HY-07 Quarantine and isolation: from Ragusa 1377 to Ebola 2014, what worked and what it cost

HEALING after the FALL, research library, HY-07

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

Findings by section

1. Three words, three things

Isolation separates a person already sick. **Quarantine** separates a well person who has been exposed. A **cordon sanitaire** seals a place. The second costs far more than the first and pays only when little transmission happens before symptoms. The third is the oldest and most abused. Everything below turns on those distinctions.

I keep apart what tradition claims, what the record shows, and what modern epidemiology infers. My own arithmetic carries [VERIFY]. The childhood-epidemic isolation periods are already in the library (THRIVING library, IN-12). The decision machinery, who may order a quarantine and by what authority, belongs to GOVERNING.

2. The invention: Ragusa 1377 and the Italian plague state

Organised separation begins with the Black Death of 1347 to 1352 (Tognotti 2013). On 27 July 1377 the Great Council of Ragusa, now Dubrovnik, entered a rule in the *Liber Viridis* beginning *Veniens de locis pestiferis non intret Ragusium vel districtum*. Arrivals from plague places waited thirty days, a *trentina*, on the barren islet of **Mrkan** or in Cavtat. (The brief's lead naming Mljet is not supported by any source I found.) Thirty days became forty, *quaranta*, for land travellers, and gave us the word.

No source gives a sound medical reason for forty days. Tognotti lists Hippocratic doctrine, Pythagorean numerology and Christ's forty days in the desert, endorsing none. It worked because it exceeds the incubation period of almost every acute epidemic disease.

Venice opened the first permanent *lazaretto* in 1423, Genoa in 1467, Marseille in 1476. England held ships in the Thames from 1663 and passed a Quarantine Act in 1710. What northern Italy built was a bureaucracy, with permanent health magistracies holding legislative and executive power (Cipolla, via reviews and secondary essays). The Florentine health board's court heard 566 cases from September 1630 to July 1631, and about 60% of offenders were imprisoned. Its 1630 cordon across the Apennines leaked, with peasants walking past guards playing cards, and the board fed the poor, believing diet made them vulnerable.

For a village: the measure is cheap in materials and expensive in authority, food and legitimacy. Every system that lasted paid people to stay in, and every system that only policed them leaked.

3. Eyam 1665 to 1666: the arithmetic behind the legend

Patrick Wallis (2006, abstract and secondary summaries only) argues the heroic account of the Derbyshire village that sealed itself is largely fiction, a romantic tragedy built on thin evidence in the late eighteenth and early nineteenth centuries and elaborated by the Victorians. What survives from 1666 is a parish register and a few letters.

Whittles and Didelot (2016) fitted a stochastic household-structured SEIR model to that register by Bayesian MCMC:

- **257 plague deaths** in an analysed population of 689, leaving 432 survivors. Crude mortality about **37%**, not the five-sixths of legend.
- **73.0% of infections were human to human** (95% CrI 67.3 to 78.2), only 27.0% rodent to human. The flea-only picture is wrong.
- **The household was the engine.** The transmission rate ratio within a household against the rest of the village is **56** in the Results and "almost 100 times more likely" in the Discussion. The two do not agree [VERIFY]. Either way, sharing a house with a case was roughly fifty to a hundred times more dangerous than sharing a village with one.
- **Poverty killed.** Only 20.2% of victims came from hearth-tax houses against 21.0 to 37.0% expected, $p < 0.001$. Children were 45.1% of victims, $p = 0.010$.
- First burial 6 September 1665 (the tailor George Viccars), last 1 November 1666.

The rector William Mompesson and the ejected minister Thomas Stanley proposed the cordon at a meeting on 24 June 1666 and it ran from about 1 July. The Earl of Devonshire sent food to the boundary, and coins sat in vinegar in the holes of the Boundary Stone. Deaths rose from 21 in June to 78 in August.

Did it work? Whittles and Didelot do not test it. They use the quarantine only to justify treating the population as closed, and note that historians have suggested it prolonged the epidemic, and that it was breached, Mompesson having sent his own children away. A 2004 *Medical Hypotheses* paper argued confinement raised the contact rate and made things worse. **My reading [VERIFY]:** Eyam is not evidence that village self-quarantine saves the village. It may save the neighbours at the village's expense, and that saving has never been measured.

4. The cordon sanitaire and its political career

The term is from 1821, when the Duke de Richelieu put troops on the Spanish border against yellow fever after the Barcelona epidemic killed at least 20,000 of about 120,000 people. Sanitary measures lapsed in September, but the troops stayed, became an observation corps, and in 1823 invaded Spain to restore Ferdinand VII. A cordon is an army with a medical excuse.

Russia's armed anti-cholera cordons produced the cholera riots: on 22 June 1831 a crowd at Sennaya Square in St Petersburg attacked the cholera hospital and its doctors. In Bombay, forced segregation and house searches under the Epidemic Diseases Act of 1897 drove the population from about 846,000 to about 450,000 by February 1897, exporting plague to the countryside, and Walter Rand, the Pune plague commissioner, was shot that June.

In 1900 San Francisco drew a quarantine line around Chinatown so that white-owned businesses fell outside it. *Jew Ho v. Williamson*, 103 F. 10, decided 15 June 1900, struck it down as "unreasonable, unjust, and oppressive". Honolulu's board began burning plague houses in Chinatown on 12 January 1900 and the fire destroyed the district (Mohr 2005, via secondary essay).

5. The rule that decides everything

Fraser, Riley, Anderson and Ferguson (2004) give the one piece of theory a village healer needs. Let **theta** be the share of transmission happening before symptoms, or from people who never show them. Then:

Isolation of the sick alone can stop an outbreak only if theta is less than 1 divided by R0.

Disease	R0	theta	Isolation alone
SARS (2003)	2 to 4	under 11%	Sufficient
Smallpox	4 to 10	0 to 20%	Not alone, but isolation plus contact tracing controls it
Pandemic influenza	up to 21	30 to 50%	Very hard even at 90% isolation plus tracing
HIV	up to 5	80 to 100%	Useless

Above 90% isolation efficiency, contact tracing buys up to a further fourfold reduction. A 2009 systematic review (secondary summary only) disputes the 30 to 50% figure for influenza, unresolved, and the practical conclusion is unchanged.

Three bins. Isolation works for Ebola, smallpox, pneumonic plague, SARS-like illness, diphtheria and typhus once the louse is dealt with. **It helps but will not stop** measles, chickenpox, whooping cough, influenza, mumps and COVID-like viruses, all of which spread before anyone looks ill. **It is nearly beside the point** for cholera, typhoid, dysentery, hepatitis A, tetanus and malaria, where the things to isolate are the **latrine, the water and the dead body**. That last is the commonest mistake a frightened village makes.

Disease	Incubation	Infectious from	Isolate until
Ebola	2 to 21 days	Symptom onset only	3 clear days after fever ends (UNICEF and WHO 2014)
Smallpox	7 to 17 days, mean 12 to 14	About fever onset	Last scab off, 3 to 4 weeks after rash (CDC)
Pneumonic plague	1 to 3 days	Symptom onset	Through illness, plus 48 to 72 h of antibiotics if any (CDC)
Bubonic plague	2 to 8 days	Not person to person except by flea	Flea control, not isolation (CDC)
Measles	10 to 15 days	About 4 days before rash	4 days after rash (THRIVING library, IN-12)
Chickenpox	13 to 17 days	1 to 2 days before rash	All lesions crusted, about 5 days (LA County 2024)
Cholera	hours to 5 days	While stool-positive	70% clear by end of week 1, 98% by week 3 (Queensland Health)

6. 1918: the best natural experiment we will ever get

6a. Markel's 43 cities Markel and colleagues (2007) coded interventions in 43 US cities from 8 September 1918 to 22 February 1919, covering 115,340 excess pneumonia and influenza deaths, an excess death rate (EDR) of 500 per 100,000. Measures fell into three classes: school closure, cancellation of gatherings, and isolation and quarantine. By Spearman rank correlation on public health response time (PHRT, days between a city's mortality doubling and

its first measure), earlier action meant a later peak (**r = -0.74, p < 0.001**), a lower peak (r = 0.31, p = 0.02) and lower total deaths (r = 0.37, p = 0.008), and longer total duration meant lower total deaths (r = -0.39, p = 0.005).

Split at the median PHRT of 7 days (medians shown):

Outcome	Early, under 7 days	Late, 7 days or more
Days to peak	18	11
Peak weekly EDR	67.6	125.8
Total EDR per 100,000	**451**	**580**

Split on duration instead, 65 days or more of measures gave a median total EDR of **451** against **559** for less. **Pittsburgh**, which banned gatherings on 4 October, delayed school closure to 24 October and had the ban rescinded on 2 November, had an EDR of **807**, worst of 43. **St Louis**, which layered early and held about ten weeks, had **358**. **New York City** acted earliest of all (PHRT **minus 11 days**) with compulsory isolation and placarded houses, but never closed schools or banned gatherings, and its **452** ranked only 15th.

Two findings matter more than the correlations. **Isolation and quarantine had an independent significant effect in the multivariate model (F = 5.67, p = 0.02)**, alongside school closure (p = 0.005) and gathering bans (p = 0.004), with r-squared 86.7%. And: **"we found no example of a city that had a second peak of influenza while the first set of nonpharmaceutical interventions were still in effect".** Denver (EDR 631) has a two-peaked curve matching its two rounds of measures. That is the closest thing to a controlled experiment in the historical record.

Limits. Grand Rapids and St Paul did well with poor responses. **John M. Barry** challenged the coding of New York City in *JAMA* in November 2007, denying it used isolation and quarantine as described, and if the earliest-acting city is miscoded the earliness correlation weakens. The authors did find no association between total EDR and population size, density, sex or age distribution.

6b. The islands McLeod and colleagues (2008) give the cleanest comparison in the literature.

Jurisdiction	Border control	Influenza mortality per 1,000
American Samoa	Strict, **5 days**, from 23 Nov 1918	**0**
Tasmania	Strict, 7 days, from 27 Jan 1919	0.81
Australia	Strict, 7 days, from Oct 1918	2.4
New Caledonia	7 days on outbound Australian ships	under 10
New Zealand	None systematic	7.4
Guam, Fiji, Tonga	Partial or none	45, 52, 84 [see note]
Nauru, Tahiti	None	160, 190
Western Samoa	None, the *Talune* landed sick passengers	**220 (19 to 22% of the population)**

Note: an automated read of the figure caption returned 840 per 1,000 for Tonga, which is impossible. Other sources give 4.2 to 10%. I take **84** and mark the conflict [VERIFY].

Governor John Martin Poyer banned travel to and from the neighbouring islands on radio news, without orders from Washington, and American Samoa recorded no influenza deaths. Western Samoa lost at least 8,500 people, the worst recorded national death rate of the pandemic. **Caveats:** different administrations, trade volumes and relations with traditional leaders, and the authors themselves say remoteness, prior immunity, socioeconomic conditions and viral attenuation may all contribute and that "the reasons for the lower mortality are unclear".

6c. Gunnison and the escape communities Gunnison, Colorado barricaded its county roads in late 1918, declared a "quarantine against all the world", warned rail passengers they would be held five days if they stepped off, closed schools and churches and banned gatherings. It passed through both waves with essentially no cases. Restrictions lifted in February 1919 and a March outbreak killed five. Silverton, Colorado, which did nothing, had 833 cases and 125 deaths. I could not read Markel's 2006 escape-communities paper in full, so this is second hand [VERIFY].

The honest reading. Protective sequestration of a small, food-sufficient, low-density community can work completely, and it fails the moment it ends if the disease is still outside. It buys time, not immunity. For a post-Fall village of 300 with its own food, this is the most directly transferable success in the record.

7. The long isolations: leprosy and tuberculosis

These are the diseases for which separation was practised hardest and the evidence is weakest.

Leprosy. Norway's isolation laws of 1877 and 1885 were for a century the global argument for segregation. Meima, Irgens and colleagues (2002, secondary summary only) modelled the Norwegian registry and concluded the decline **cannot be explained fully by isolation**, that an independent fall in transmission tied to living conditions must be assumed, and that the share attributable to isolation depends heavily on assumptions. The decline began about twenty years before the law. Hawaii's compulsory isolation at Kalaupapa ran 1866 to 1969, with residents falling from about 1,200 around 1890 to 425 by 1936, which the National Park Service attributes to rising natural resistance. There is no comparison group anywhere in that record, and the cost, thousands taken from their families for life, is documented far better than the benefit.

Tuberculosis. A Portuguese sanatorium study of 315 files found an age-adjusted hazard ratio of **1.94 (95% CI 1.03 to 3.63)** for dying during admission in the pre-chemotherapy group (Matos and Santos 2015, abstract only), and an ecological analysis found TB mortality already falling in several countries before antibiotics (Holloway, conference abstract only). The one clean result is not about sanatoria: Hansen, Jensen and Madsen's difference-in-differences study of **tuberculosis dispensary** rollout across Danish cities found a **19% decline in TB mortality**, with null placebo tests. A dispensary is case-finding, education, and separating sputum and sleeping arrangements at home.

My reading [VERIFY]. For a slow disease with long infectiousness, copy the dispensary, not the colony.

8. SARS 2003: the yield of quarantine, counted

SARS is the disease quarantine suits best, theta under 11%. The 2003 record lets us count what it cost per case found (Cetron and Simone 2004, Hsieh 2005).

Place	Quarantined or screened	Cases found	Yield
Taiwan Level A (close contacts)	50,319	112	0.22%
Taiwan Level B (travellers)	80,813	21	0.03%
Beijing	30,178, 60% at home	2,521 citywide	about 12 quarantined per case
Toronto	about 30,000 recommended	-	about 100 per case
Hong Kong entry and exit screening	90 million passengers, 5,000 fevers	**2**	essentially nil

Mass traveller screening is near-worthless. Contact quarantine finds few cases but speeds detection: quarantined people in Taiwan were diagnosed a mean of **1.20 days** after onset against **2.89 days** for others, saving about

1.7 days of community infectiousness per case (Hsieh 2005). One model credited Level A with preventing about 461 cases and 62 deaths, Level B with about 5%. **Home quarantine shifts risk to the household:** SARS developed in **2.7%** of home-quarantined household contacts in Hong Kong, and Toronto reported only **57% compliance** (13,291 of 23,103). A CDC analysis of Beijing concluded that quarantining only contacts of an actively ill patient would have cut numbers by about two thirds with no loss of effect.

9. Ebola 2014: the home, the care centre and the corpse

West Africa in 2014 is the closest modern analogue to a post-Fall epidemic: high case fatality, no drug, no vaccine.

Isolating faster is what mattered. Pronyk and colleagues (2016) studied 46 Community Care Centres of 8 to 24 beds, run close to the community from November 2014 to January 2015. Over 13 weeks they triaged 6,129 patients and found 719 Ebola suspects. Isolation within 4 days of onset was achieved in **85% at CCCs against 49% elsewhere (OR 6.0, 95% CI 4.0 to 9.1)**, with mean onset to isolation **2.9 days against 5.8**, contributing an estimated **13 to 32% reduction in the reproduction number**.

But a care centre can become an incubator. Kucharski and colleagues (2015, *EID*) fitted Western Area data with R0 1.94 (95% CrI 1.86 to 1.98). Expert elicitation gave a median **63% transmission reduction** for patients in CCCs (IQR 41 to 81%) and a median **9% probability** (IQR 1 to 36%) that an Ebola-negative patient waiting for a result would be exposed. With a 75% reduction and 25% exposure risk, 500 beds slowed transmission. With a 50% reduction and 10% exposure risk, **no number of beds stopped case growth**. Turning the epidemic over required onset-to-attendance **below 3 days**. A village isolation hut that halves transmission but mixes Ebola cases with people who merely have malaria will kill more people than it saves. **Entry triage is the whole safety case.**

Separately, Kucharski and colleagues (2015, *PNAS*, abstract only) estimated additional treatment beds averted **56,600 cases (95% CrI 48,300 to 84,500)** in Sierra Leone to 2 February 2015. The widely quoted 40,000 deaths averted is press coverage, not the abstract.

The corpse. Tiffany and colleagues (2017, abstract and secondary summaries) estimated **2.58 secondary cases per unsafe burial** (district range 0 to 20), and that the Red Cross safe and dignified burial programme averted **1,411 to 10,452** secondary cases, **4.9% to 36.5%** of the epidemic. In Guinean chains unsafe burial carried an incidence rate ratio of 1.82 (95% CI 1.10 to 3.02). The same paper found caregivers **2.63 to 5.92 times** more likely to be infected than people with post-mortem contact only, and argued early isolation of the living would achieve more than burial reform alone.

What families were told. The UNICEF and WHO key messages of 26 August 2014 are the clearest household instructions in the humanitarian record and need no equipment a village cannot have. They run through the means ledger and Protocols 2, 3 and 6 below. Their four load-bearing lines: give the sick person their own space and utensils, washed separately. **Assign one person** to care for them, and a survivor can do it safely. A person without symptoms cannot infect anyone. Do not touch, kiss or wash the body.

What happened without consent. On 20 August 2014 Liberia sealed West Point in Monrovia, about 70,000 people, intending 21 days, with no food plan announced. Security forces killed a boy, Shakie Kamara, aged 15 or 16 depending on the source, and the cordon was lifted after **10 days**. The WHO representative in Liberia had warned beforehand that quarantine needs the community's consent, which was never sought. A negotiated quarantine at Dolo Town passed without violence.

The indirect toll. Parpia and colleagues (2016, abstract only) modelled excess malaria, HIV and TB deaths under a 50% reduction in treatment access: Guinea **6,269**, Sierra Leone **2,819**, Liberia **1,535**. For Sierra Leone that is roughly three quarters of its direct Ebola deaths.

10. 2020: the largest test and the hardest to read

COVID-19 had a large theta, which is why isolation of the sick was never enough and the response reached for general movement restriction.

Cochrane. Nussbaumer-Streit and colleagues (2020) found simulated quarantine averted **44 to 81% of incident cases and 31 to 63% of deaths**, earlier being better and cheaper, and combinations beating quarantine alone. The certainty is **very low**: most included studies were models, observational COVID studies lacked a no-quarantine comparison, and the evidence on quarantining travellers was weakest of all.

Haug. Haug and colleagues (2020) analysed 6,068 coded interventions across 79 territories with four independent methods. The six on which all four agreed:

Intervention	Consensus	Change in Rt
Cancelling small gatherings	83%	-0.22 to -0.35
Closing educational institutions	73%	-0.15 to -0.21
Border restriction	56%	-0.057 to -0.23
More protective equipment available	51%	-0.062 to -0.13
Individual movement restrictions	42%	-0.08 to -0.13
National lockdown	25%	-0.008 to -0.14

Quarantine itself scored 30% with three of four methods agreeing, ranging -0.28 to +0.023. **Least effective: active case detection, contact tracing, environmental cleaning and disinfection, and land border and airport health checks.** A suitable combination matters more than any one measure, and less disruptive measures can match a national lockdown. That last finding is about surfaces and gates, not handwashing or water treatment, which are separate and strongly supported (THRIVING library, HY-01, HY-02).

The costs. Brooks and colleagues (2020, abstract and summaries only) screened 3,166 papers and included 24, mostly SARS and Ebola. Most reported negative psychological effects, some long-lasting, and named the stressors: **longer duration, fear of infection, frustration, boredom, inadequate supplies, inadequate information, financial loss and stigma.** Roberton and colleagues (2020) modelled **253,500, 447,180 or 1,157,000 additional under-five deaths over six months** across 118 countries. Those are forecasts. Measured consequences followed: nearly **40 million children missed a measles dose in 2021**, first-dose coverage fell to about 81%, the lowest since 2008, and WHO and CDC estimated 9 million measles cases and 128,000 measles deaths that year. TB deaths rose from about 1.2 million in 2019 to 1.6 million in 2021 (WHO 2022).

Evidence grades

Column 2 is the claim tradition or common sense makes, column 3 what the measured record shows.

Measure	Claim	Record	Grade
Isolating the symptomatic sick separately	Stops the spread	Independent significant effect in the 1918 multivariate model. Faster isolation cut Ebola R by 13 to 32%	**B**

Measure	Claim	Record	Grade
One named carer, a survivor if possible	Keeps it in one pair of hands	UNICEF and WHO standing advice 2014. Eyam shows the household is the engine	**B**
Quarantine of named close contacts	Catches them before they infect	Yield only 0.22%, but cuts onset-to-isolation by about 1.7 days. Cochrane: 44 to 81% averted in models, very low certainty	**B**
Protective sequestration of a healthy community	Keeps the plague out	Complete success at Gunnison through two waves. Fails on release	**B**
Maritime or single-road quarantine, 5 to 7 days	Keeps it off the island	American Samoa 0 against Western Samoa 220 per 1,000	**B**
Layering measures rather than using one	More is better	Layered cities beat New York, which acted earliest but did not layer	**B**
Safe burial of the infectious dead	The body is dangerous	2.58 secondary cases averted per burial, 4.9 to 36.5% of the epidemic	**B**
Feeding and supplying the quarantined	Makes it hold	Florence fed the poor. West Point failed partly for want of it	**C, ethically mandatory**
Dispensary-style home separation for TB	Finds cases, separates sleeping	Danish dispensaries, 19% decline, difference-in-differences, null placebos	**B**
Lifelong segregation for leprosy	Stops leprosy	Not explicable by isolation alone in Norway. No comparison group at Kalaupapa	**D**
Sanatorium confinement for TB	Cures and protects	Hazard ratio 1.94 for dying in admission pre-chemotherapy. The decline preceded and outran it	**D**
Town cordon against a presymptomatic respiratory disease	Stops the epidemic	Haug: national lockdown lowest of the six. Herby's contested 0.2%	**C, contested**
Mass fever screening at a gate or port	Catches carriers	90 million screened, 2 cases. Among Haug's least effective	**X for yield**
Isolating people against cholera, typhoid, dysentery	Breaks the chain	Faecal-oral. The chain runs through water and hands, not breath	**X as a substitute for sanitation**

Measure	Claim	Record	Grade
Sealing a family in one room with a case	Protects the village	Household transmission 56 to 100 times village transmission. It concentrates the deaths	**X**

Means ledger

A. Isolating a sick person

Rung	What it can do	What it changes
Hands and knowledge	Patient at the far end of the house, head to the door. One named carer. Window open	Moving infants and pregnant women out is the single highest-value act
Hearth	Own plate, cup, spoon and towel washed apart in boiling water. Soap at the door. Cloth over the mouth. Bedding boiled or sunned	Reaches the UNICEF and WHO 2014 home standard, the best-documented household package there is
Garden and still	Separate outbuilding with its own door. Lye soap. Ethanol hand rub. A latrine for the sick room only. Lime for excreta	Removes the Eyam problem: real separation of air and faeces
Village dispensary (300)	Isolation hut of 2 to 4 beds, triaged at the door. Register of cases, contacts and dates. Carer rota	Cuts onset-to-isolation from about 6 days to under 3, Kucharski's threshold for turning an epidemic over
District infirmary (3,000)	10 beds, suspected and confirmed apart, clean and dirty zones, burial team, microscope, nurse	Pronyk's 85% isolated within 4 days instead of 49%, and people admit the sick rather than hide them
Pre-Fall hospital	Negative pressure, laboratory confirmation, antivirals, oxygen	Case fatality falls by what the drug is worth. The isolation is no better than the infirmary's

B. Quarantine of exposed contacts

Rung	What it can do	What it changes
Hands and knowledge	Name the contacts, ask them to stay near home and report fever	A few cases found earlier, at almost no cost
Hearth	Contacts stay in their own houses, fed by neighbours, for the incubation period	The Taiwan effect, about 1.7 days less community infectiousness per case
Garden and still	Food stores and a delivery system, so nobody comes out to eat	The difference between a quarantine that holds and West Point
Village dispensary	Contact register with exposure dates, daily checks, a quarantine house	Turns quarantine from a hope into a count

Rung	What it can do	What it changes
District infirmary	Travellers' hostel, 5 to 21 day holds by disease	The American Samoa effect, if the district holds the roads
Pre-Fall hospital	Testing to release early	Cuts the cost enormously, where the village pays the full time

C. Village cordon and market closure

Rung	What it can do	What it changes
Hands and knowledge	Agree the rule at a village meeting, tell the neighbours	Legitimacy, the only enforcement a village has
Hearth	Households stop visiting and stop sharing meals	Cuts the small-gathering channel, Haug's highest-ranked measure
Garden and still	Market closed, trade moved to a goods drop at the boundary	The Eyam Boundary Stone, a working design costing nothing
Village dispensary	Boundary watchers, a log of arrivals, a hut for anyone who must come in	The Gunnison model at village scale
District infirmary	Coordination, so a cordon does not export flight	Avoids the Bombay error, where sealing the city emptied it
Pre-Fall hospital	Not applicable. The state does this, badly	-

D. Safe burial

Rung	What it can do	What it changes
Hands and knowledge	Nobody touches, kisses or washes the body of a feared-fever death	2.58 secondary cases averted per unsafe burial avoided
Hearth	Wrap in the bedding they died in, bury the same day, deep and away from water	Removes the largest discrete transmission event in the Ebola record
Garden and still	Lime in the grave. Oiled-cloth gloves, burned after. A shroud kept ready	Protects the burial party, otherwise the next cases
Village dispensary	Trained team of survivors, a replacement rota, a ritual the family accepts	Acceptance, not coercion, is what made safe burial work
District infirmary	A burial ground set aside for epidemic deaths, with a register	Lets the district count its dead, which is how it knows the epidemic is over
Pre-Fall hospital	Sealed body bags, cremation	Marginally safer than a well-run village burial

Harm test

How it kills and maims when done wrong.

1. **Sealing a family in with a case kills the family.** Household transmission at Eyam was 56 to 100 times the village rate. A cordon that leaves households intact and only stops movement between them concentrates death inside houses. **Separate the person, not the family,** and move the infants, the pregnant and the old out first.
2. **Mixing the undiagnosed with the diagnosed turns an isolation hut into a source.** Kucharski's failure mode: a 9% chance a negative patient is exposed while waiting, and below about 50 to 60% transmission reduction the centre adds cases. Half the fevers in a village will be malaria or typhoid.
3. **Quarantine without food starves people or breaks.** West Point sealed 70,000 people with no food plan and collapsed in 10 of 21 days after a death.
4. **A cordon drives flight, and flight spreads it further than the disease would have gone.** Bombay halved in weeks.
5. **Quarantine applied to a group rather than an exposure destroys the authority you need next time.** *Jew Ho*, Honolulu, Mary Mallon's 26 years while 400 other carriers walked free.
6. **An armed cordon becomes an army,** as the 1821 Pyrenean line became the 1823 invasion, and **psychological harm is real and lasts**, worst when quarantine is long, unexplained, under-supplied and stigmatising (Brooks 2020).
7. **Stopping too early wastes everything spent.** Denver's second peak, Gunnison's five deaths in March 1919.
8. **Isolation substituting for sanitation kills by the back door.** Isolating a cholera patient while the village drinks the same water consumes the labour that should be boiling it.

The thresholds. Below about 50 to 60% transmission reduction inside your isolation space, with more than about 10% cross-infection at the door, isolation makes things worse (Kucharski 2015). Beyond about 7 days of delay you lose roughly a fifth of the benefit measured in 1918.

Who must never be subjected to it. As **carer**, anyone pregnant, nursing, under 15, over 60 or chronically ill, because the carer takes the highest risk in the house. A **nursing mother and her infant** should not be separated unless the disease passes in milk and a wet nurse exists, since the infant's risk from separation usually exceeds its risk from exposure [VERIFY, my judgement from the general child-survival literature, not from a quarantine study]. **Nobody** should be quarantined without food, water, fuel and a daily visit. **The dehydrated:** a cholera or dysentery patient shut in a hut without an attendant giving fluids dies of the isolation, and isolation never outranks rehydration (THRIVING library, HY-03).

Misidentification. The great danger is treating a non-transmissible illness as transmissible. A village that quarantines every fever will exhaust itself and stop believing the healer. Work from the pattern instead: rash, cough, bleeding or watery stool, each with fever, each leading to a different rule.

Signs it is going wrong. Cases in the carers rather than only the first household. Cases in people who entered the isolation space for something else. Deaths with no preceding illness reported, meaning households are hiding their sick. People leaving at night. The quarantined going hungry. Any use of force. **Then stop,** shorten to the smallest thing that still helps (isolation of the clearly sick plus safe burial), re-explain, fix the food, and replace coercion with neighbours who bring food and sit at a distance.

Red flags

1. **Pneumonic plague.** Fever, chest pain and blood-streaked sputum within 1 to 3 days of exposure to a case who had the same. Without antibiotics close to uniformly fatal, and Manchuria 1910 to 1911 killed about 60,000. **Do anyway:** the strictest isolation in the book, a separate hut, a carer with a tight cloth mask boiled daily, immediate deep burial, 7 days of quarantine for every household contact.
2. **A viral haemorrhagic fever.** Fever, then vomiting and diarrhoea, then bleeding from gums, nose or puncture sites. **Do anyway:** aggressive oral rehydration (THRIVING library, HY-03) is the one thing that changes survival. One carer, a survivor if possible. Do not touch the body.

3. **Diphtheria with a spreading membrane and a swollen neck.** Without antitoxin a quarter to a third die (THRIVING library, IN-12). **Do anyway:** strict isolation, propped sitting, absolute bed rest for weeks, because the heart fails later.
4. **Smallpox-like illness.** Deep hard pustules, all at the same stage. **Do anyway:** isolate until the last scab is off. Smallpox has the lowest theta of any killer in the table and is the disease isolation was made for.
5. **A quarantined household with no food on day three.** This kills as surely as the disease. **Do anyway:** break the quarantine to feed them, openly, rather than let it collapse in anger.
6. **Dehydration in isolation.** Sunken eyes, no tears, no urine for 8 hours, skin that stays pinched. **Do anyway:** send the carer in and treat. Fluids beat isolation every time.
7. **A birth, a fracture or an obstructed labour during a cordon.** The measure must bend: a midwife crossing a boundary with clean hands is a smaller risk than an unattended obstructed labour. **The first weapon raised at a boundary** means the quarantine has already failed, so end it and start again with consent.
8. **A second generation of cases with no contact with the first.** The chain is wider than your register. Widen to gathering restrictions or accept that the epidemic will run.

Honest comfort. For the dying in isolation the cruelty is the loneliness, not the room. Let one person, a survivor if you have one, stay. Let the family stand at a window and speak. Let the burial keep a ritual, even a changed one.

The case against

1. All of it is observational and confounded. Every study here is a before-and-after, a city comparison or a model. There has never been a randomised trial of quarantine and there never will be. Markel's 43 cities is the best of its class, and its authors concede outliers and deep uncertainty about ninety-year-old records. **John M. Barry** challenged its coding of New York City in *JAMA* in 2007.

2. The Cochrane verdict is "very low certainty". The 44 to 81% reductions come from models with differing assumptions, and the observational COVID studies had no comparison group. The most rigorous appraisal of quarantine concludes that we do not really know.

3. The strongest critics say movement restriction did almost nothing. Jonas Herby, Lars Jonung and Steve H. Hanke (2022) found lockdowns reduced COVID mortality by an average of **0.2%**, shelter-in-place by 2.9% and business closures by 10.6%, and concluded lockdowns "should be rejected out of hand". The criticism is also strong: not peer reviewed, not endorsed by Johns Hopkins, 32 studies admitted and 22 pooled, excluding interrupted time series and synthetic control designs. **Neil Ferguson** argued the policies varied too much to pool, and **Karsten Juhl Jørgensen** and **Mathias Heltberg** that one study dominates the result. The effect of general movement restriction, as against isolation of the sick, is genuinely contested among serious people.

4. The yield is terrible. Taiwan quarantined 131,000 people to find 133 cases. Hong Kong screened 90 million travellers to find two. Village labour is finite.

5. The history is a history of abuse. Tognotti's central argument. The measure has been aimed at Jews, at the Chinese in two Pacific cities, at the Indian poor, at beggars in Naples in 1836, and at one Irish cook for 26 years. A village of 300 knows everyone, and the capacity for one family to be blamed and excluded is total.

6. Home isolation moves the risk to the person least able to refuse. The household carer, usually a woman. SARS gave it to 2.7% of home-quarantined household contacts, and Ebola caregivers were 2.63 to 5.92 times more likely to be infected than those with post-mortem contact only. Any rule that says "nurse them at home" allocates risk by sex and age, and should say so out loud.

7. For the diseases most likely to kill a post-Fall village, separation is the wrong tool. Cholera, typhoid, dysentery, worms, malaria, tetanus and childbirth will kill far more in a village of 300 than an exotic epidemic. Every hour on cordons is an hour not spent on the latrine, the water and the midwife.

8. The romance cuts both ways. Wallis's verdict on Eyam applies equally to the modern image of a well-run isolation facility: the Sierra Leone care centres were praised, and the same modelling showed they could amplify the epidemic.

10-line summary

1. Isolation separates the sick, quarantine the exposed. The second costs far more and pays only when little transmission happens before symptoms.
2. Fraser's rule governs: isolation alone stops an outbreak only if theta, the share of transmission before symptoms, is less than 1 divided by R0.
3. It works for Ebola, smallpox, pneumonic plague and SARS-like illness, partly for measles and chickenpox, hardly at all for influenza. For cholera and typhoid, isolate the latrine and the water.
4. In 1918, US cities acting earlier had later peaks (r = -0.74) and a median excess death rate of 451 per 100,000 against 580 for late cities.
5. No 1918 city had a second mortality peak while its first measures were still in force.
6. Strict maritime quarantine kept influenza out of American Samoa while Western Samoa lost 19 to 22% of its people. Gunnison sealed itself and had no cases until it reopened.
7. Isolating faster matters more than isolating more people: Sierra Leone's care centres cut onset to isolation from 5.8 to 2.9 days and the reproduction number by 13 to 32%.
8. Eyam's lesson is not heroism. Transmission within a house was 56 to 100 times that in the village, and 37% of the village died.
9. Quarantine of the well has a very low yield, 0.03 to 0.22% in Taiwan, and fever screening of travellers is worthless: 90 million screened gave two cases.
10. Quarantine fails and turns violent when imposed without consent, without food and without a stated end.

Open questions

1. **Did Eyam's cordon save anyone outside Eyam?** No counterfactual exists, and nobody has reconstructed mortality in the surrounding parishes.
2. **Was the Eyam household rate ratio 56 or about 100?** The paper reports both [VERIFY].
3. **How much of 1918's city-to-city variation was intervention?** Barry's challenge to the New York coding remains unresolved in my reading.
4. **What is theta for the respiratory diseases a village will actually meet?** The 2009 review disputing presymptomatic influenza transmission has never, so far as I found, been reconciled with Fraser's framework.
5. **Does a village isolation hut cross or fall below Kucharski's harm threshold?** Neither parameter has been measured for a lay-run facility without laboratory triage.
6. **What quarantine length is actually optimal per disease when the cost of error is hunger?** Thirty, forty, twenty-one and fourteen days are institutional conventions, not optimisations.
7. **How much of the Norwegian leprosy decline was isolation?** Meima and colleagues say the answer depends entirely on assumptions.
8. **Is the Herby, Jonung and Hanke result real?** Contested on methods, unresolved.
9. **What does the village owe the quarantined?** Upshur's reciprocity principle says a great deal, but no historical community wrote down what it provided, and nobody has quantified how much safer a survivor is as carer.

Sources to read in full

1. **Markel H and colleagues. 2007. *JAMA* 298(6):644-654.** The largest quantitative study of epidemic separation ever done. Read the second-peak discussion.

2. **Fraser C and colleagues. 2004. *PNAS* 101(16):6146-6151.** One rule, four pathogens, the whole logic of when to bother.
3. **Whittles LK, Didelot X. 2016. *Proceedings of the Royal Society B* 283:20160618.** The only rigorous reconstruction of a village self-quarantine.
4. **Tognotti E. 2013. *Emerging Infectious Diseases* 19(2):254-259.** Six hundred years in five pages, including the abuses.
5. **Kucharski AJ and colleagues. 2015. *Emerging Infectious Diseases* 21(3):393-399.** The most useful paper for planning a village isolation hut, because it says when the hut makes things worse.
6. **Pronyk P and colleagues. 2016. *American Journal of Public Health* 106(4):727-732.** What a community-run isolation facility achieved.
7. **Brooks SK and colleagues. 2020. *The Lancet* 395(10227):912-920.** The cost side.
8. **McLeod MA and colleagues. 2008. *Emerging Infectious Diseases* 14(3):468-470.** The island evidence in four pages.
9. **UNICEF and WHO. 2014. *Social Mobilization: Key Messages*, 26 August 2014.** Household instructions written for people with nothing.

At the bedside after the Fall

The household

Minimum viable version. One room, or one end of the house, for the sick person. One named carer at lowest risk and highest immunity: an adult who has had this illness, failing that an adult who is not pregnant, not nursing, not old and not ill. The patient's own plate, cup, spoon, towel and bedding, washed separately in boiling water. Hands washed with soap on leaving the room and before touching food. A window open. Infants and pregnant women moved out if there is anywhere to move them. The dead not touched, not washed, not kissed, buried the same day.

What it needs to start. Soap or lye (THRIVING library, HY-05), a pot for boiling, spare cloth, and ideally a shed.

The first failure to expect. There is only one room and the carer sleeps beside the patient, which is the Eyam condition and the normal case. Then the goal is not to protect the household but the village and the two or three most vulnerable in it. Move the baby and the pregnant woman out, and let the rest go.

The village of 300

Minimum viable version. A standing rule agreed before the epidemic, not during it. A healer who can be told about any fever the same day. A register: name, house, first symptom, date, household members, visitors. An isolation hut of two to four beds with one door, its own latrine and a visible boundary, and a triage bench outside it. A burial team of three, preferably survivors, with a fixed ritual. A food rota leaving meals at the threshold of every isolated household daily. A boundary drop for trade with the next village.

What it needs to start. The hut and the latrine, buildable in a week. Cloth and soap. A written register, which matters more than it looks, because without dates you cannot tell a contact from a new chain. One or two trained carers. An agreement made in advance about who decides, for how long, and what the village owes the isolated, which belongs to GOVERNING.

The first failure to expect. Hiding. If the first family isolated goes hungry, is gossiped about, or is still shut in after everyone thinks it is over, the next family will hide its sick and the register goes blind. The counter-measure is not enforcement but food on the doorstep, a visible end date, and the healer saying aloud that this family did the village a service. Reciprocity is the mechanism, not the courtesy.

The district of 3,000

Minimum viable version. Ten beds with genuine separation between suspected and confirmed, and a clean zone no patient enters. A travellers' house on the main road, fed by the district. A district register collecting village registers weekly. A published rule set: this disease, this many days, this is what you get while you wait. A burial ground set aside. A microscope, if one survived, to tell malaria from the thing you fear.

What it needs to start. A building that can be divided. A food reserve able to feed about 5% of the district for three weeks, roughly 150 people, about 1.5 tonnes of grain [VERIFY, my arithmetic at 450 g per person per day]. A nurse or the nearest thing. Agreement among the villages, because a cordon one village imposes and another ignores is an argument, not a measure.

The first failure to expect. The district orders something the villages did not agree to, probably a market closure at harvest, it is ignored, and the authority spent on it is gone when a real epidemic comes.

Protocols

Protocol 1. Deciding what you face, before isolating anyone

1. Of the first case ask: did anyone else fall ill first, what is the main symptom, and where has this person been in the last 21 days?
2. Sort it. **Rash, cough or bleeding with fever:** person to person, go to Protocol 2. **Watery stool and vomiting, several cases, same water:** go to the latrine and the water (THRIVING library, HY-02, HY-04), isolating only to contain stool and give fluids. **Fever with chills and sweats, no spread in the house:** malaria, do not isolate. **One case, a wound or a birth:** not an epidemic.
3. Write it down the same day: name, house, date of first symptom, main symptom, household members, visitors in the last 7 days.
4. **Tolerance:** if you cannot tell within a day, treat as person to person and reconsider on day three. Over-isolating a household for two days is cheap. Under-isolating a haemorrhagic fever for two days is not.

Protocol 2. Isolating a sick person at home

1. **Space.** A separate building, or a room with its own door and window, or the far end of one room with the patient's head to the door and at least 2 metres from any sleeping place.
2. **One carer only,** in this order: someone who has had and recovered from this illness in this outbreak, then a healthy adult of 20 to 50, then anyone. **Never** a pregnant woman, nursing mother, child under 15, anyone over 60, or anyone with a chronic cough or wasting.
3. **Move out the vulnerable** that day: infants under 6 months, pregnant women, the frail old.
4. **Fit the room:** own plate, cup, spoon, towel and bedding, a covered bucket for stool and vomit, water and soap at the door, window open in daylight.
5. **Carer discipline, every entry.** Soap and water before and immediately after, a full count of twenty. Clean cloth over mouth and nose for a coughing patient, boiled daily. Change outer clothing at the door where there is vomiting, diarrhoea or bleeding, and boil it.
6. **Wash the patient's utensils separately,** in boiled water, with soap or wood ash.
7. **Laundry and surfaces.** Soak soiled cloth in boiling water at least 10 minutes, dry in full sun. With a known household bleach, **1 part bleach to 10 parts water** for body fluids and surfaces, mixed fresh daily [VERIFY, standard outbreak practice in the MSF cholera guidance I read in summary, not confirmed against a second primary source]. Never chlorine on hands, use soap.
8. **Waste** into a deep pit at least 30 metres from any water source and never uphill of one, covered with ash or lime each time.

9. **Fluids first.** The carer's first job is making the patient drink (THRIVING library, HY-03). Isolation never outranks fluids.
10. **Length:** section 5, and (THRIVING library, IN-12) for the childhood diseases. Unknown illness, 7 days after the fever ends. After Ebola-like illness add 3 weeks of no sexual contact, and for men 3 months with a condom.
11. **At the end** air the room in sun for a day, boil or sun all bedding, and the carer washes and changes clothes.
12. **Tolerance.** With no separate room, do steps 2, 3, 5, 6, 8 and 9 anyway. They are most of the benefit.

Protocol 3. Quarantining contacts

1. **A contact is** (UNICEF and WHO 2014) anyone who slept in the same house, touched the person alive or dead, touched their fluids or their clothes, towels or bedding, had sex with them, or breastfed or was breastfed by them. For coughing illnesses add more than 15 minutes within about 2 metres indoors [VERIFY, the conventional definition, not confirmed against a primary source].
2. **List them by name and date of last exposure.** That date starts the clock.
3. **Quarantine them at home, never together.** Putting contacts in one place is how a quarantine becomes an outbreak.
4. **Length from last exposure:** viral haemorrhagic fevers **21 days**, smallpox **17**, pneumonic plague **7**, measles day 5 to 21, chickenpox day 10 to 21, influenza-like illness **4 days** and expect it to fail, unknown illness **21 days** shortened once you know the incubation. Cholera, typhoid and dysentery: no quarantine, watch the water and the latrine.
5. **Check daily** at the door, ask about fever, write it down.
6. **Feed them.** A named household on a rota brings food, water and fuel to the threshold every day. **A quarantine without this will break and should not be ordered.**
7. **Release on the stated day.** Say the date aloud at the start and keep to it.
8. **If a contact develops fever,** go to Protocol 2 and restart the clock for that house.
9. **Tolerance.** Once more than about 10% of the village is quarantined at once it cannot be fed and will collapse. Abandon contact quarantine then and put everything into isolating the sick and burying safely.

Protocol 4. Travellers and the road

1. **One entrance** into the village, and one place where goods change hands.
2. **A travellers' house** outside the village with bedding, water, a latrine, a fire and a daily delivery of food.
3. **Hold times from arrival:** 21 days for a haemorrhagic fever, 17 for smallpox, 7 for plague or an unidentified air-borne fever, 7 as the default. Seven days sufficed for Australia, Tasmania and New Caledonia in 1918, five for American Samoa.
4. **Goods, not people.** Leave goods at the stone, step back, let the other party collect.
5. **Trusted watchers, not armed ones,** and announce the end in advance. Florence's cordon leaked past bored soldiers. Gunnison's held because the town agreed with it.
6. **Tolerance.** Excluding a known neighbour's family in a crisis costs more than the disease. Admit them to the travellers' house and feed them.

Protocol 5. The village isolation hut

1. **Site:** more than 100 metres from housing and market, less than 30 metres from a water point, draining away from every well and stream, latrine pit bottoms at least 1.5 metres above the water table. These are the MSF cholera treatment centre rules and they transfer.
2. **Size:** about 4 square metres per bedridden patient inside, about 2.5 square metres per patient plus one caregiver in the ward, 20 to 30 square metres per patient for the whole site.
3. **Two zones, one door each.** A **dirty zone** with triage, beds, latrine, washing and the place the dead are laid. A **clean zone** with stores, water, kitchen and the carers' rest place. Nothing crosses except through a

handwashing station.

4. **Triage at the door is the safety case.** Never put an undiagnosed fever in the same room as a confirmed case. Keep a physically separate observation corner for anyone you are unsure of. This is the Kucharski failure mode and the difference between saving lives and manufacturing cases.
5. **Fence it,** even with thorn or rope, so every contact is deliberate, and staff it two carers per shift on a rota of at least six, survivors where possible.
6. **Target: first symptom to hut in under 3 days.** That is the number that mattered in Sierra Leone.
7. **Records:** name, village, date of first symptom, date of admission, outcome. Count weekly, or you cannot tell whether the epidemic is turning.

Protocol 6. Burial during an epidemic

1. **Nobody touches, washes or kisses the body** of someone who died of a feared fever.
2. **A named team of three,** preferably survivors, in long sleeves, with oiled cloth or leather over the hands, cloth over mouth and nose, rags or boots on the feet.
3. **Wrap the body in the bedding it died in,** without shaking the bedding out, and carry it on a hurdle.
4. **Bury the same day,** at least 2 metres deep if the ground allows, at least 50 metres from any water source or dwelling, never uphill of a well.
5. **Lime or ash** over the body before filling, and do not reopen the grave.
6. **Burn or boil** everything the team wore, and wash with soap at once.
7. **Keep the ritual.** Let the family stand at a stated distance and speak, pray or sing, and record the name. Burials families could accept were the ones that got done.
8. **Tolerance.** If a family refuses, do not use force. Let them choose the grave, watch, and name the team. Forced burial creates hidden burials.

Protocol 7. Whether to close the market

1. Close it only when all three hold: the disease spreads person to person, there are cases in more than one household, and the village can eat for two weeks without it.
2. Take the smaller measures first: stop feasts and gatherings, stop visiting between houses, stagger the market by household, and only then close it.
3. **Say the date it reopens,** and reopen only after no new case for twice the incubation period: 42 days for Ebola, 34 for smallpox, 42 for measles, 14 for plague.
4. **Never reopen into a rising epidemic.** Every 1918 city that reopened early got a second peak.
5. **Tolerance.** If closing the market means hunger, do not close it. Run it outdoors, spaced, fewer people at a time.

Numbers to carry

1. **Theta less than 1 over R0.** Isolation of the sick stops an outbreak only when the share of transmission before symptoms is less than 1 divided by R0. Ebola and smallpox pass. Influenza does not.
2. **Three days from first symptom to isolation.** Below that an Ebola-like epidemic turns over. Sierra Leone's care centres achieved 2.9 days against 5.8.
3. **21 days for Ebola, 17 for smallpox, 7 for pneumonic plague, 7 as the default for an unknown airborne fever.** Contact quarantine lengths, add half again if guessing.
4. **Fifty to a hundred times.** The multiplier on risk from sharing a house with a case, measured at Eyam. The household, not the village, decides the deaths.
5. **Act within seven days.** In 1918, cities intervening within 7 days of their mortality doubling had a median excess death rate of 451 per 100,000 against 580.

6. **Measures work while they are on.** No city in the 43-city study had a second mortality peak while its measures held.
7. **Five days of quarantine kept 1918 influenza out of American Samoa,** while Western Samoa lost 19 to 22% of its people.
8. **One carer, a survivor if you have one,** who cannot catch the same illness again this outbreak.
9. **2.58 secondary cases per unsafe burial.** Safe burial averted 4.9 to 36.5% of the West African epidemic.
10. **Quarantine the contacts, not the road.** Taiwan found 21 cases in 80,813 travellers (0.03%) against 112 in 50,319 close contacts (0.22%).

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