake. New England Journal of Medicine. https://read.qxmd.com/read/2507706/teratogenicity-of-vitamin-a (search listing only)
33. Salama P, Assefa F, Talley L et al. 2001. Malnutrition, measles, mortality, and the humanitarian response during a famine in Ethiopia. JAMA 286:563-571. https://library.alnap.org/node/58700 (abstract only)
34. Shanks GD, Waller M, Briem H, Gottfredsson M. 2015. Age-specific measles mortality during the late 19th to early 20th centuries. Epidemiology and Infection 143(16). https://www.cambridge.org/core/journals/epidemiology-and-infection/article/agespecific-measles-mortality-during-the-late-19thearly-20th-centuries/F4D013C76395921C5338067A0BD0278C (read in summary)
35. THRIVING library. HY-08, IN-01, IN-02, IN-03. Research reports in the THRIVING after the FALL library, 10 October 2026.
36. Toole MJ, Steketee RW, Waldman RJ, Nieburg P. 1989. Measles prevention and control in emergency settings. Bulletin of the World Health Organization. https://pmc.ncbi.nlm.nih.gov/articles/PMC2491262/ (abstract only)
37. UCT Open Access Atlas of Otolaryngology. Cricothyroidotomy and needle cricothyrotomy. https://vula.uct.ac.za/access/content/group/ba5fb1bd-be95-48e5-81be-586fbaeba29d/Cricothyroidotomy%20and%20needle%20cricothyrotomy.pdf, and Merck Manual Professional, How to do a percutaneous cricothyrotomy, https://www.merckmanuals.com/professional/critical-care-medicine/how-to-do-other-airway-procedures/how-to-do-a-percutaneous-cricothyrotomy (search summaries only)
38. Vitek CR, Wharton M. 1998. Diphtheria in the former Soviet Union: reemergence of a pandemic disease. Emerging Infectious Diseases 4(4). https://wwwnc.cdc.gov/eid/article/4/4/98-0404_article (read in summary)
39. Wang K, Bettiol S, Thompson MJ et al. 2014. Symptomatic treatment of the cough in whooping cough. Cochrane Database of Systematic Reviews, CD003257. https://cochranelibrary.com/cdsr/doi/10.1002/14651858.CD003257.pub5/information (abstract only)
40. Weaver GH. 1924. Measles, diphtheria, scarlet fever, chicken pox, and whooping cough. Haldeman-Julius Company, Girard, Kansas. Project Gutenberg. https://www.gutenberg.org/ebooks/78158 (read in full text)
41. Wendelboe AM, Njamkepo E, Bourillon A et al. 2007. Transmission of Bordetella pertussis to young infants. Pediatric Infectious Disease Journal. No URL confirmed. Read through secondary summary only.
42. WHO (World Health Organization). 2005. Pocket book of hospital care for children: guidelines for the management of common illnesses with limited resources. WHO, Geneva. https://www.afro.who.int/sites/default/files/2017-06/pocket_booklet_hospital_care.pdf (read in full text, measles, pertussis and diphtheria sections)
43. WHO. 2024. Clinical management of diphtheria: guideline. WHO, Geneva. https://medbox.org/document/clinical-management-of-diphtheria-guideline (PDF unreadable in this

session, recommendations known only through secondary summaries)
44. WHO prequalification. Measles vaccine (live, attenuated), Serum Institute of India. https://extranet.who.int/prequal/vaccines/p/measles-vaccine-live-attenuated-2 (read in summary)
45. Yang H, Mao M, Wan C. 2011 [VERIFY year of update]. Vitamin A for treating measles in children. Cochrane Database of Systematic Reviews, CD001479 (first version by Huiming Y, Chaomin W, Meng M, 2005). https://pmc.ncbi.nlm.nih.gov/articles/PMC7076287/ (read in summary)