ME-03 Ethanol for the dispensary: fermenting and distilling spirit for tinctures, antiseptics and anaesthetics

HEALING after the FALL, research library, ME-03

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

Findings

1. Distilled spirit is not a surgical anaesthetic, and the survival literature is wrong about this

Say it first, without hedging. You cannot take a limb off, open an abdomen or reduce a badly displaced fracture under alcohol. The dose of ethanol that abolishes the response to a knife is at or above the dose that stops breathing. There is no window to aim at, no sign that tells you where in it a patient sits, and the two commonest effects of a large oral dose, vomiting and loss of airway reflexes, kill by aspiration in a village with no suction and no tube.

The numbers. Death from respiratory depression occurs in non-habituated people at blood ethanol concentrations of 400 to 500 mg/dL, that is 87 to 109 mmol/L, while some heavy drinkers appear minimally intoxicated at 400, so blood level predicts neither depth nor danger (Aneskey, *Alcohols*, undated clinical reference). A pharmacology text read in search extract places stupor and coma at 400 mg per 100 mL and death above 500, and states directly that ethanol behaves like an inhalational general anaesthetic except that its surgical stage practically coincides with the stage of respiratory paralysis, which is why it was never adopted as an anaesthetic drug [VERIFY]. The reported lethal oral dose for an adult is 5 to 8 g/kg, with toxic reactions recorded in a small child at 0.6 g/kg (dental-journal review of mouthwash ingestion, search summary only) [VERIFY].

The clinical record is not theoretical. Ethanol was given a serious modern trial as an intravenous induction agent by John Dundee's group in Belfast between 1969 and 1971, a run of at least six papers (Dundee and Isaac 1969, *British Journal of Anaesthesia* 41:1063, Dundee 1970, *Anesthesia and Analgesia* 49:467, Isaac, Pandit, Dundee and Galway 1971, *Acta Anaesthesiologica Scandinavica* 15:141). Twelve volunteer patients given 0.8 g/kg as an 8 per cent w/v solution over four to six minutes were unconscious (Dundee, Knox and Isaac 1970, *British Medical Journal* 3:552). For a 70 kg adult that is 56 g of ethanol, about 175 mL of 40 per cent spirit, straight into a vein over five minutes, and it bought unconsciousness, not surgical anaesthesia. The group's own follow-up paper is titled a study of sequelae and their implications, and a later review calls ethanol a low-quality anaesthetic agent plagued by wide variations in dose requirement together with emergence delirium, headache and emesis (*Liquor made quicker*, 2008, abstract only) [VERIFY]. The line of work was abandoned.

The historical record agrees and is more honest than the survival manuals. Roswell Park's 1896 semi-centennial lecture states that opium and alcohol were the only agents regarded as of practical value in diminishing the pain of operation, that some surgeons pushed alcohol to the point of intoxication, and that surgery nonetheless proceeded with patients writhing and screaming until Warren's ether operation of 16 October 1846 (Park 1896, PMC8939665). Alcohol was in the room for two thousand years and never once made surgery painless. The nineteenth-century glass

of wine before chloroform was for preventing vomiting and speeding induction of a real anaesthetic (Fischer 1861, contemporary abstract, PMC9981011).

What alcohol can honestly do is blunt anxiety, lower the threshold at which another agent works, and give the dying comfort. In rats ethanol at 1 and 2 g/kg reduced the minimum alveolar concentration of sevoflurane by 26.3 and 51.8 per cent (*Scientific Reports* 2022, 12, s41598-021-04364-8), which is a reason to count alcohol already drunk when dosing ether or opium. It is not a reason to pour spirit into a man and cut.

The one place concentrated ethanol genuinely abolishes pain is as a neurolytic, injected onto a nerve to destroy it. Alcohol at 50 to 100 per cent is an established neurolytic agent, though the minimum effective concentration has never been established, and it works by extracting phospholipids, cholesterol and cerebroside from neural tissue. One millilitre of 70 per cent onto a trigeminal branch gives relief of six months to two years in small reports, and a larger series found median relief of 39 months for first blocks, complications resolving within six months [VERIFY]. Coeliac plexus neurolysis with alcohol is standard for the pain of pancreatic cancer. This is a district-infirmary procedure, trading a permanent deficit for relief, and absolute alcohol injected wrongly destroys the wrong nerve. But it is real, it is cheap, and for the dying it may be the most powerful thing the district has.

2. What alcohol is actually for: solvent, antiseptic, preservative, vehicle, fuel

Solvent, and the strengths that matter. ME-01 owns the preparation forms and found that tinctures do not keep for years pharmacologically (THRIVING library, ME-01). This document owns the strength. The pharmacopoeial rule is that rectified spirit, about 92 to 93 per cent by volume, suits drugs insoluble in water such as resins and volatile oils, while diluted spirit suits drugs soluble in both (Felter and Lloyd 1898, *Tincturae*). Working strengths: 25 to 45 per cent for most dried-herb tinctures of alkaloids, glycosides and bitters, with 1:5 dried in 40 per cent the right village default. 45 to 60 per cent where tannins and flavonoids matter. 60 to 90 per cent for resins, gums, oleoresins and propolis, which will not dissolve in weak spirit. 85 to 95 per cent for fresh plant at 1:2, because the plant brings its own water. At or above 20 to 25 per cent for self-preservation, so a tincture made in wine or cider at 10 to 12 per cent is perishable and must be treated as a syrup (ME-01).

Antiseptic. Ethanol between about 60 and 85 per cent is bactericidal and 80 to 90 per cent virucidal within five minutes (ethanol and povidone-iodine review, PMC7520996). The World Health Organization's locally produced handrub Formulation I is ethanol 80 per cent v/v, glycerol 1.45 per cent and hydrogen peroxide 0.125 per cent (WHO, *Guide to Local Production*, read through the NCBI Bookshelf reproduction, quantities in P5 below). The glycerol stops hands cracking, the peroxide kills spores in the product, not on the hands. The guide forbids batches over 50 litres in an unventilated place, forbids naked flames in the production and storage area, and requires the strength to be checked with an alcoholmeter, noting specifically that locally produced ethanol must have its concentration determined first.

Absolute alcohol is worse, not better, because it evaporates before it has worked (PMC10809080) [VERIFY]. Formulation beats the last few per cent of strength: of eleven products tested against the United States criteria of at least 2 log10 reduction after one application and 3 log10 after ten, only two passed, both 70 per cent ethanol (PMC3239688, PMC3239703).

Alcohol does not touch spores. Against *Clostridioides difficile* spores on volunteers' hands, three alcohol rubs gave reductions of 0.11 to 0.37 log10 against chlorhexidine soap's 0.89 (Jabbar et al. 2010) [VERIFY]. For spore-formers, which here means tetanus, gas gangrene and anthrax, the answer is soap, water, mechanical removal and heat, never a wipe with spirit.

For skin before an incision the best trial is Darouiche and colleagues' six-hospital randomised trial of 849 adults undergoing clean-contaminated surgery. Chlorhexidine-alcohol gave surgical site infection in 9.5 per cent against povidone-iodine's 16.1, relative risk 0.59, superficial infections 4.2 against 8.6 per cent, deep 1 against 3, number needed to treat 17 (Darouiche et al. 2010, *New England Journal of Medicine* 362:18). Grade A. A village with no

chlorhexidine should read this as evidence that an alcohol-based prep beats an aqueous iodine one, not that alcohol alone equals chlorhexidine-alcohol.

Alcohol does not go into an open wound. Ethanol significantly reduces keratinocyte viability and inhibits their migration, and migration is what re-epithelialises (PMC10826152) [VERIFY]. In acute wounds saline and potable tap water effectively prevent infection. Alcohol on intact skin around the wound, water in it.

Preservative, vehicle, fuel. Above 20 to 25 per cent any liquid preparation is microbiologically stable for years, and alcohol is the carrier that makes an insoluble drug dosable, which is the logic of the whole laudanum family. Flash point falls with strength, about 26 degrees for 40 per cent, 24 for 50 and 13 for 96 (Engineering Toolbox), so a spirit lamp wants 80 per cent or better and below about 50 will not hold a flame in a cold room. Alcohol burns almost without soot, which is why it is the right fuel near a patient. Ether synthesis needs 95 per cent and upward, and WO-10 owns that chemistry. The consequence belongs here: an ether programme multiplies a district's alcohol demand several times over and makes the still the limiting piece of infrastructure in the medical system.

3. Making it: the ferment, the yield, and what it costs in food

Yeast turns one hexose into two ethanol and two carbon dioxide. By mass that is the Gay-Lussac limit of 51.1 per cent ethanol from the sugar, and real fermentations reach 90 to 95 per cent of it because some substrate goes to cell mass and by-products. Converting by ethanol's density of 0.789 kg/L:

- **One kilogram of sugar** gives a theoretical 0.68 litres of absolute ethanol and 0.58 to 0.62 in a good fermentation. Honey is about 80 per cent sugars, so a kilogram of honey gives 0.46 to 0.49 litres. These conversions are my arithmetic from the sourced stoichiometry [VERIFY].
- **One kilogram of grain** gives about 0.42 litres in an industrial dry-grind plant with purchased enzymes. Maize is quoted at 2.8 US gallons per 56-pound bushel, that is 417 litres per tonne. Wheat runs 368 to 447 litres per tonne in laboratory work and 336 in one commercial plant. A village malting its own barley and mashing in a tub should expect 0.30 to 0.35 litres per kilogram [VERIFY, my own downward adjustment].
- **One tonne of potatoes** gives about 91 to 94 litres, under 0.1 per kilogram. Poor per unit weight, good per unit land.

I could find no source giving a general ethanol ceiling for *Saccharomyces cerevisiae* and will not state one. What is measured: an industrial strain in a 34 per cent w/v glucose medium gave a maximum of 97.03 g/L at its optimum of 35 degrees, about 12.3 per cent by volume (Thai study 2014), and stuck fermentations arise from high temperature combined with accumulated ethanol, appearing late in the stationary phase (*BMC Genomics* 2019, 20). A village should expect a wash of 6 to 12 per cent. A careful two-run pot operation then keeps perhaps 85 to 90 per cent of that ethanol as usable spirit [VERIFY, my inference], so a kilogram of sugar yields roughly half a litre of absolute ethanol finished, which is 1.3 litres at 40 per cent or 0.7 at 70.

What it costs in food. A kilogram of wheat carries roughly 3,340 kcal. Turned into 0.37 litres of ethanol it carries about 2,070 kcal, in a form no child can be fed on, though the spent grain keeps the protein and will feed a pig. Distilling destroys roughly a third of the food energy outright and moves the rest into a calorie that cannot nourish [VERIFY, my arithmetic]. This is why every state facing a grain shortage has banned distilling. The corollary, worked in section 8, is that the dispensary's own requirement is so small it never competes with food. What competes with food is drink.

4. Getting it stronger: the still, the ceiling, and drying past it

FEASTING owns still design. What the dispensary needs is which strengths are reachable by which route. A stripping run roughly triples the wash, so a 10 per cent wash gives low wines around 25 to 30 per cent [VERIFY, a workshop rule for which I found no measured source]. A second pass gives a heart of 65 to 75 per cent, and a third, or a packed column with some reflux, reaches 90 to 95.

There the ceiling arrives, and it is a law rather than a limit of equipment. Ethanol and water form an azeotrope at 95.6 per cent by weight, boiling at 78.17 degrees and producing a vapour of the same composition as the liquid, so no number of further distillations changes anything (Smith College geosciences reference). By volume that is about 97 per cent, and in practice a good column gives 95 to 96.

To pass it the water must be taken out by something other than boiling, and the historical route is quicklime. King's 1854 *American Eclectic Dispensatory* gives Souberain's method: rectified spirit of about 86 degrees Gay-Lussac is first distilled from carbonate of potassa to raise it to 94 or 95, then brought to 97 and beyond by digestion with quicklime in excess, King being explicit that the excess matters because water released from slaked lime otherwise weakens the product. A 1932 Iowa Academy of Science study measured the rate: two successive treatments of two months each with lime at room temperature dehydrated 95 per cent ethanol satisfactorily, and warming to 45 degrees shortened this to two treatments of one week each, with no refluxing necessary. A modern review reports calcined calcium oxide reaching 99.8 per cent. Quicklime a village can burn from limestone and potassium carbonate it can get from wood ash. The practical warning is that absolute alcohol pulls water from the air, so it is made for a purpose and used at once.

5. Measuring it, with and without a hydrometer

Strength is measured as density, which is inversely proportional to strength (King 1854). Three rules govern an alcoholmeter, and the first two kill more batches than anything else.

It only works in a two-component mixture of water and alcohol. Any dissolved sugar, glycerol, residual carbon dioxide or suspended yeast makes it read low, because sugar and alcohol push density in opposite directions and partly cancel. A commercial vodka labelled 40 per cent can register 36 because of additives used for mouthfeel. To measure a wash, take a brewing hydrometer reading before and after fermentation, or distil a measured volume completely and measure the distillate.

It must be read at its marked temperature or corrected. Instruments are calibrated to 15 or 20 degrees and the marking says which. One worked example from a distillers' correction tool: a reading of 43 per cent at 37 degrees, multiplied by 0.949, gives a true 40.8. The rule that needs no table is to stand the sample in water until it settles, and always read at the same temperature.

Without any hydrometer, weigh it. Mark a bottle with a scratch at the neck. Fill to the scratch with water and weigh, then empty, dry, fill to the same scratch with spirit at the same temperature and weigh. The ratio is the specific gravity. King's reference points: absolute alcohol 0.794 to 0.796, rectified spirit 0.835 which he equates to 86 degrees Gay-Lussac, proof spirit about 0.920, diluted alcohol about 0.935. King carries his own discrepancy between 0.920 and 0.935 in different lines, so treat the proof figure as approximate. A balance good to one part in two hundred gives strength within a few per cent, enough for everything here except ether.

The gunpowder test, honestly. Proof spirit in the British system weighs twelve-thirteenths as much as an equal volume of water at 51 degrees Fahrenheit, which is 57.15 per cent by volume, and the system was law until 1 January 1980. The test was to wet gunpowder with spirit and try to fire it, and below 57.15 per cent it would not take. A recent treatment argues the test was more legend than gauge, because how damp powder burns depends on the powder as much as on the spirit (Sizes.com, *proof (alcoholic)*, and Wikipedia, *Alcohol proof*). Keep it as a yes or no about 57 per cent and never write a number from it.

6. Methanol: the real hazard, the false procedure, and the dose

Where it comes from. Methanol in a home still is not made by the still. It is made in the mash, before any heat, when pectin methylesterase hydrolyses pectin and releases pectic acid and methanol, how much depending on the pectin's degree of esterification and the fruit's sugar-to-pectin ratio (Blumenthal, Steger, Einfalt, Rieke-Zapp, Quintanilla Bellucci, Sommerfeld, Schwarz and Lachenmeier 2021, *Molecules* 26:2585). Stone fruits of the genus *Prunus*,

cherries and plums, and pome fruits of *Malus* and *Pyrus*, apples and pears, carry the most. Grain mashes carry much less and a clean sugar wash has almost no pectin, though that claim rests on mechanism rather than measurement, and I will not state zero.

How much, measured. The contrast between feedstocks is the most useful number here.

- Natural background in ordinary drink: 6 to 27 mg/L in beer and 10 to 220 mg/L in spirits, described by the World Health Organization as not harmful (quoted in Blumenthal et al. 2021).
- Home-distilled rice spirit, North Vietnam: detectable in 17 of 20 samples, median 9 mg/L, range 2 to 37, symptoms from the worst sample requiring over 424 litres (Lachenmeier, Anh, Popova and Rehm 2019, *Drug and Alcohol Review*, search summary) [VERIFY].
- Home-distilled fruit brandy, Transylvania: 56 samples, only 18 per cent meeting the European limit, plum brandies averaging 0.91 per cent methanol against 0.52 for other fruits, p equals 0.01, worst single plum brandy 2.39 per cent (Croitoru, Topor, Fülöp and Fogarasi 2014, *Acta Medica Marisiensis* 206 to 208).
- Home-distilled spirits from Texas, feedstock unrecorded: 1.28 to 22.68 microlitres per millilitre against 2.16 to 15.62 in commercial spirits, no significant difference, p greater than 0.43 (Lapierre et al. 2024, *Heliyon* 10:e32317).

A plum brandy at 0.91 per cent holds roughly 9,100 mg/L. A rice spirit at 9 mg/L holds a thousandth of that. The feedstock, not the still and not the operator's skill, decides the methanol. For scale, the European limit for fruit spirits is 1,000 g per hectolitre of pure alcohol, 1,200 for plum, apple and pear, against 10 for vodka. A thousand grams per hectolitre is about 0.4 per cent methanol in a drink containing 40 per cent ethanol, which is the threshold Croitoru's survey used.

Does a heads cut remove it. No. This is the most important correction in the document. Methanol boils at 64.7 degrees, below ethanol, and every distilling tradition has reasoned from that to the belief that the first of the run carries it away. In a pot still that is not what happens, because methanol's high water solubility dominates its low boiling point. Blumenthal and Lachenmeier state it flatly: methanol will appear in almost equal concentration in almost all fractions of pot still distillation, until the very end where it accumulates in the so-called tailings fraction. They call the heads belief not plausible, and attribute the heads' smell and taste to acetaldehyde and ethyl acetate. A review chapter on fruit-spirit distillation agrees (Spaho, IntechOpen chapter 54078, search summary), and Balcerek and colleagues, on plum brandy, found methanol in significant quantities in the tail fractions, attributing it to hydrogen bonding between water and the alcohols (Balcerek et al. 2017, *Journal of the Institute of Brewing* 123).

The folklore is not merely useless, it is backwards. The only distillation-based reduction Blumenthal's group identifies is cutting the tails early and not recycling them, credited with up to 80 per cent reduction, and they note an extremely late cut raises product methanol by about 20 per cent. Their other estimates all act on the mash: raw material quality up to 40 per cent, acidifying it up to 50, sterilising it 40 to 90, shortening storage before distillation up to 50, yeast strain 20 to 25, lower fermentation temperature up to 25. Discard the foreshots anyway, for the acetaldehyde and ethyl acetate, but never call it a safety step.

The dose that harms. Blindness has followed as little as 4 to 10 mL of methanol in adults, and permanent loss of vision is the characteristic injury (UK Health Security Agency, *Methanol toxicological overview*). The minimum lethal dose by ingestion is 300 to 1,000 mg/kg, for a 70 kg adult 26 to 88 mL. The lowest reported fatality is 15 mL of a 40 per cent solution, that is 6 mL of methanol, and at the other extreme one person survived 500 mL, concomitant ethanol a likely reason. Médecins Sans Frontières teaches a field rule of 10 mL, two teaspoons, for blindness and 30 mL, a mouthful, as the minimum fatal adult dose.

The poison is formate, not methanol. Alcohol dehydrogenase makes formaldehyde and aldehyde dehydrogenase makes formic acid, which accumulates, drives the acidosis, crosses the blood-brain barrier undissociated and inhibits cytochrome-c oxidase (Barceloux, Bond, Krenzelok, Cooper and Vale 2002, *Clinical Toxicology* 40:415). Toxicity tracks the acidosis more closely than the methanol level. Absorption takes 30 to 60 minutes, volume of distribution

about 0.6 L/kg, half-life 2.5 to 3 hours below 100 mg/kg but 24 hours or longer above 1,000. The latent period is typically 12 to 24 hours and occasionally 48. Early nausea, vomiting, abdominal pain and mild central depression, then the quiet interval, then acidosis and blurring that may go to complete blindness.

Why home stills do not blind people, and industrial methanol does. Work the arithmetic on the worst brandy anyone measured. Croitoru's maximum of 2.39 per cent puts 10 mL of methanol in 418 mL of spirit, which at 40 per cent also carries about 132 g of ethanol, a very heavy evening holding a blood ethanol near 150 to 200 mg/dL for hours. At the plum mean of 0.91 per cent, a nominal blinding dose sits in 1.1 litres carrying 347 g of ethanol, around 5 g/kg for a 70 kg adult, at the threshold of the lethal ethanol dose itself. Alcohol dehydrogenase has about eighteen to twenty times the affinity for ethanol that it has for methanol (UKHSA, and a pharmacokinetic study reporting eighteen-fold). Every spirit off a home still therefore delivers its own antidote, in vast excess, in the same glass. These calculations are mine, built on the sourced concentrations and doses [VERIFY].

The outbreaks confirm it. At Pärnu in western Estonia in September 2001, illegally sold spirits containing 50 to 100 per cent methanol killed 68 of 154 verified poisonings, 43 found dead outside hospital. Of 111 hospitalised, 86 survived to discharge, 20 with sequelae, and at six-year follow-up every sequela was still present (Paasma, Hovda, Tikkerberi and Jacobsen 2009, *BMC Clinical Pharmacology* 9:5). In the Czech Republic from September 2012, adulterated spirits produced 121 confirmed poisonings and overall mortality of 34 per cent. The independent predictors of death were a pH below 7.0, coma on admission with an odds ratio of 29.4, and a negative serum ethanol (Zakharov et al. 2014, *Clinical Toxicology*). Read that last one again: having drink in the blood on arrival was protective. Kenya in 2014 gave case fatality rates of 29 per cent, 100 of 341, and 21 per cent, 26 of 126. The poison in all of these was industrial methanol sold as spirit, not pectin from a plum.

The protection is partial and temporal. Co-ingested ethanol delays the onset of the metabolic features rather than abolishing them (UKHSA), and the methanol is still there when the ethanol clears. The chronic question is open: a probabilistic European analysis concluded that regular consumption of unrecorded fruit spirits can push daily methanol intake above the oral reference dose, with thresholds around 8,598 mg/L for men and 6,382 for women per 10 g of ethanol (Muhollari et al. 2022, *Toxicology Letters*). The same literature consistently finds that ethanol itself comprises by far the highest risk of all compounds in alcoholic beverages.

The antidote the village has. It is ethanol, and this is the one circumstance in the book where you deliberately make a patient drunk. Target a blood ethanol of 100 mg/dL, some guidelines allowing 100 to 150, because alcohol dehydrogenase is not effectively blocked below 100 (McMartin, Jacobsen and Hovda 2016, *British Journal of Clinical Pharmacology* 81:505). The classic regimen is a loading dose of 0.6 g/kg then maintenance at 66 mg/kg/h for non-drinkers and up to 154 for chronic drinkers (McCoy et al. 1979), which McMartin's Table 3 translates into drink. P8 below carries the volumes. Keep it running for days, because with the enzyme blocked the methanol half-life runs past 24 hours and the village has no dialysis to shorten it. Expect the treatment to harm: in one outbreak 40 per cent of patients awake on admission were comatose within an hour of starting ethanol, and 48 per cent in Zakharov's series developed severe intoxication short of coma. Folinic acid speeds formate clearance and haemodialysis above a methanol of 50 mg/dL is definitive. Neither exists after the Fall. Say so.

7. The other poisons of the still: lead, copper, fusel, cyanide, fire

Lead is the serious one and it is entirely avoidable. A 1992 CDC report found elevated blood lead associated with illicitly distilled alcohol in rural Alabama in 1990 and 1991, and named stills built from automobile radiators with lead-soldered parts as an important source (*MMWR* 1992, PubMed 1565093). An Atlanta emergency department study found moonshine drinkers about eleven times more likely to carry a blood lead of 10 micrograms per decilitre or more, odds ratio 10.94. The clinical face was saturnine gout: of 43 gout admissions to the Birmingham Veterans Administration hospital in 1967, 37 were saturnine gout from lead-contaminated moonshine (*New England Journal of Medicine* 1969, 280:2203). Modern measurement still finds it: lead in 13 of 36 home-distilled Texas samples at 0.44 to 0.76 mg/L (Lapierre et al. 2024). Copper is different. The same study found copper above 0.5 mg/L in four

home samples, worst at 8.96 mg/L, a reason to rinse and dry a copper still rather than to avoid copper, the traditional and correct still metal. The absolute rules: no automobile radiator, no lead solder, no lead-glazed vessel, no galvanised sheet touching vapour or distillate. Pure tin or silver solder only, and better, riveted and brazed joints.

Fusel oils are a flavour problem, not a poison. The higher alcohols, chiefly amyl, concentrate in the tails and form more when fermentation runs hot, at low pH or with limited nitrogen. Whether they cause hangover is debated, and one controlled animal study found whisky fusel oil had no effect on the ethanol-induced emetic response. The practical upshot is that the tails cut is a flavour decision that happens also to be the one real methanol control.

Cyanide and ethyl carbamate, from stone fruit. Cyanogenic compounds sit in the stones. Crush them and hydrogen cyanide enters the ferment, and cyanide reacting with ethanol forms ethyl carbamate, a genotoxic carcinogen. The European limit for hydrogen cyanide in stone fruit spirits is 70 mg/L. Ethyl carbamate has only a target, 1 mg/L, described as achievable with good practice, against measured levels up to 18 mg/L in stone fruit spirits (EU Recommendation 2010/133, Regulation 110/2008). The village rule is one sentence: do not crush the stones.

Fire and pressure. A garage in Vancouver, Washington exploded while a grape spirit was distilled, the distiller's open flame having ignited alcohol vapours, and a UK factory believed used as an illegal distillery exploded and killed five. At Silver Trail Distillery in Hardin, Kentucky in April 2015 a 300-gallon pot still ruptured and the 27-year-old apprentice died on 11 May 2015 from infection complicating his burns, the state fire marshal finding the still was not designed to hold pressure and had not been fitted with the correct pressure relief valve (CDC NIOSH FACE 15KY019). The flash points say why: a 50 per cent distillate releases ignitable vapour at 24 degrees and a 96 per cent one at 13, which is to say at any working temperature in any season.

8. The dispensary's ethanol plan for 300 people

My own build from the uses above, marked as inference throughout [VERIFY]. *Tinctures*: 150 courses a year at 9 mL a day for ten days needs about 14 litres of finished tincture, and allowing for the unpressed marc, 30 to 40 litres of menstruum at an average 40 per cent, that is 12 to 16 litres of absolute ethanol, say 15. *Skin antisepsis and hand rub*: 200 procedures a year at 15 mL of 70 per cent is about 2 litres absolute, and hand rub at 3 mL, ten applications a day on 150 working days, is 3.6 litres absolute. Allow double for a bad year of wounds or epidemic, so 10 litres. *Lamp fuel, preservation and drug vehicle*: 2 to 3 litres.

That is 25 to 30 litres of absolute ethanol a year, 65 to 75 litres of 40 per cent spirit or 35 to 40 of 70 per cent. At half a litre of absolute ethanol per kilogram of sugar it costs 55 to 60 kg of sugar, and at 0.35 litres per kilogram of grain it costs 80 to 90 kg of grain. That is less than half what one adult eats in a year, for a village of 300. The labour is roughly 250 litres of 12 per cent wash, which in 20-litre batches is thirteen stripping runs and three or four spirit runs, perhaps 80 hours of still tending across the year, and about 270 kg of dry firewood, one ordinary cord [VERIFY, my thermal arithmetic].

The rule that matters most is social, not technical. The dispensary's alcohol will be drunk unless it is made undrinkable or inaccessible. Denature the external grades with a tenth of their volume of a bitter decoction, which costs nothing in solvent or antiseptic power, keep the drinkable grades under a two-person lock with every litre entered in a book, and make the still the property of the village rather than a household. Expect the register to be falsified at least once, because it always is.

Evidence grades

Claim or use	Grade	Basis
Ethanol is not usable as a surgical anaesthetic	A toxicology, B clinical	Aneskey, Dundee 1969 to 1971, Park 1896

Claim or use	Grade	Basis
Alcohol-based skin prep reduces surgical site infection	A	Darouiche 2010, n 849, RR 0.59, NNT 17
Ethanol 60 to 85 per cent is bactericidal, 70 to 80 optimal	A	EN 1500 and FDA log-reduction studies
Ethanol is not sporicidal on hands	A	Jabbar 2010, 0.11 to 0.37 log10
Ethanol is the antidote to methanol poisoning	B	McMartin 2016, McCoy 1979, Zakharov 2014
Methanol does not concentrate in the heads of a pot still	B	Blumenthal 2021, Spaho, Balcerek 2017
Fruit mashes give 100 to 1,000 times the methanol of grain or sugar	B	Croitoru 2014 against Lachenmeier 2019
Alcohol at 20 to 25 per cent self-preserves a preparation	C	Pharmacopoeial practice, no primary source (ME-01)
Rectified spirit for resins, diluted spirit for water-soluble drugs	C	Felter and Lloyd 1898, rule not measurement
Quicklime dries 95 per cent spirit to absolute	B	King 1854, Iowa Academy 1932
Alcohol neurolysis gives months to years of relief	C	Small series, no RCT, concentration unestablished
Lead from radiator and soldered stills causes clinical poisoning	B	MMWR 1992, NEJM 1969, Atlanta OR 10.94
The gunpowder test measures strength	D, near X	Go or no-go near 57 per cent only
A heads cut makes a fruit spirit safe from methanol	X	Contradicted directly by Blumenthal 2021
Spirit as an anaesthetic for amputation	X	Tried, failed, lethal margin

Means ledger

Rung	What it can do with ethanol	What changes
Hands alone	Nothing. No alcohol without a vessel and fire	No tinctures, no alcohol antisepsis. Boiled water, honey, salt, heat instead
Hearth	Ferment to 6 to 12 per cent. Wine, cider, mead, beer as preservative media and comfort	Preparations at 10 to 12 per cent, perishable. No antisepsis, no resin tincture, no fuel
Garden and still	Distil to 40 to 75 per cent routinely, 90 to 95 with reflux or a third run. All tincture grades, hand rub, skin prep, spirit lamp, methanol antidote in quantity	The decisive rung. Resin tinctures, a real antiseptic, a reliable preservative, and the only drug a village can give for methanol poisoning

Rung	What it can do with ethanol	What changes
Village dispensary, 300	The above plus measured strength, a tincture register, a locked store, denatured external grades, 95 per cent for a district ether programme	Reproducible medicines rather than variable ones. Strength written on every label
District infirmary, 3,000	Absolute alcohol by quicklime. Alcohol neurolysis for intractable pain. Antidote run for days against clinical signs	The dying get nerve blocks. Methanol poisoning gets days of supervised therapy
Hospital before the Fall	Fomepizole, haemodialysis, hourly blood ethanol assay, chlorhexidine-alcohol, folinic acid, blood gas	Methanol mortality falls from the outbreak record's 20 to 34 per cent toward single figures. Nothing below reproduces it

Harm test

Ethanol as an attempted anaesthetic. Kills by respiratory depression at 400 to 500 mg/dL and by aspiration of vomit well below that. The error is the attempt itself and nobody must ever receive a deliberately anaesthetic dose. Signs: snoring respiration, falling respiratory rate, cold clammy skin, vomiting in a patient who cannot roll over. What to do: stop, roll into the recovery position, clear the mouth with a finger and cloth, keep warm, give nothing more by mouth, wait it out. Park's 1896 lecture records patients taken to intoxication who still writhed and screamed.

Ethanol by mouth in the vulnerable. Children are poisoned at doses adults tolerate, a toxic reaction reported at 0.6 g/kg in a small child, and are at particular risk of hypoglycaemia because ethanol inhibits gluconeogenesis. The malnourished, the dehydrated and the old share that risk. No therapeutic alcohol dose is safe in pregnancy, the only exception being ethanol as the methanol antidote where fomepizole is unavailable. Never give a tincture to a child under six (ME-01).

Methanol. Blindness from 4 to 10 mL, death from 300 to 1,000 mg/kg. The failure mode is the latent period: a patient who feels well six hours after drinking is not safe and the eye signs come at 12 to 48 hours. Signs: deep sighing respiration, abdominal pain, blurred or snowfield vision, dilated unreactive pupils, then coma. What to do: ethanol by mouth to the doses in P8, bicarbonate if available, warmth, days of watching. Historical cases: Pärnu 2001, 68 dead of 154, Czech Republic 2012, 34 per cent mortality, Kenya 2014, 21 to 29 per cent case fatality.

Ethanol antidote therapy itself. Only 27 per cent of measured ethanol levels in one audit were in target range and 47 per cent were below. Without an assay the village titrates blind, so expect to under-dose, and watch the breathing continuously.

Lead. Chronic, cumulative, silent until it is not. Anaemia, colic, wrist drop, gout, encephalopathy in children. The error is a radiator condenser or lead solder. There is no antidote below a hospital and the only control is the construction of the still.

Fire and pressure. A sealed still is a bomb and an open flame beside a condenser is an explosion. Both killed people in the documented record. The signs are pressure building with no vapour escaping, hissing from a joint, and the smell of spirit in the air.

Alcohol in a wound, and cross-contamination of the stock. Alcohol kills keratinocytes and stops them migrating, so it goes around a wound and never in it. A still that has run a fruit mash carries fruit methanol across in the residue, so the medical still runs sugar or grain only, and if shared is cleaned with the first run after fruit discarded.

Red flags

1. **Deep sighing breathing, blurred or snowfield vision, dilated unreactive pupils after drinking spirit of unknown origin.** Methanol with established acidosis. Without dialysis the outbreak mortality is 20 to 34 per cent and survivors keep their blindness for life. Do anyway: ethanol loading and maintenance at once, bicarbonate, warmth, darkness for the eyes, a watcher through the night. Tell the family honestly that sight already lost will not come back.
2. **Coma on admission after suspected methanol.** Odds ratio 29.4 for death. Do anyway: airway on the side, ethanol by tube if you have one, and comfort.
3. **A patient who smells of spirit, unrousable, breathing slowing.** Ethanol poisoning near the respiratory threshold. No antidote exists. Do anyway: recovery position, clear the airway repeatedly, warmth, sugar by mouth if they can swallow, stay with them. Most survive if they do not aspirate.
4. **Vomiting in an unconscious drinker.** Aspiration is the commonest way alcohol kills in a village. Roll them now and keep them rolled.
5. **A child who has drunk any quantity of spirit.** Hypoglycaemia and respiratory depression at doses adults shrug off. Do anyway: sugar by mouth, warmth, constant observation, nothing else.
6. **Wrist drop, abdominal colic and anaemia in a habitual drinker of local spirit.** Lead. There is no chelation after the Fall. Do anyway: find and destroy the still, treat the anaemia with food, record the case so the next is recognised.
7. **A still with no vapour path, hissing at a joint.** Everyone moves away. Do not approach to loosen it.

The case against

That the anaesthesia verdict is too absolute. Alcohol did blunt pain for two thousand years and people survived operations under it. The counter is that they survived the operation, not the anaesthesia. Park's 1896 account, by a surgeon who worked both sides of 1846, is the most damaging witness: he lists alcohol among the only agents of practical value and in the same lecture describes patients writhing and screaming. The Belfast group spent three years trying to make intravenous ethanol work with full hospital support and abandoned it.

That the methanol reassurance is dangerous. The critics are the European regulators and the probabilistic risk workers. Muhollari and colleagues concluded that regular consumption of unrecorded fruit spirits can exceed the oral reference dose for methanol, and Croitoru found 82 per cent of Transylvanian home brandies over the European limit and concluded that home-distilled fruit spirits are a health threat. They are right about chronic exposure and I have not softened it. What they do not claim, and what this document denies, is that a competent home still blinds people acutely.

That a village should not distil at all. Distilling destroys food, burns wood, starts fires, fuels drunkenness, and the thing it is most wanted for it cannot do. Every state facing famine has banned it. The honest answer is that the dispensary's requirement, 25 to 30 litres of absolute ethanol a year for 300 people, costs under 90 kg of grain and a cord of wood, and buys the only broad-spectrum skin antiseptic a village will have, the only solvent for resinous medicines, the only preservative for a liquid pharmacy and the only treatment for methanol poisoning. The argument against distilling is an argument against distilling for drink.

That alcohol antisepsis is overrated. One study found 70 per cent failing to eliminate staphylococci, formulation beats concentration, alcohol does nothing against spores, and for acute wounds clean water prevents infection as well as anything. All true, and none of it displaces alcohol from the one job it does better than any other village-makeable substance: killing vegetative bacteria and enveloped viruses on intact skin and on a healer's hands, in thirty seconds, with no water supply and no rinse.

10-line summary of robust findings

1. Distilled spirit is not a surgical anaesthetic. The dose that abolishes surgical response sits at or above the dose that stops breathing, and the survival literature is wrong.
2. Alcohol's real dispensary uses are solvent, skin antiseptic, preservative, drug vehicle, fuel and, at district level, neurolytic and ether precursor.
3. Working strengths: 25 to 45 per cent for most tinctures, 60 to 90 for resins, 85 to 95 for fresh plant, 60 to 85 for antisepsis with 70 to 80 the optimum, 95 and above for ether.
4. Absolute alcohol is a worse antiseptic than 70 per cent, because it evaporates before it works.
5. Distillation stops at the azeotrope, 95.6 per cent by weight. Past that, only quicklime, and the product does not keep.
6. One kilogram of sugar gives about half a litre of absolute ethanol as finished spirit, a kilogram of grain about a third.
7. Methanol comes from pectin in the mash, not from the still. Fruit mashes carry a hundred to a thousand times the methanol of grain or sugar washes.
8. A heads cut does not remove methanol. It distils through the whole run and accumulates in the tails, so cutting the tails early is the only distillation-based control.
9. Home-still spirit carries its own antidote, because ethanol blocks the enzyme that makes methanol poisonous and arrives in vast excess. The blinding outbreaks come from industrial methanol sold as drink.
10. A village of 300 needs 25 to 30 litres of absolute ethanol a year for medicine, under 90 kg of grain. The food argument against distilling is an argument about drink.

Open questions

- No measured value exists, that I could find, for the methanol content of a pure sugar wash distillate. The claim that it is near zero rests on the absence of pectin, not on a measurement.
- No controlled comparison exists of resin yield against ethanol strength. The 60 to 90 per cent rule is pharmacopoeial tradition, not data (also noted in ME-01).
- The 20 to 25 per cent self-preservation threshold appears in no pharmacopoeia I or ME-01 could locate.
- Yeast ethanol tolerance has no general published ceiling for *Saccharomyces cerevisiae*. The 12.3 per cent figure here is one strain at one optimum in a very-high-gravity medium.
- The rule that a stripping run roughly triples wash strength is universal in workshop practice and absent from the literature I reached.
- Whether chronic low-level methanol from fruit spirits causes measurable harm is contested, the European probabilistic work saying yes for heavy regular drinkers and the outbreak literature saying the acute problem is adulteration.
- The minimum effective concentration for alcohol neurolysis has never been established, which matters because a village would want the lowest that works.
- Whether a lay healer can titrate oral ethanol antidote without any blood assay is untested. The audit figure of 27 per cent of levels in range is not encouraging.

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At the bedside after the Fall

A household. The minimum viable version is a crock, a cloth cover and whatever sugar, honey or fruit is spare, giving a 6 to 12 per cent ferment and nothing stronger. Use it as a preservative medium for a herb that will not keep otherwise, as a comfort and as a vehicle. It needs a vessel, a warm corner, patience, and the discipline not to put a fruit ferment anywhere near a still later. The first failure to expect is vinegar: a ferment left open or warm turns to acetic acid within weeks, useful but not what you wanted.

A village of 300. The minimum viable version is one still, owned by the village, running sugar or grain only, producing about 70 litres of 40 per cent spirit a year with a third redistilled to 70 for antisepsis. It needs a copper vessel with no lead solder and no galvanised part, a condenser that is not a radiator, cooling water, fuel, a beam balance and a scratched bottle for measuring strength, a locked store with a two-person key, a register book, and a denaturant for the external grades. The skills are mashing, fermenting, running a still without sealing it, and reading a specific gravity. The first failure to expect is theft. The second is a tincture of unrecorded strength, because somebody will put up a jar without writing down the menstruum. The third is a fire.

A district of 3,000. Add a reflux column or a third-run practice for 95 per cent spirit, a quicklime line for absolute alcohol, and a written strength-and-batch record travelling with every bottle to the villages. It needs a kiln for burning lime, a trained person who understands why absolute alcohol absorbs water, and a standing decision about whether to attempt ether, because that decision quadruples the alcohol budget. The first failure to expect is diversion of the 95 per cent spirit to drink or trade, because it is the most valuable liquid in the district.

Protocols

P1. Choosing the feedstock for medical spirit

- ☐ Use sugar, honey or grain. Never fruit, for anything the dispensary will use.
- ☐ If fruit must be used for drink, run it on a different day and discard the first litre of the next run before collecting medical spirit.
- ☐ Never crush stone-fruit stones. Cyanide from them becomes ethyl carbamate in the spirit.
- ☐ Target a wash of 8 to 12 per cent. Pitch healthy yeast, keep the ferment between 18 and 30 degrees, give nitrogen if the wash is pure sugar.

P2. Running for strength, not for flavour

- ☐ Never seal the still. There must always be an open vapour path or a relief that lifts well below any pressure the vessel can hold.

- ☐ Run outdoors or under an open-sided cover. No flame within three metres of the receiver or condenser outlet.
- ☐ Discard the first 50 mL per 20 litres of wash as foreshots, for acetaldehyde and ethyl acetate, not for methanol.
- ☐ Cut the tails early, when the distillate falls below about 40 per cent at the spout, and do not recycle tails into a medical run. Early tails cutting is the only distillation step that reduces methanol.
- ☐ Expect 25 to 30 per cent from a stripping run on a 10 per cent wash, 65 to 75 from the heart of a second run, 90 to 95 from a third or a packed column. No amount of redistilling passes 95.6 per cent by weight.

P3. Measuring strength without instruments

- ☐ Mark a small bottle with a scratch at the neck. Fill to the scratch with water at room temperature and weigh.
- ☐ Empty, dry, fill to the same scratch with the spirit at the same temperature, weigh. Divide the spirit weight by the water weight for the specific gravity.
- ☐ Read against 0.79 absolute, 0.835 rectified spirit about 86 per cent, 0.92 proof spirit about 57 per cent, 0.935 diluted alcohol about 49 per cent.
- ☐ With an alcoholmeter, stand the sample in water until it reaches the temperature marked on the instrument. Never read a wash, a sweetened cordial or a tincture with one, because sugar makes it read low.
- ☐ The gunpowder test tells you only whether the spirit is above or below about 57 per cent. Never write a number from it.

P4. Diluting to a working strength

- ☐ Targets: 40 per cent for standard tinctures, 60 to 90 for resins, 70 to 80 for antisepsis, 80 for hand rub, 95 for ether.
- ☐ Add water to spirit, never spirit to water, and let the mixture stand and cool before measuring. Mixing releases heat and the volume contracts, so a sum of volumes does not give the expected total.
- ☐ Measure again once cooled. Write the measured strength and the date on the vessel.

P5. The hand rub, WHO Formulation I

- ☐ For one litre: 833.3 mL of 96 per cent ethanol, 41.7 mL of 3 per cent hydrogen peroxide, 14.5 mL of 98 per cent glycerol, made to 1,000 mL with boiled and cooled water.
- ☐ Without peroxide or glycerol, dilute 96 per cent spirit to 80 per cent by volume and accept that it will dry the hands and may carry spores.
- ☐ Use 3 mL per application and rub until dry, 20 to 30 seconds. If the hands are dry in under 10 seconds, too little was used.
- ☐ Wash with soap and water instead whenever hands are visibly soiled, and always after a patient with suspected spore-forming infection.
- ☐ Mix in batches under 50 litres, ventilated, with no flame, and store cool.

P6. Skin preparation before an incision

- ☐ Wash the area with soap and clean water first and dry it.
- ☐ Apply 70 to 80 per cent spirit on a clean cloth, working outward from the incision line, and let it dry completely before cutting. The drying is the disinfection.
- ☐ Do not pool spirit under the patient or in a skin fold, and bring no flame or cautery near until dry.
- ☐ Put no spirit into the wound. Irrigate it with clean boiled water or saline.

P7. Making a tincture at a known strength

- ☐ Decide the ratio and the strength and write both before starting, for example 1:5 dried in 40 per cent.

- ☐ Weigh the herb, measure the menstruum, combine in a closed jar, macerate 14 days with occasional shaking (ME-01 owns the procedure).
- ☐ Press the marc or accept the loss. An unpressed marc holds a quarter to a third of the menstruum, so either make the volume back up or write the true yield on the label.
- ☐ Label with plant, part, ratio, ethanol per cent, date and maker. An unlabelled tincture is destroyed, not guessed at.

P8. Methanol poisoning, the village protocol

- ☐ Suspect it in anyone who drank spirit of unknown origin and who, 6 to 24 hours later, has abdominal pain, deep sighing breathing or any visual change. A patient who feels well at six hours is not safe.
- ☐ Start ethanol at once, without waiting for signs, if several people drank from the same bottle and one is ill.
- ☐ Loading dose with 40 per cent spirit: 2 mL per kg of body weight, so 140 mL for a 70 kg adult. Dilute in water or juice and give slowly. With 20 per cent spirit, double the volume to 4 mL per kg.
- ☐ Maintenance with 40 per cent spirit: 0.25 mL per kg per hour for someone who does not drink habitually, 0.5 for a habitual drinker. For a 70 kg adult that is about 18 mL or 35 mL an hour.
- ☐ Give it hourly, around the clock, for at least three days, longer if visual symptoms or deep breathing persist.
- ☐ Judge the dose by the patient. The aim is someone clearly drunk but rousable and talking. If they stop responding or their breathing slows, hold the next dose and watch.
- ☐ Give sodium bicarbonate if you have it, for the acidosis. Keep the patient warm, in a darkened room, on their side, with somebody awake beside them.
- ☐ Give sugar by mouth regularly. Ethanol causes hypoglycaemia, especially in the thin and the malnourished.
- ☐ Do not give more alcohol to someone already unconscious unless you can protect their airway.
- ☐ Record who drank from which bottle and find the rest of it. An outbreak is never one person.

P9. Keeping the dispensary's alcohol

- ☐ Denature every external grade with one part in ten of a bitter decoction or wormwood. It makes it undrinkable and no less effective.
- ☐ Hold the drinkable grades under a lock with two keys held by two people.
- ☐ Enter every litre out of the store in a register against the batch it went into, signed.
- ☐ Count the store at a fixed interval in front of a witness.
- ☐ Store in full, tightly stoppered vessels, cool, dark and away from flame. Absolute alcohol absorbs water from the air and must be used the day it is made.

Numbers to carry

1. **400 to 500 mg/dL.** The blood ethanol at which breathing stops in a person without tolerance. There is no anaesthetic dose below it.
2. **70 to 80 per cent.** The strength for antisepsis and hand rub, 3 mL rubbed for 30 seconds. Stronger is weaker, and no strength kills spores.
3. **40, 60 to 90, 95.** Forty per cent for the ordinary tincture, 60 to 90 for resins, 95 for ether and nothing else.
4. **95.6 per cent by weight.** Where distillation stops, for ever. Past it, quicklime only.
5. **Half a litre per kilogram.** Absolute ethanol from a kilogram of sugar as finished spirit, a third of a litre from grain. Thirty litres a year runs a village dispensary and costs under 90 kg of grain.
6. **A thousand times.** The methanol in a fruit mash against a grain or sugar wash. Plum brandy at 9,000 mg per litre, rice spirit at 9.
7. **The heads cut removes nothing.** Methanol distils through the whole run and gathers in the tails. Cut the tails early. Use grain or sugar.

8. **10 mL blinds, 30 mL kills.** Methanol, with wide variation, and a latent period of 12 to 24 hours during which the patient feels well.
9. **2 mL per kg, then 0.25 mL per kg per hour.** Forty per cent spirit as the methanol antidote, doubled for a habitual drinker, continued for days.
10. **No radiator, no lead solder, no sealed vessel, no flame.** The four rules covering every way a still kills someone who is not drinking from it.

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