ME-06 Willow, meadowsweet and the salicylates, and the other analgesic plants

HEALING after the FALL, research library, ME-06

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

Scope and what this report adds to the library

This report weighs the plant painkillers against the salvaged drugs a village may still hold. It builds on ME-02 (salicin by taxon, dose measurement, the one-in-a-village rule), IN-02 (fever, Stone's dosing, aspirin, Reye's syndrome, the paracetamol table), PH-01 (willow and meadowsweet among the forty European plants) and WO-11 (opium, morphine, naloxone, clove, cold for procedures), and does not repeat them (THRIVING library, ME-02, IN-02, PH-01, WO-11). ME-05, CH-05 and NU-08 were not yet in the library, so the opium rung points to WO-11 and ME-02.

New here: how much salicylate a willow dose delivers, set against aspirin. The trial record for pain. Wintergreen oil as a poison. Whether salicylic acid or aspirin can be made at the district rung. Capsaicin, devil's claw, turmeric, cannabis and kratom. A pain ladder and a card of doses by weight.

Grades follow the brief (A trials, B clinical series, C convergent tradition, D single tradition, X ineffective or harmful). An A can rest on weak trials, so each carries a word on certainty. The grade belongs to the preparation tested: a willow extract with a trial behind it does not lend its grade to a willow tea.

1. Willow (*Salix* species, bark)

1.1 The tradition on its own terms

Willow grows where the ground is wet, and many unrelated peoples beside it used it for pain. The Native American Ethnobotany database (NAEB) records the Blackfoot drinking a decoction of new twigs of pussy willow (*Salix discolor*) as a painkiller (Johnston 1987), the Crow chewing the bark for headache (Hart 1992), and the Montagnais drinking an infusion of shining willow leaves (*S. lucida*) and binding the bark on the head (Speck 1917). The Koasati took an infusion of black willow root (*S. nigra*) for headache (Taylor 1940), and the Chickasaw used the roots or a poultice. The Seminole gave an infusion of coastal plain willow bark (*S. caroliniana*) as an emetic for "thunder sickness", with fever, dizziness, headache and diarrhoea (Sturtevant 1954). The Thompson people washed painful, swollen feet in a decoction (Steedman 1928), and the Nunivak used tealeaf willow (*S. pulchra*) as an analgesic (Smith 1973). All are as recorded in NAEB.

Two things stand out. The Seminole drink belonged to a wider treatment, with vomiting, for an illness with a name and cause of its own. This report records that frame and does not reduce it to a dose of salicin. And much use was external, as washes and poultices. Salicylate passes the skin poorly from bark, so these may work by cold, pressure and care as much as chemistry [VERIFY, my inference].

In southern Africa the Nama are said to have used willow bark for rheumatic disease, a remark made by a Dr Ensor at the Cape in reply to Maclagan in 1876 (Schrör 2009). The willow there would have been the Cape willow, *S. mucronata* [VERIFY, species not named in the source].

In Europe the usual story begins with Hippocrates. It is mostly legend. The only Hippocratic mention one careful reader could find is willow leaves burned to fumigate the womb after a miscarriage (Martyr 2020). Standard histories still repeat claims of Egyptian, Sumerian and Hippocratic use (Schrör 2009). This report treats ancient Mediterranean use as unproven.

1.2 What the record shows: Edward Stone, 1763

The Reverend Edward Stone of Chipping Norton wrote to the Earl of Macclesfield, President of the Royal Society, on 25 April 1763 (Stone 1763). The printed heading calls him "Edmund" (Schrör 2009). He found white willow bark (*Salix alba*) bitter like Peruvian bark and reasoned that a tree of wet ground, where agues abound, might cure them. He took about a pound of bark from three- to four-year-old pollard shoots, dried it outside a baker's oven for over three months, and gave 20 grains every four hours between fits, rising to a dram, in water, tea or small beer, to about fifty patients over five years. For stubborn autumnal and quartan agues he added one part Peruvian bark to four (Stone 1763). IN-02 records the fever doses.

The record is narrow. Stone treated intermittent fevers, likely malaria in part, and counted cures, not failures. Willow does not kill the parasite, so he probably saw fever lowered and spontaneous remission [VERIFY, my inference]. He recorded nothing on pain.

1.3 The chemistry: how much willow equals an aspirin

Willow bark holds salicin and related glycosides (salicortin, tremulacin), tannins at 8 to 20 per cent and flavonoids (EMA AR 2017). Salicin is a prodrug: the gut and liver turn it into salicylic acid (Schrör 2009). Aspirin also becomes salicylic acid, but first its acetyl group binds irreversibly to platelet cyclo-oxygenase 1, which salicylic acid alone does not do. Hence willow's small effect on platelets.

The key measurement: in ten volunteers, 1,360 mg of extract (240 mg salicin) gave a serum peak at about 2 hours of 1.2 mg per litre, 86 per cent of it salicylic acid, and an exposure equal to 87 mg of aspirin. Peaks after analgesic aspirin are "considerably higher" (Schmid 2001a, in EMA monograph 2017). The assessment report gives 50 to 87 mg as the range (EMA AR 2017).

So the full daily trial dose gives the salicylate of a sixth or less of one 300 to 900 mg aspirin dose (THRIVING library, IN-02). To match one 600 mg aspirin would take about 1,650 mg of salicin, seven times the trial dose: about 28 g of bark at 6 per cent salicin, or 330 g of *S. alba* at 0.5 per cent [VERIFY, my arithmetic from 600 / 87 × 240]. Nobody can drink that. Willow is not a quick painkiller for a tooth or a broken bone.

Yet the extract relieved back pain with a dose response (section 1.4). The EMA allows that the polyphenols may contribute (EMA monograph 2017). Willow works slowly, modestly, and not by being a small aspirin.

1.4 The trials

Low back pain, the best trial. Chrubasik and colleagues randomised 210 patients with flares of chronic low back pain to extract giving 120 or 240 mg salicin a day, or placebo, for four weeks, with tramadol as rescue. In week 4, 39, 21 and 6 per cent were pain-free for at least five days (p below 0.001). One patient had a severe allergic reaction (Chrubasik 2000, in EMA AR 2017). That is an NNT of about 3 at 240 mg and 7 at 120 mg [VERIFY, my arithmetic], on an outcome unlike the 4- to 6-hour outcome of section 5.

The Cochrane review. The review of herbal medicine for low back pain (Oltean 2014, also published in *Spine* in 2016 with Gagnier first [VERIFY, journal details]) found 14 trials with 2,050 participants. Willow rested on two

trials with 261 people, moderate quality, and one open trial of 228 against rofecoxib, very low quality. Only cayenne was clearly better than placebo, and conflicts of interest were noted in eight trials (Oltean 2014).

Osteoarthritis and rheumatoid arthritis. Results are mixed. Schmid and colleagues gave 78 patients 240 mg of salicin for two weeks and found a borderline benefit on the WOMAC pain score, with 6 allergic skin reactions among 38 patients on willow. Biegert and colleagues gave 127 patients 240 mg of salicin, diclofenac or placebo for six weeks. Diclofenac beat placebo clearly and willow did not. A parallel trial of 26 patients with rheumatoid arthritis was negative (Schmid 2001b, Biegert 2004, both in EMA AR 2017).

Platelets. In patients given willow extract (240 mg salicin a day, 35 patients), aspirin 100 mg a day or placebo, aggregation induced by arachidonic acid reached 61 per cent on willow, 78 per cent on placebo and 13 per cent on aspirin. Willow lowered aggregation, but to a far lesser extent than aspirin (Krivoy 2001, in EMA AR 2017). Willow thins the blood a little, not much.

Safety in practice. In a German surveillance study of 4,731 patients, digestive side effects occurred in 0.93 per cent and skin reactions in 0.30 per cent, with no bleeding from the gut (Werner 2004, in EMA AR 2017).

1.5 Bark, species and dose: where extract-trial doses are misquoted

The trials used a dry extract (8 to 14:1, 70 per cent ethanol, about 15 per cent salicin), registered at 393 to 1,572 mg a day for low back pain for up to four weeks (EMA monograph 2017). It is the only willow preparation with well-established use status in Europe.

The traditional bark doses are smaller. The EMA allows a tea of 1 to 3 g in 150 ml three times daily, or a decoction of 4 g in 200 ml, boiled covered 15 minutes and stood 15 minutes, three times a day after meals (EMA monograph 2017). The German pharmacopoeia commentary, Bisset and Barnes give 1 to 3 g three to four times a day for 60 to 120 mg of salicin a day (in EMA AR 2017). The assessors state that 6 to 12 g of bark as a decoction will usually not deliver the trial amounts (EMA AR 2017).

That conclusion holds for ordinary bark and fails for the rich species. The table shows the arithmetic.

Willow	Total salicin in bark	Salicin in 12 g bark a day (3 × 4 g)	Against the 240 mg trial dose
S. alba, white willow	0.5 per cent (EMA AR 2017)	60 mg	a quarter
Pharmacopoeia floor	1.5 per cent	180 mg	three quarters
S. daphnoides, violet willow	over 4 per cent (EMA AR 2017)	over 480 mg	double
S. purpurea, purple willow	4 to 8 per cent (EMA AR 2017)	480 to 960 mg	double to four times

[VERIFY, my arithmetic, which assumes full extraction into the decoction. How much salicortin passes into hot water and converts to salicin is not known to this report.]

Two cautions follow. The white willow Stone used, and most people will pick, is the poorest. And a purple willow decoction may give more salicin than any trial tested, with unmeasured harms. Autumn bark of two-year shoots carries about a quarter more salicin (THRIVING library, ME-02). A village should coppice purple or violet willow, as IN-02 proposed, and keep to the EMA decoction dose until someone measures the bark (THRIVING library, IN-02).

PH-01 graded the willow decoction B for back pain (THRIVING library, PH-01). This report disagrees in part. The trials tested an ethanol extract, not a decoction, so the decoction is grade C for back pain by extrapolation, and only the extract is A.

1.6 Harms of willow

The EMA contraindications are salicylate or anti-inflammatory hypersensitivity, salicylate asthma, active ulcer, the third trimester, G6PD deficiency, age under 18 (Reye's syndrome), severe liver or kidney disease and bleeding disorders. No combining with other salicylates or anti-inflammatory drugs. It may strengthen coumarin anticoagulants. Not recommended in early pregnancy or breastfeeding (EMA monograph 2017).

The case reports bear this out. An aspirin-allergic patient had anaphylaxis after a willow supplement (Boullata 2003, in EMA AR 2017). A four-year-old boy of 17 kg went into hypovolaemic shock from gut bleeding (blood pressure 60/40, haemoglobin 6.4 g/dl) after a syrup of meadowsweet and willow prescribed by his paediatrician for a feverish cold. Salicylates were confirmed, the link was judged probable, he recovered after intensive care, and the product was withdrawn in Italy (Moro 2011, abstract). The dehydrated risk kidney injury (THRIVING library, ME-02).

Willow carries aspirin's harms at a lower dose, with less platelet effect, but the allergy, the child and the kidney risks remain. Lookalikes (the buckthorns, whose bark purges, and poplars, which also hold salicin) are in PH-01 and IN-02.

2. Meadowsweet (*Filipendula ulmaria*, flowering tops)

Tradition. Meadowsweet grows in wet meadows across Europe. It has long been taken as a tea for colds, rheumatic pain and an acid stomach. Its old name, *Spiraea ulmaria*, gave aspirin its name (section 4).

Chemistry. The flowers hold salicylaldehyde, methyl salicylate and salicylate glycosides [VERIFY, from general knowledge]. Total salicylates in dried flower heads of wild populations ranged from 21.7 to 63.5 mg per gram (Stawarczyk 2021), but by an iron chloride colour test that reacts with many phenols [VERIFY]. The same authors place meadowsweet below willow. PH-01 found no figure (THRIVING library, PH-01).

Record. There are no controlled trials of meadowsweet for pain or fever in humans that this report could find. The EMA registers it under traditional use only, for the supportive treatment of the common cold and for minor joint pain (EMA meadowsweet monograph 2011).

Dose. Infusion of 1.5 to 6 g a dose, 2 to 18 g a day. Powder 250 to 500 mg a dose, up to 1,500 mg a day. Tincture 1:5, 2 to 4 ml a dose, 6 to 12 ml a day. At most one week for a cold and four weeks for joint pain. PH-01 gives the same figures (EMA meadowsweet monograph 2011, THRIVING library, PH-01).

Harms. Not under 18. Not in pregnancy or breastfeeding. Not with salicylate allergy or with anti-inflammatory drugs. A fever above 39 °C needs a healer (EMA meadowsweet monograph 2011). The Italian child in section 1.6 had taken a syrup with meadowsweet in it (Moro 2011).

Lookalikes. It shares wet ground with deadly hemlock water-dropwort (*Oenanthe crocata*). Meadowsweet has foamy cream flowers in irregular clusters and leaflets silvery beneath. Water-dropwort has flat white umbrellas and pale finger-like roots. If uncertain, do not pick [VERIFY, from general botanical knowledge].

Grade. C for minor joint pain and colds, on tradition across Europe and the plausible salicylate content. No trial.

3. Wintergreen oil and methyl salicylate: the kitchen poison

The plants. Oil of wintergreen comes from the leaves of *Gaultheria procumbens*, a creeping evergreen of eastern North America (teaberry, checkerberry). Its glycoside gaultherin breaks down in water to methyl salicylate. Sweet

birch bark (*Betula lenta*) gives a nearly identical oil (King's American Dispensatory 1898, via Henriette's Herbal, secondary). European *Pyrola* species are also called wintergreen and are a different plant [VERIFY].

How much is a dose of poison. Oil of wintergreen is 98 per cent methyl salicylate, and 1 ml equals 1.4 g of aspirin (Chyka 2007). A 5 ml teaspoon equals about 7 g, as RCH Melbourne also states (RCH 2017). A teaspoon or less has been implicated in deaths of children under six (Davis 2007, abstract). In the American poison-centre record, about 5 ml killed a boy of two and a half (about 432 mg per kg), 5 ml killed a one-month-old, 10 ml and 15 ml killed two girls aged two, 4 ml moderately poisoned a 21-month-old, and 30 ml killed a man of 44 (Chyka 2007).

The consensus guideline sends to hospital any child under six who has taken more than a lick or taste, and anyone older who has taken more than 4 ml (Chyka 2007). RCH and Chyka agree on the scale of danger.

Why it is worse than tablets. It is liquid, smells of sweets, is absorbed fast, and a spoonful holds a lethal dose.

Where it hides. In muscle rubs, liniments and flavourings (RCH 2017). In a salvaged pharmacy, every liniment is a possible salicylate.

Grade. As a drink, X. As a rub, not reviewed here [VERIFY]. After the Fall it belongs in the locked poisons cupboard.

4. Can salicylic acid or aspirin be made at the district rung?

4.1 What the record shows

The chain from willow to aspirin took seventy years and several countries.

- 1826 to 1833: Brugnatelli and Fontana, then Buchner, extracted and named salicin. Leroux crystallised it in 1830, and Merck sold it at half the price of quinine (Schrör 2009).
- 1839: Piria made salicylic acid from salicin. It was also obtained from meadowsweet (spiraeic acid) and wintergreen oil. Schrör calls *Spiraea ulmaria* "the American teaberry", an error: the teaberry is *Gaultheria* (Schrör 2009).
- 1853 to 1869: Gerhardt, von Gilm and Kraut each made an impure acetyl derivative (Schrör 2009).
- 1859 to 1874: Kolbe synthesised salicylic acid from phenol. Von Heyden scaled it up in his villa kitchen, then at a factory at Radebeul making 4,000 kg in its first year and 25 tonnes four years later. The price fell tenfold (Schrör 2009).
- 1876: Stricker in Berlin and Maclagan in Dundee showed salicylate relieved rheumatic fever. Sodium salicylate at 4 to 6 g a day brought stomach upset, nausea and ringing in the ears (Schrör 2009).
- 10 August 1897: Felix Hoffmann at Bayer made the first pure, stable acetylsalicylic acid. The name Aspirin, registered on 1 February 1899, comes from "a" (acetyl) and "spir" (spiraeic acid) (Schrör 2009).
- The story that Hoffmann did it for his father's rheumatism first appeared in a 1934 footnote. Arthur Eichengrün, his superior, claimed in 1949 to have directed the work. Eichengrün, who was Jewish, was interned in 1944. Sneader's archive work supports him, and Bayer disputes it (Sneader 2000).

4.2 Honest feasibility

Salicylic acid and sodium salicylate. The record shows nineteenth-century pharmacists obtained salicylic acid from wintergreen oil before Kolbe made it cheap (Schrör 2009). This report gives no method. A district would need a reliable oil source (in Europe, salvaged methyl salicylate or planted *Gaultheria* or *Betula lenta*, neither native [VERIFY]), a balance, a trained preparer, a way to test identity and strength, and the one-in-a-village rule (THRIVING library, ME-02). The failure to expect is a product of unknown strength given at the old 4 to 6 g a day, with tinnitus and vomiting [VERIFY, my inference]. It carries aspirin's harms, is easier to overdose than willow, and offers little a purple willow coppice does not [VERIFY, my judgement].

Aspirin. Three competent nineteenth-century chemists failed to make it pure. Pure, stable aspirin came from an

industrial laboratory with reagents of known purity (Schrör 2009). The acetylating reagent itself needs industrial chemistry and is internationally controlled as a heroin precursor [VERIFY]. Verdict: aspirin cannot reliably be made at the district rung. Salvaged aspirin is precious and its stock should be logged.

5. The yardstick: salvaged drugs by number needed to treat

The Oxford league table pools single-dose trials in acute pain, mostly after dental and other surgery. The outcome is at least 50 per cent pain relief over 4 to 6 hours. Placebo gives that to about 18 per cent of patients (Oxford league table 2007).

Drug and dose	NNT
Paracetamol 1,000 mg + codeine 60 mg	2.2
Aspirin 1,200 mg	2.4
Ibuprofen 400 mg	2.5
Ibuprofen 200 mg	2.7
Diclofenac 50 mg	2.7
Morphine 10 mg by injection	2.9
Paracetamol 1,000 mg	3.8
Aspirin 600 or 650 mg	4.4
Tramadol 100 mg	4.8
Codeine 60 mg alone	16.7

(Oxford league table 2007.) A later Cochrane overview found no evidence of effect for aspirin 500 mg, on low-quality evidence (Moore 2015). No plant here was tested this way. For a sprain, a tooth or a wound, the village has trial evidence only for salvaged drugs and opium.

The aspirin exclusions, which apply to willow and meadowsweet too:

- **Children and teenagers with a viral illness.** Reye's syndrome, with a high death rate, followed aspirin in children with influenza or chickenpox. Not under 16 for aspirin, not under 18 for willow (THRIVING library, IN-02, EMA monograph 2017).
- **Dengue and other haemorrhagic fevers.** Aspirin and other anti-inflammatory drugs worsen bleeding. Where dengue occurs, an undiagnosed fever gets neither (THRIVING library, IN-02).
- **Pregnancy.** Willow is contraindicated in the third trimester (EMA monograph 2017). The American regulator advises avoiding anti-inflammatory drugs from 20 weeks (harm to the unborn baby's kidneys and the fluid around it) and from 30 weeks (early closure of a vessel in the baby's heart). Low-dose 81 mg aspirin for pre-eclampsia is exempt (FDA 2020, secondary summary).
- **Asthma.** On oral challenge 21 per cent of asthmatic adults reacted to aspirin, though only 3 per cent knew it. Of those, 98 per cent also react to ibuprofen and 93 per cent to diclofenac, but only 7 per cent to paracetamol (Jenkins 2004, abstract). An asthmatic in pain gets paracetamol first.
- **Stomach ulcer, bleeding, anticoagulants, kidney disease and dehydration** (EMA monograph 2017, THRIVING library, ME-02).

6. Capsaicin (*Capsicum annuum* and *C. frutescens*, fruit)

Tradition and record. Chilli came from the Americas and spread worldwide after 1492. Capsicum plasters for aches were sold in Europe and America long before the trials [VERIFY, not sourced]. Capsaicin first releases substance P from pain fibres, which burns, then desensitises them for a time (EMA capsicum monograph 2015).

Trials. *- Back pain, plasters.* Three trials with 755 people, moderate quality: cayenne beat placebo, the one herbal product the Cochrane review endorsed (Oltean 2014). Responders were 60.8 against 42.1 per cent in 154 patients (Keitel 2001) and 67 against 49 per cent in 320 (Frerick 2003, both in Oltean 2014), an NNT of about 5 to 6 [VERIFY, my arithmetic]. *- Low-strength cream.* Musculoskeletal pain, 0.025 per cent or plaster for four weeks, 3 trials, 368 patients: NNT 8.1 (4.6 to 34). Neuropathic pain, 0.075 per cent for eight weeks, 6 trials, 656 patients: NNT 5.7 (4.0 to 10). Local burning 54 against 15 per cent, NNH 2.5 (Mason 2004). A later review of 6 old trials (389 people) judged it unlikely to be clinically useful (Derry and Moore 2012). *- 8 per cent patch.* Eight studies, 2,488 people: NNT 8.8 at eight weeks for pain after shingles (Derry 2017). A factory and clinic product, not a village remedy.

The burning of low-strength cream is better established than its benefit. The plaster for back pain is the best case.

Dose. The EMA allows a plaster of 11 mg capsaicinoids (35 μg per cm^2) or 4.8 mg (22 μg per cm^2), once a day for 4 to 12 hours, at least 12 hours before another on the same spot. Creams of 0.04 to 0.053 per cent, a thin layer two to four times daily. Three weeks, then a two-week break. Not under 18 (EMA capsicum monograph 2015). Mason's trials used 0.025 to 0.075 per cent, so the sources agree (Mason 2004).

A village ointment. Dried hot chilli holds roughly 0.3 to 1 per cent capsaicinoids (Altmeyer, secondary [VERIFY]). If fully extracted into fat, about 5 g of dried chilli powder in 100 g of lard or oil would give 0.015 to 0.05 per cent, inside the trial range [VERIFY, my arithmetic, untested]. Chillies vary tenfold in heat, so the first batch must be tried on a small patch of skin.

Harms. Burning, and agony in eyes or mucous membranes. Not on broken skin, no heat on top, wash hands. Allergy is rare. Pregnancy only after weighing the risk (EMA capsicum monograph 2015).

7. Devil's claw (*Harpagophytum procumbens* and *H. zeyheri*, secondary root tuber)

The tradition on its own terms. Devil's claw grows in the Kalahari sands, named for its hooked fruit. The Herero call it *otjihangatene*. In 1907 the Herero Samuel Kariko described its use for cough, diarrhoea, constipation and venereal disease to Hellwig, a German army medical officer. Nama and Damara, San and Tswana have their own names. Records describe tuber infusions and decoctions for digestion, childbirth, pain, fever and as a tonic, and the powder on wounds (Brendler 2021). The knowledge belongs to these peoples.

The popular story has Gottreich Mehnert, a German in the colony, learning of it from a healer during the 1904 to 1908 war, a genocide of the Herero and Nama. Brendler judges that version a marketing romance, since Hellwig had already named the plant. Mehnert passed it to O. H. Volk while both were interned in the Second World War, and Zorn published the first pharmacology in Germany in 1958. Listing under CITES was once considered (Brendler 2021). Benefit sharing with harvesters is contested and was not read here [VERIFY].

Trials. The root must contain at least 1.2 per cent harpagoside (EMA devil's claw AR 2016). - Chrubasik 1996: 118 back pain patients, 50 mg harpagoside a day, no difference.

The Cochrane review rated the two placebo trials with 315 people as low quality (Oltean 2014). The EMA assessor found the evidence insufficient for well-established use and registered only traditional use, for minor joint pain and mild digestive complaints (EMA devil's claw monograph 2016).

Dose. Tea for joints: 4.5 g of cut root in 500 ml of boiling water, steeped 8 hours, divided into three doses a day. Powder: 435 mg three times a day. Not under 18 (EMA devil's claw monograph 2016). At 1.2 per cent, 4.5 g of root holds about 54 mg of harpagoside, near the trial doses, if water extracts it [VERIFY, my arithmetic].

Harms. Stomach upset, diarrhoea, headache, allergy. Not with an active ulcer or in pregnancy. Gallstones need advice (EMA devil's claw monograph 2016). Outside southern Africa it is a salvage item.

8. Turmeric (*Curcuma longa*, rhizome)

Tradition. A spice, dye and medicine across South and South-East Asia, used in Ayurveda and households for swelling, wounds and digestion. Its Ayurvedic framework is left to the traditions reports.

The trials. Daily and colleagues pooled eight trials in arthritis at about 1,000 mg of curcumin a day. Against placebo, pain fell by 2.04 points on a ten-point scale (1.24 to 2.85, three trials) and WOMAC by 15.4 (3.8 to 26.9, four trials). Against painkillers there was no clear difference. The authors judged the evidence insufficient for firm conclusions (Daily 2016). A review of 15 trials with 1,670 knee osteoarthritis patients found pain 1.77 points lower, adverse events no higher than controls, and low-quality, heterogeneous evidence (Feng 2022).

The critique. Nelson and colleagues, medicinal chemists, argued that curcumin is unstable, reactive and barely absorbed, gives false positives in laboratory assays, and that "no double-blinded, placebo controlled clinical trial of curcumin has been successful" (Nelson 2017). Others disputed parts of this. Kitchen turmeric is a few per cent curcumin, so a teaspoon does not resemble a gram of curcumin [VERIFY].

The EMA view. Traditional use for digestive complaints only, 0.5 to 1 g of powder two to three times a day, not under 18, not with bile duct obstruction, gallstones or liver disease. No claim for pain at all (EMA turmeric monograph 2018).

Harms. Liver injury is linked to supplements, mainly enhanced forms with black pepper extract. Italy had 28 reports of hepatitis in early 2019 and made a warning compulsory (LiverTox and Italian reports, secondary). An American network found ten cases, five in hospital and one death (DILIN 2023, abstract via secondary). Bangladeshi turmeric dyed with lead chromate was traced to lead in pregnant women's blood (Stanford 2019, secondary). As food it is safe.

Grade. A, low certainty, for curcumin extracts in knee osteoarthritis. D for kitchen turmeric. No place on the ladder above willow.

9. Cannabis (*Cannabis sativa*, female flower) [OWNER]

Tradition. Long used for pain across Asia, Africa and Europe. Its history was not researched here.

The evidence. - The US National Academies found "substantial evidence" that cannabis is effective for chronic pain in adults, with a modest effect (NASEM 2017, secondary summaries). - The International Association for the Study of Pain, on 18 March 2021, declined to endorse general use of cannabinoids for pain for lack of high-quality evidence, while not dismissing patients' experience (IASP 2021). - The largest meta-analysis (104 studies, 47 randomised, 9,958 participants) found 30 per cent relief in 29.0 against 25.9 per cent: NNT 24 (15 to 61). No difference for 50 per cent relief. Adverse events 81.2 against 66.2 per cent: NNH 6 (5 to 8). Cannabinoids are "unlikely" to be highly effective here (Stockings 2018).

NASEM and IASP read the same trials with different bars. For each patient helped by a third, four are harmed in some way [VERIFY, my arithmetic from 24 / 6].

Psychosis. Across 11 sites, 901 first-episode patients and 1,237 controls, daily use carried odds of 3.2 and daily high-potency use (10 per cent THC or more) 4.8. Assuming cause, 30 per cent of new psychoses in London and 50 per cent in Amsterdam would not occur without high-potency cannabis (Di Forti 2019).

After the Fall. A village crop has unknown strength. Young people, those with family psychosis and pregnant women are most at risk [VERIFY, my synthesis]. Whether to grow it, for whom and under what rule is the owner's decision [OWNER]. The evidence gives modest benefit for chronic pain in adults, real harm, and no place above willow, paracetamol and ibuprofen.

Grade. A, low certainty, for chronic pain in adults. X for young people and anyone at risk of psychosis.

10. Kratom (*Mitragyna speciosa*, leaf)

The tradition on its own terms. Kratom (*ketum* in Malaysia) is a tree of southern Thailand and northern Malaysia. Village women use the leaves for fever, cough, pain, diabetes and anxiety. Rural labourers chew fresh leaves several times a day against fatigue in blistering heat. Where Islam forbids alcohol, a kratom drink is shared at social and village religious gatherings. Thais chew the leaves, Malaysians boil them for up to four hours into a drink (Singh 2017).

The record. Thailand banned it in 1943 and moved it under the Narcotics Act in 1979. Malaysia controls it under the Poisons Act 1952 (Singh 2017). Drinking three or more glasses of about 350 ml a day predicted severe dependence, with withdrawal of poor sleep, vomiting, muscle spasms, sweating, aches and hostility over one to three days (Singh 2014, in Singh 2017). Young people in both countries now take a "4x100" cocktail of kratom and other ingredients (Singh 2017).

Trial. The only controlled study found: in 26 Malaysian men who had drunk kratom daily for about six years, cold-water tolerance rose from 11.2 to 24.9 seconds an hour after kratom, with no rise on placebo (Vicknasingam 2020). This shows raised pain tolerance in habitual users, not relief in patients.

Harms. Of 27,338 US overdose deaths from July 2016 to December 2017, 152 were kratom-positive, kratom was a listed cause in 91 and the only substance found in 7. Fentanyl was found in 65 per cent (Olsen 2019). It does not grow in Europe.

Grade. D for pain, on a single tradition region and one experimental study. Where it grows, a village should treat it like the poppy: one named person, a logbook, and no daily use.

11. Clove, cold and heat

Clove (*Syzygium aromaticum*, bud and oil). In WO-11: a clove gel numbed the gum like 20 per cent benzocaine in 73 volunteers, and 5 to 10 ml of the oil has seriously poisoned infants (THRIVING library, WO-11). Grade A, low certainty. Clove oil goes in the locked cupboard.

Heat. In a Cochrane review of nine trials (1,117 people), a heat wrap reduced acute back pain at five days against a pill placebo in two trials with 258 people, moderate evidence. Evidence on cold was insufficient (French 2006, abstract). Grade A, moderate certainty. The village version is a hot stone or bottle in cloth. Burns happen on numb skin or a sleeping patient [VERIFY].

Cold. WO-11 covers cold for minor procedures (THRIVING library, WO-11). For sprains, this report found nothing to grade above C. Ice or snow must not touch skin directly for more than a few minutes [VERIFY].

12. The village pain ladder

Climb only when the rung below has failed or is clearly too weak. Always treat the cause as well: splint the fracture, drain the abscess, pull the tooth.

Rung	What	For	Best evidence
0. Hands	Reassurance, rest, splint, position, distraction, cold for a fresh injury, heat for a stiff back, clove for a tooth	Every pain	Heat A, clove A low, cold C
1. Plant	Willow decoction (adult), meadowsweet tea (adult), chilli ointment or plaster, devil's claw if held	Chronic back and joint pain, aches with a cold	Willow extract A, decoction C, capsicum plaster A

Rung	What	For	Best evidence
2. Salvaged	Paracetamol, ibuprofen, aspirin (adult), paracetamol with ibuprofen in turn	Acute pain, fever with pain, injury, period pain	A, NNT 2.4 to 4.4
3. Opium	Salvaged morphine or opium tincture of known strength, one named person, logbook, naloxone	Fracture, burn, dressing, dying	A for morphine, WO-11, ME-02

Rules for the ladder: - Never two salicylates at once. Willow, meadowsweet, aspirin and wintergreen rubs all add up (EMA monograph 2017). - Never willow or aspirin with ibuprofen or another anti-inflammatory drug (EMA monograph 2017). - Paracetamol can be added to any rung. - No salicylate under 16 (aspirin) or 18 (willow, meadowsweet), in dengue country with an undiagnosed fever, in late pregnancy, or in an asthmatic who has reacted before. - Cannabis and kratom are not on the ladder unless the owner decides otherwise [OWNER].

Evidence grades

Remedy and preparation	Use	Grade	Certainty and size
Willow ethanol extract, 240 mg salicin a day	Low back pain	A	Moderate, 2 trials, 261 people, NNT about 3 for pain-free at week 4 [VERIFY]
Willow ethanol extract	Osteoarthritis	A	Low, mixed results
Willow decoction or tea	Back and joint pain	C	Extrapolated, depends on species
Willow	Acute pain such as tooth or injury	D	Dose too low on salicylate alone
Willow	Fever in adults	C	IN-02
Meadowsweet tea	Colds, minor joint pain	C	No trial
Wintergreen oil	Taken by mouth	X	Lethal near 5 ml in a toddler
Aspirin 600 mg	Acute pain	A	NNT 4.4
Ibuprofen 400 mg	Acute pain	A	NNT 2.5
Paracetamol 1 g	Acute pain	A	NNT 3.8
Capsicum plaster	Chronic low back pain	A	Moderate, 3 trials, 755 people, NNT 5 to 6 [VERIFY]
Capsaicin 0.025 to 0.075 per cent cream	Muscle and nerve pain	A	Low, NNT 5.7 to 8.1, NNH 2.5
Devil's claw extract	Back pain, osteoarthritis	A	Low, NNT about 10 [VERIFY]
Devil's claw tea	Joint pain	C	Traditional, southern Africa and Europe
Curcumin extract	Knee osteoarthritis	A	Low, contested (Nelson 2017)

Remedy and preparation	Use	Grade	Certainty and size
Kitchen turmeric	Pain	D	No trial at food doses
Cannabis	Chronic pain in adults	A	Low, NNT 24, NNH 6
Cannabis	Young people, psychosis risk	X	OR 4.8 for daily high potency
Kratom	Pain	D	One experimental study in users
Clove gel	Dental pain	A	Low, one trial, 73 people
Heat wrap	Acute back pain	A	Moderate, 2 trials, 258 people
Cold	Sprain, bruise	C	Not reviewed in depth

Means ledger

Remedy	Hands	Hearth	Garden and still	Village of 300	District of 3,000	Hospital before the Fall
Willow	Know the tree	Decoction of 4 g, three times a day, scale needed	Coppice of *S. purpurea* or *S. daphnoides*, dried bark weighed, tincture	One preparer, logbook, contraindication check	Bark tested against a stored reference [VERIFY]	Standardised extract or aspirin
Meadowsweet	Know the plant	Tea	Dried flower store	As willow	As willow	Not used
Wintergreen oil	Nothing	Nothing, poison	Nothing	Locked cupboard, rubs only	Possible source of sodium salicylate, not advised	Poison centre, alkalinisation, dialysis
Salvaged aspirin, paracetamol, ibuprofen	Nothing	Weigh, read labels	Scale, tablet knife	Logged stock, dose card, dose diary	Same plus clinician	Full range, intravenous forms
Capsicum	Nothing	Chilli in fat	Grown chilli, weighed, patch test	Labelled jars	Same	8 per cent patch
Devil's claw	Nothing	Tea if stored	Not grown in Europe	Salvage only	Same	Extract
Turmeric	Nothing	Food only	Grows only in warm climates [VERIFY]	No role	No role	Not standard
Cannabis [OWNER]	Nothing	Unknown dose	Grows, strength unknown	Owner's rule	Owner's rule	Licensed products

Remedy	Hands	Hearth	Garden and still	Village of 300	District of 3,000	Hospital before the Fall
Opium	Nothing	No safe form	Poppy grows, dose unknowable	Salvaged morphine, naloxone	Morphine, naloxone	Full range
Heat and cold	Warm cloth, cold water	Hot stone, snow	Same	Same	Same	Same

What each rung changes. The garden brings a known willow, which can multiply the salicin by eight and so needs a rule. The village brings records and one preparer, which prevent the doubled dose and the child given willow. The district brings a clinician but no blood test. The hospital adds salicylate levels, bicarbonate and dialysis (RCH 2017).

Harm test

Willow and meadowsweet. Harms: stomach bleeding, allergy and anaphylaxis, asthma, kidney injury in the dehydrated, Reye's syndrome, bleeding with anticoagulants, haemolysis in G6PD deficiency (EMA monograph 2017). The errors that harm: a child with a cold or chickenpox given willow, willow on top of aspirin, purple willow dosed as if it were white [VERIFY]. Signs: black stools, vomited blood, wheeze, hives, ringing ears, a child who vomits and grows drowsy after a viral illness. Then stop it, give fluids if not vomiting, and send to the district. The record holds the Italian four-year-old in shock (Moro 2011).

Wintergreen and salicylate overdose. Rapid deep breathing, vomiting and ringing ears, then confusion, fits and death [VERIFY, general clinical description]. 150 mg per kg of aspirin equivalent warrants hospital, 300 is severe, and above about 500 is potentially lethal (RCH 2017, Chyka 2007). Do not make the patient vomit (Chyka 2007). What saves lives, alkaline urine by bicarbonate and dialysis, needs a district or hospital (RCH 2017).

The others. Capsicum burns eyes, mucous membranes and heated skin. Devil's claw upsets the gut. Turmeric supplements can injure the liver and may carry lead (DILIN 2023, Stanford 2019). Cannabis brings psychosis and an NNH of 6 (Stockings 2018, Di Forti 2019). Kratom brings dependence and deaths in combination with opioids (Singh 2017, Olsen 2019).

Red flags

These pains mean something the village cannot fix, and a plant will only hide it: - Headache that is sudden and the worst ever, or comes with fever, stiff neck, rash or confusion. - Belly pain that is constant, with a hard belly, fever or vomiting, or with a missed period. - Chest pain with breathlessness, sweating or pain into the arm or jaw. - Back pain with numb buttocks, loss of bladder or bowel control, or weak legs. - A hot, red, swollen joint with fever. - Pain after a fall in an old person who cannot stand. - Black stools or vomited blood in anyone taking willow, aspirin or ibuprofen. - A child who vomits repeatedly and becomes drowsy days after a cold, flu or chickenpox, especially after aspirin or willow (Reye's syndrome). - Any child who has swallowed wintergreen oil or a liniment.

What to do anyway. Send to the district at once. On the way, give paracetamol, which does not thin the blood. Keep the patient warm and drinking if not vomiting. Stop every salicylate.

Honest comfort. When the cause cannot be treated, pain can still be eased. The opium rung exists for this, under the rules in WO-11 and ME-02. Someone sitting with the patient, warmth, position, and the knowledge that nobody will be left alone are part of the treatment, and are never wasted.

The case against

Against willow as the "natural aspirin". The EMA's own assessors say ordinary bark doses do not reach trial doses, and the full trial dose equals 50 to 87 mg of aspirin in salicylate (EMA AR 2017). Biegert's osteoarthritis trial was negative while diclofenac worked (Biegert 2004, in EMA AR 2017). The best back pain trials share an author, Chrubasik, and the Cochrane authors flagged conflicts of interest across the herbal trials (Oltean 2014).

Against the opposite dismissal. One good trial with a dose response, 4,731 patients in surveillance with few side effects, and a sound rationale are more than most plants have. A village with purple willow and no aspirin has something real.

Against turmeric, cannabis and devil's claw. Nelson and colleagues argue that curcumin trials rest on a compound that barely reaches the blood (Nelson 2017), and the EMA makes no pain claim (EMA turmeric monograph 2018). The IASP task force chaired by Andrew Rice declined to endorse cannabinoids (IASP 2021). The best devil's claw trial gave 15 against 5 per cent pain-free with no dose response (EMA devil's claw AR 2016).

Against the plants as a class. None was tested in acute pain as the salvaged drugs were. For a broken arm, a burn or an abscess, the plant rung only holds until the cause is treated.

Against this report. The rich-willow arithmetic assumes full extraction, which nobody has measured. The meadowsweet figure came from a non-specific test. Several historical claims rest on secondary sources.

10-line summary

1. Salicin is a prodrug: 240 mg a day of willow salicin gives the salicylate of about 50 to 87 mg of aspirin.
2. A willow extract at 240 mg salicin a day relieved chronic low back pain in a good trial, with an NNT of about 3 for being pain-free at four weeks.
3. Bark doses in the books give 60 to 120 mg salicin a day, below the trials, except from purple or violet willow.
4. Willow carries aspirin's exclusions: no children, no late pregnancy, no salicylate allergy or asthma, no ulcer, no dengue.
5. One teaspoon of wintergreen oil equals about 7 g of aspirin and has killed small children.
6. Salicylic acid was made from wintergreen oil in the nineteenth century, but pure aspirin took an industrial laboratory and cannot reliably be made at the district rung.
7. For acute pain the salvaged drugs win: ibuprofen 400 mg NNT 2.5, paracetamol 1 g 3.8, aspirin 600 mg 4.4.
8. The capsicum plaster is the best-supported plant remedy for back pain, and heat helps acute back pain.
9. Devil's claw and turmeric have small, low-quality trials, and turmeric has no pain claim in Europe.
10. Cannabis helps one chronic pain patient in 24 and harms one in 6, with psychosis risk, and its place after the Fall is the owner's decision.

Open questions

- How much salicin passes from purple willow bark into a home decoction, and how much is lost as bark ages?
- What is meadowsweet's salicylate content by a specific method?
- Do willow's polyphenols contribute, and is a tea better or worse than the extract?
- Can a home chilli ointment be made to a predictable strength?
- What did the Seminole, Blackfoot and other peoples understand willow to do, beyond the database entries?
- How much of the devil's claw trade reaches the San and other harvesters?
- What place, if any, should cannabis have in the village [OWNER]?

Sources to read in full

1. EMA assessment report on *Salix* cortex (EMA/HMPC/80628/2016), the best single source on willow.

2. Chrubasik and others 2000, *American Journal of Medicine*, the back pain trial.
3. Chyka and others 2007, *Clinical Toxicology*, with the wintergreen cases.
4. Schrör 2009 chapter 1 and Sneader 2000, for the history.
5. Stockings and others 2018, *Pain*, on cannabinoids.
6. Brendler 2021, *Pharmaceuticals*, on devil's claw.

At the bedside after the Fall

Household. Know the red flags. Heat, cold, a splint and a calm voice come first. For chronic adult back or joint ache, a weighed willow decoction from a known tree. No salicylate for children. Wintergreen oil, clove oil and every liniment in a locked box. To start: a kitchen scale reading in grams, a known willow, a pot with a lid, a written card. First failure to expect: a child given willow tea for a cold.

Village of 300. A coppice of purple or violet willow, cut in autumn on a two-year cycle, dried in labelled batches. Dried meadowsweet. Chilli for ointment. Salvaged paracetamol, ibuprofen and aspirin logged by strength, dispensed by one person with this card. Opium or morphine only under the WO-11 and ME-02 rules, with naloxone. A pain register: name, weight, pain, drug, dose, time, effect. To start: a scale, the dose card, the register, a locked cupboard, one trained healer. First failure to expect: willow given on top of aspirin or ibuprofen, or a salvaged liniment mistaken for a cooking oil.

District of 3,000. A clinician who can examine for the hidden causes of pain. Salvaged stock pooled and logged. Activated charcoal and, if held, sodium bicarbonate and a way to check urine pH for salicylate poisoning (RCH 2017). A reference sample of each year's willow bark. To start: the district stock register, a poisons protocol, and a messenger to bring patients with red flags. First failure to expect: salicylate poisoning missed because the patient looked well for the first 6 hours.

Protocols

Protocol 1. Willow bark decoction (adults 18 and over only)

- ☐ Check: not pregnant, no asthma made worse by aspirin, no allergy to aspirin or ibuprofen, no stomach ulcer or black stools, no bleeding problem, not on anticoagulants, not dehydrated, no dengue risk, not taking aspirin or ibuprofen (EMA monograph 2017).
- ☐ Use bark from two- to three-year-old shoots of a known willow, best *S. purpurea* or *S. daphnoides*, dried and chopped.
- ☐ Weigh 4 g of dried bark (tolerance 3.5 to 4.5 g). If the willow is unknown, use the same dose and expect little.
- ☐ Put it in 200 ml of cold water, bring to the boil, cover, boil 15 minutes, take off the heat and stand 15 minutes, strain (EMA monograph 2017, THRIVING library, PH-01).
- ☐ Drink after a meal, three times a day. Never more than three doses in 24 hours.
- ☐ Expect slow relief over days, not hours. Review at one week. Stop at four weeks for joint or back pain, three days for fever, one day for headache (EMA monograph 2017).
- ☐ Stop at once for rash, wheeze, ringing in the ears, black stools or stomach pain.

Protocol 2. Meadowsweet tea (adults only)

- ☐ Same checks as Protocol 1.
- ☐ Weigh 2 to 4 g of dried flowering tops (EMA range 1.5 to 6 g).
- ☐ Pour on 150 ml of boiling water, cover, steep 10 minutes, strain [VERIFY, steeping time].
- ☐ Up to three cups a day, never more than 18 g of herb in a day. One week for a cold, four weeks for joint pain (EMA meadowsweet monograph 2011, THRIVING library, PH-01).
- ☐ Never with willow or aspirin.

Protocol 3. Chilli ointment for back or muscle pain (adults only)

- ☐ Weigh 5 g of dried hot chilli powder into 100 g of melted lard or oil. Keep warm, not boiling, for 30 minutes, stir, strain through cloth, cool, label "CHILLI, NOT FOR EYES" [VERIFY, untested household recipe, strength by my arithmetic].
- ☐ Test a pea-sized amount on the inner forearm for 30 minutes before first use of each batch.
- ☐ Rub a thin layer on intact skin two to four times a day. Wash hands at once.
- ☐ Never on broken skin, near eyes or genitals, or under a hot-water bottle (EMA capsicum monograph 2015).
- ☐ Three weeks, then a two-week break.

Protocol 4. Heat for acute back pain

- ☐ Heat a stone, brick or bottle of water until hot but bearable to the hand for 10 seconds.
- ☐ Wrap it in two layers of cloth. Place on the back while the patient is awake.
- ☐ Check the skin every 15 minutes. Remove if red and painful.
- ☐ Never on numb skin, on a sleeping patient or on a child unattended [VERIFY].

Protocol 5. Ibuprofen by weight (from 3 months)

- ☐ Weigh the child. No ibuprofen in dengue country with undiagnosed fever, in dehydration, asthma with previous reaction, or with willow or aspirin (THRIVING library, IN-02).
- ☐ Give the dose in the card below, with food, no more than three times in 24 hours.
- ☐ Tolerance: within 10 per cent of the card dose. Never round up.

Protocol 6. Suspected wintergreen oil or salicylate overdose

- ☐ Find the bottle. Estimate the amount: 1 ml of wintergreen oil equals 1.4 g of aspirin (Chyka 2007).
- ☐ Add every salicylate in 24 hours, including willow and liniments, in mg of aspirin equivalent. Divide by weight in kg.
- ☐ Child under six who swallowed more than a lick, anyone over six who swallowed more than 4 ml, or anyone over 150 mg per kg: send to the district now (Chyka 2007, RCH 2017).
- ☐ Do not make the patient vomit (Chyka 2007). Give activated charcoal 1 g per kg if held and the patient is awake (RCH 2017).
- ☐ Watch for at least 12 hours even if well [VERIFY, duration]: fast or deep breathing, vomiting, ringing ears, sweating, confusion, fits.

Card of doses by weight

Weight	Paracetamol	Ibuprofen (from 3 months), max 3 a day	Aspirin	Willow, meadowsweet	Wintergreen oil that reaches 150 mg/kg
Under 5 kg	15 mg/kg, IN-02 Protocol 4	None	Never	Never	under 0.5 ml
5 to under 8 kg	15 mg/kg, IN-02 Protocol 4	50 mg	Never	Never	0.5 to 0.9 ml
8 to under 12 kg	15 mg/kg, IN-02 Protocol 4	75 mg	Never	Never	0.9 to 1.3 ml

Weight	Paracetamol	Ibuprofen (from 3 months), max 3 a day	Aspirin	Willow, meadowsweet	Wintergreen oil that reaches 150 mg/kg
12 to under 17 kg	15 mg/kg, IN-02 Protocol 4	100 mg	Never	Never	1.3 to 1.8 ml
17 to under 25 kg	15 mg/kg, IN-02 Protocol 4	150 mg	Never	Never	1.8 to 2.7 ml
25 to under 34 kg	15 mg/kg, IN-02 Protocol 4	200 mg	Never under 16	Never under 18	2.7 to 3.6 ml
34 to under 50 kg	15 mg/kg, IN-02 Protocol 4	300 mg	Age 16 and over only: 300 to 600 mg, at most 60 mg/kg a day	Age 18 and over only, Protocol 1	3.6 to 5.4 ml
50 kg and over	1 g, max 4 g a day	400 mg, max 1,200 mg a day	Age 16 and over: 300 to 900 mg every 4 to 6 hours, max 3.6 to 4 g a day	Age 18 and over, Protocol 1	5.4 ml and up

Sources and arithmetic: paracetamol from IN-02, ibuprofen 5 to 10 mg per kg and at most 30 mg per kg a day from MSF via IN-02, aspirin adult doses from IN-02, wintergreen volumes from 150 mg/kg divided by 1,400 mg per ml (Chyka 2007). Band doses, the 60 mg per kg ceiling for small adults and the wintergreen volumes are my arithmetic [VERIFY]. The ceiling is set below the 100 mg per kg a day at which chronic poisoning has been reported (Chyka 2007). Opium and morphine doses: WO-11 and ME-02, given only by the named person.

Numbers to carry

1. **240 and 87.** 240 mg of willow salicin a day gives the salicylate of only 50 to 87 mg of aspirin (EMA monograph 2017, EMA AR 2017).
2. **4 g, three times.** The willow decoction: 4 g bark in 200 ml, boil 15, stand 15, three times a day after meals, adults only (EMA monograph 2017).
3. **18.** No willow or meadowsweet under 18. No aspirin under 16.
4. **1.4.** One ml of wintergreen oil equals 1.4 g of aspirin. A teaspoon has killed a toddler (Chyka 2007).
5. **150 and 300.** mg per kg of salicylate: 150 means hospital, 300 means severe (RCH 2017).
6. **2.5, 3.8, 4.4.** NNTs for ibuprofen 400 mg, paracetamol 1 g and aspirin 600 mg in acute pain (Oxford league table 2007).
7. **5 to 10 and 30.** Ibuprofen mg per kg a dose, and the daily ceiling (THRIVING library, IN-02).
8. **24 and 6.** Cannabis helps one in 24 and harms one in 6 with chronic pain (Stockings 2018).
9. **Never two.** Never two salicylates or two anti-inflammatory drugs at once.

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