For larger burns, ideally single rooms are most appropriate, and these should be kept warm at all times. It is extremely important that they are clean and that insects, etc. are controlled.

One of the most serious problems is cross-infection between patients, and adequate plastic aprons, gloves and hand-washing facilities must be available for all staff and relatives.

In the early stages of burn resuscitation, and after surgery, nursing should be on a one-to-one basis (if available).

Psychology

There are frequently major psychological consequences to major burns. First, there is a long and often painful stay in hospital. Secondly, there is the loss of function and appearance that can result from the burn injury.

There are often psychological consequences for the parents of a burnt child, both as a result of the guilt about allowing the accident to happen, and from having to come to terms with the often major alterations in appearance and function of their child.

Prevention

The best solution to the problem of the burn injury is prevention.

Use antenatal classes, posters in village halls and talks in school.

The causes of burns in children will vary in different communities, and prevention should be directed at local causes.

If possible:
- limit the temperature of water coming from domestic taps
- do not cook on the floor
- keep children away from boiling water, coffee, tea, etc. In many communities these are the commonest causes of scalds.

Features of burns that suggest child abuse

Burns are a common feature of child abuse and the clinician should have a high degree of awareness both of the physical appearance of inflicted burns and also of the developmental stage of the child to see if the injury is compatible with that stage.

Burns are sometimes used as a punishment in child rearing practices. Children with developmental delay are at particular risk of burns, both accidental and intentional.

Physical signs:
- Pattern burns that suggest contact with an object of a specific shape, such as an iron.
- Cigarette burns.
- Stocking, glove or circumferential burns.
- Burns to the genitals or perineum.

7.4 Poisoning

Introduction

The World Health Organization (WHO) definition of poisoning is the injury or destruction of cells by the inhalation, ingestion or absorption of a toxic substance. Key factors that predict the severity and outcome of poisoning are the nature, dose formulation and route of exposure of the poison, co-exposure to other poisons, the state of nutrition of the child or their fasting status, age, and pre-existing health conditions.

Mortality: Low- and middle-income countries have 91% of the world mortality from poisoning as reported by WHO in 2004. Accidental poisoning is most common in the 12–36 months age group.

Intentional overdose may be a cry for help, rather than a serious attempt at suicide. However, all children and young people who take intentional overdoses should have a full psychiatric and social assessment and always be admitted to hospital if facilities are available.

Drug abuse may be misuse of alcohol or abuse of volatile substances or more potent recreational drugs, such as ecstasy, LSD or opiates.

Deliberate poisoning of children by adults is rare. It may be associated with depressive illness or may be part of a spectrum of abuse inflicted on the child (see Section 7.6).

Clinical diagnosis and management

Symptoms and signs of poisoning

These can include:
- respiratory distress

<table>
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<th>BOX 7.4.1 Minimum standards</th>
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<tr>
<td>ABC, oxygen and glucose.</td>
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<td>Naloxone.</td>
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<td>Activated charcoal.</td>
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<td>Paediatric ipecacuanha.</td>
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Management of poisoning

**First aid**
- Remove the patient from the source of the poison. This mainly applies to fumes (e.g. in a house fire).
- Wash contaminated skin and eyes with water.
- **Never** try to induce vomiting with salt or by inserting an object into the pharynx.

**Primary assessment and resuscitation**

Identify life-threatening emergencies and the early signs of a seriously ill child using the structured ABC approach (see Section 1.11).

The whole assessment should take less than a minute. Treat any problems with the ABC approach as they are found.

An alternative approach to emergencies such as this is the Emergency Triage and Treatment (ETAT) approach, if it is practised at your hospital.

Once Airway, Breathings and Circulation are recognised as being stable, or have been stabilised, definitive management of specific conditions can proceed. During definitive management, reassessment of ABCD at frequent intervals will be necessary to assess progress and detect deterioration.

**Secondary assessment and emergency treatment**

Identify the substance ingested or inhaled, if at all possible. Ask the following questions:
- What medicines, domestic products, berries and plants has the child had access to?
- How much has been taken?
- When did the child have access to these substances?
- Is the container or a sample available? This will be helpful at the hospital.
- Are other children involved?
- What symptoms has the child had?

Use National Poisons Information Centres or Internet references, if these services are available, to obtain information on the side effects, toxicity and treatment needed.

**Hypoglycaemia:** Test blood glucose levels for all patients, and if hypoglycaemia is present, treat with a sugar drink orally if the patient is conscious. If they are unconscious give by IV or intraosseus routes 2 to 5 mL/kg 10% glucose over 3 minutes then 5 mL/kg/hour to keep blood glucose at 5–8 mmol/litre. In pregnancy, dilute 50 mL of 50% glucose with 50 mL of Ringer-lactate, Hartmann’s or 0.9% saline and give IV over 5 minutes followed by an IV infusion containing 5% glucose (see Appendix). If blood glucose testing is not available, then treat for hypoglycaemia if this diagnosis is possible (especially in infants and young children).

**Convolutions:** Treat convulsions in children with diazepam 300–400 micrograms/kg IV or IO slowly or 500 micrograms/kg per rectum.

In pregnancy the loading dose of diazepam is 2 mg increments IV every 2 minutes up to 10 mg. The maintenance dose is diazepam 40 mg in 500 mL of Ringer-lactate or Hartmann’s solution, titrated to keep the mother sedated but able to be woken and without hypoventilation. Maternal respiratory depression may occur when the dose exceeds 30 mg in 1 hour. Alternatively, in pregnancy the loading dose diazepam is 20 mg in a 10-mL syringe. Remove the needle, lubricate the barrel and insert the syringe into the rectum to half its length. Discharge the contents and leave the syringe in place, holding the buttocks together for 10 minutes to prevent expulsion of the drug. Alternatively, the drug may be instilled in the rectum through a catheter.

Ensure close observation after treatment with diazepam at any age, and make sure that a bag-valve-mask of suitable size is available and the staff giving the diazepam know how to use it.

**Opiate or methadone overdose:** If an opiate or methadone overdose is suspected, give naloxone.
- IV dose for children aged 1 month to 12 years: 10 micrograms/kg; if there is no response, give 100 micrograms/kg (review the diagnosis if there is still no response).
- Give patients over 12 years of age and in pregnancy 400 microgram–2.0 mg; if there is no response, repeat every 2–3 minutes up to a maximum of 10 mg (then review the diagnosis).

Remember that naloxone has a short half-life and further boluses or an infusion of and further boluses or an infusion of 10–20 micrograms/kg/hour or more may be required. Give this treatment even if poisoning is only suspected (because of the presence of such drugs in the home) because breathing is shallow or the patient has stopped breathing. If the patient is hypoventilating or has stopped breathing, ventilate with bag-valve-mask before giving the naloxone as hypoglycaemia with naloxone can cause arrhythmias, acute pulmonary oedema, seizures or asystole.

**Minimising the effects of the ingested substance as quickly as possible**

If the substance is non-toxic give oral fluids liberally.

If the substance is corrosive, there may be serious injury to the mouth, throat, airway, oesophagus or stomach (see also Section 7.3.l.a). The most dangerous substances are sodium or potassium hydroxide cleaning fluids (e.g. toilet cleaners). Others include bleach and other disinfectants. Serious oesophageal injury can result in perforations and mediastinitis, later leading to oesophageal strictures. The presence of burns within the mouth is of concern, and suggests that oesophageal injury is possible. Stridor suggests laryngeal damage. No emetic should be given. Milk or water...
given as soon as possible may be of benefit, especially with solid caustics such as sodium hydroxide crystals. If there is a severe stricture it may be necessary to bypass the oesophagus with a gastrostomy tube. Ideally, flexible endoscopy should be performed to identify injury, but this may not be available. A perforated oesophagus will lead to mediastinitis and should be treated with gastrostomy and prophylactic antibiotics (cefuroxime and metronidazole).

In a few instances, specific antidotes are advised. These should only be given when full information on the poison is available from a Poisons Centre. Never give salt to induce vomiting.

For all other poisons except heavy metals, iron, alcohol and domestic products give activated charcoal if this is available (1 gram/kg suspended in water for a child and 50 gram in pregnancy). The sooner it is given the better (preferably within 1 hour of ingestion of the poison), Repeat after 4 hours if a sustained-release drug has been taken. If charcoal is not available and a potentially life-threatening dose of poison has been taken (particularly of iron), give paediatric ipecacuanha (10 mL for those aged 6 months to 2 years, and 15 mL for those aged over 2 years, plus a glass of water) to induce vomiting. Do not give ipecacuanha if the child has a decreasing level of, or impaired, consciousness. Do NOT give if corrosive solutions have been ingested or if kerosene, turpentine or petrol have been ingested, as they could be inhaled following vomiting, resulting in lipoid pneumonia.

Gastric lavage with a wide-bore orogastric tube should be used only if a potentially life-threatening dose has been taken, and provided that the airway is protected. It should not be used if there is a decreasing level of, or impaired, consciousness without airway protection. It should not be used for poisons containing hydrocarbons or corrosives. Lavage cycles of 15 mL/kg are usually appropriate. Gastric lavage is not an effective way of removing most poisons, and may wash tablets into the duodenum. In a small child the size of nasogastric tube that can be inserted will almost certainly be too small to allow tablets to be drawn through it. Liquid preparations may be evacuated in this way, but in most cases they will have left the stomach within an hour, which is likely to sooner than the child reaches hospital.

Treat symptoms as they arise.

Child abuse: Always remember that an older child or adult may have given the child drugs intentionally. This is child abuse, and if there is the slightest suspicion of this, the appropriate child protection procedures should be instituted if they are available. The child should be admitted (see Section 7.6).

Admit all patients with symptoms or signs attributable to poisons, all patients who have ingested iron, pesticides, corrosives, paracetamol (unless blood testing shows a low level of drug), salicylate, narcotic drugs or tricyclic antidepressants. All who allege deliberate ingestion, and any cases in which child abuse is suspected.

**Commonly ingested drugs**

**Local medicines**

- These are often prescribed for diarrhoea and vomiting.
  - They may cause profound acidosis and respiratory distress. They can also cause paralytic ileus.
  - Treat the metabolic disturbance.
  - Consider using a nasogastric tube.

**Iron**

- Poisoning is usually the result of taking iron tablets prescribed for another family member. Even two or three adults’ tablets can cause serious symptoms in a small child.
- Iron poisoning causes severe gastrointestinal effects, with vomiting, diarrhoea, gastrointestinal bleeding and metabolic acidosis. Subsequently after 12–24 hours there is encephalopathy, liver damage and circulatory collapse.
- Late effects include scarring of the stomach, which may produce pyloric stenosis.

- If available, a serum iron level at 4 hours of more than 300 micrograms/dL indicates significant poisoning.
- X-ray may show the number of tablets. In a child aim to remove as much as possible by induced vomiting with ipecacuanha.
- Gastric lavage with a wide-bore orogastric tube may also remove significant amounts of iron if it is still in the stomach, but there is also a risk that the lavage may wash the tablets through into the bowel. Do not use gastric lavage in pregnancy.
- Desferrioxamine should be given by deep IM injection, 1 gram for children under 12 years and 2 grams for those aged 12 years and in pregnancy. IM doses of desferrioxamine of 1–2 g should be repeated every 12 hours until serum iron is normal (serum iron less than iron binding capacity). If the patient is very ill, give an IV infusion of desferrioxamine 15 mg/kg/hour up to a maximum dose of 80 mg/kg in 24 hours. Usually reduce the rate after 6 hours.

**Paracetamol**

- Paracetamol poisoning can lead to liver and renal failure (see Section 5.6.C and Section 5.7.B).
- Induce vomiting and, if possible, measure the paracetamol level.
- Give N-acetylcysteine or methionine as soon as possible, ideally within 8 hours of ingestion. If the patient is conscious and tolerating oral fluids, and within 8 hours of ingestion, give methionine orally (for children under 6 years, give 1 gram every 4 hours for four doses; for those aged 6 years or over and in pregnancy, give 2.5 g every 4 hours for four doses).
- If the patient presents more than 8 hours after ingestion or cannot be given an oral preparation, give IV N-acetylcysteine (initially as a loading dose of 150 mg/kg over 15 minutes, then as an IV infusion of 50 mg/kg over 4 hours, and finally as 100 mg/kg IV over 16 hours). An oral form of N-acetylcysteine is available (give a loading dose of 140 mg/kg, and then 70 mg/kg every 4 hours for 16 doses).

**Salicylates**

- Salicylate poisoning produces acidic-like breathing, vomiting and tinnitus.
- Hyperventilation is due to direct stimulation of the respiratory centre and produces respiratory alkalosis, but also there is a metabolic acidosis from ketosis. Consequently, the hyperventilation is extreme.
- A fever may occur.
- There is peripheral vasodilatation.
- Moderate hyperglycaemia develops.
There is delayed gastric emptying, so give activated charcoal if available (1 gram/kg in a child and 50 gram in pregnancy and repeat after 4 hours) even if more than 4 hours after ingestion. If charcoal is not available, induce vomiting.

Give sodium bicarbonate 1 mmol/kg IV as 4.2% over 4 hours to correct acidosis and aid excretion of salicylate. Give sufficient IV fluids to compensate for hyperventilation, and give sufficient glucose to minimise ketosis, but regularly monitor blood glucose levels.

Monitor electrolytes carefully and avoid hypokalaemia and hypernatraemia. In very severe cases, peritoneal haemodialysis (if available) is ideal. In its absence, exchange transfusion may help.

**Benzodiazepines**

Flumazenil is a specific antagonist. The initial dose is slow IV 10 micrograms/kg; repeat at 1-minute intervals up to a maximum of 40 micrograms/kg (2 mg maximum dose). If necessary this can be followed by an infusion of 2–10 micrograms/kg/hour (not recommended in children who have received long-term benzodiazepine treatment for epilepsy). In pregnancy give 200 micrograms IV then 100 micrograms per minute IV up to a maximum total of 1 mg until reversal has occurred.

**Tricyclic antidepressants**

- In overdose these cause drowsiness, ataxia, dilated pupils and tachycardia.
- Severe poisoning results in cardiac arrhythmias (particularly ventricular tachycardia) and severe hypotension and convulsions.

In children induce vomiting, perform gastric lavage and administer charcoal as described above, but first protect the airway if the patient is drowsy. In pregnancy only administer charcoal.

Treat convulsions as for any status epilepticus (see Section 5.16.E).

Monitor the ECG (if available) continuously. Arrhythmias can be reduced by using IV phenytoin which must be diluted only in 0.9% saline. Phenytoin is given as a loading dose of 15–20 mg/kg over 30–45 minutes (maximum dose 2 grams) and then 2.5–7.5 mg/kg 12 hourly. The maximum infusion rate is 1 mg/kg/minute (maximum 50 mg/minute). A lidocaine infusion (10–50 micrograms/kg/minute) is an alternative to phenytoin.

Alkalisation of the intravascular compartment has been shown to reduce the toxic effects on the heart. Give sodium bicarbonate 1–2 mmol/kg slowly. This can be repeated if necessary.

The aim is to increase the arterial pH to 7.45–7.5.

Where there is severe cardiac toxicity, prolonged external cardiac massage may keep the patient, especially a child, alive long enough for the effects of the drug to wear off.

**Poisonous household and natural products**

**Petroleum compounds such as kerosene, turpentine and petrol**

Do not induce vomiting.

- If inhaled these may cause hydrocarbon (lipoid) pneumonia, leading to a cough, and respiratory distress with hypoxaemia due to pulmonary oedema and lipoid pneumonia. A chest X-ray is essential in all cases.
- If large amounts are ingested they may cause encephalopathy.
- Additional inspired oxygen may be required.
- An antibiotic may be needed, but only for secondary chest infections.
- Dexamethasone may help in lipoid pneumonia.

**Organophosphorus compounds and carbamates**

- Insecticides such as malathion, chlorthion, parathion, TEPP and phosdrin can be absorbed through the skin, lungs or gastrointestinal tract.
- Symptoms are due to excessive parasympathetic effects caused by inhibition of cholinesterase, and include excessive secretions of mucus in the lungs (bronchorhoea) with ensuing respiratory distress and sometimes wheezing, salivation, lacrimation, bradycardia, sweating, gastrointestinal cramps, vomiting, diarrhoea, convulsions, blurred vision and small pupils, muscle weakness and twitching, progressing to paralysis, and loss of reflexes and sphincter control.

**Bleach (3–6% sodium hypochlorite)**

Do not induce vomiting.

- Symptoms: burning sensation, vomiting and abdominal discomfort.
- Treatment: liberal fluids and milk.

**Corrosive agents**

Do not induce vomiting.

- Oven cleaners (30% caustic soda).
- Kettle descalers (concentrated formic acid).
- Dishwashing powders (silicates and metasilicates).
- Drain cleaners (sodium hydroxide).
Car battery acid (concentrated sulphuric acid).

Symptoms: considerable tissue damage to the skin, mouth, oesophagus or stomach; late strictures may occur. Treatment consists of washing the skin and mouth to dilute the corrosive fluid (see Section 7.3.1.a).

**Lead poisoning**
This is usually a chronic form of poisoning. The lead can come from paint, lead piping or car batteries. In some cultures, lead-containing substances may be applied to the skin for cosmetic purposes (e.g. Surma in India).
- Early signs are non-specific (e.g. vomiting, abdominal pain, anorexia).
- Anaemia is usually present.
- Prior to encephalopathy with raised intracranial pressure, there may be headaches and insomnia.
- Peripheral neuropathy may be present.
- X-rays may show bands of increased density at the metaphyses.
- Harmful effects on the kidneys result in hypertension, aminoaciduria and glycosuria.
- There is a microcytic hypochromic anaemia with punctate basophilia.
- The diagnosis is made by showing a marked increase in urinary lead levels after d-penicillamine, and elevated blood lead levels.

**Treatment**
- Treat by first removing the source of ingested lead.
- A diet rich in calcium, phosphate and vitamin D (plenty of milk) should be given if possible.
- In cases of lead encephalopathy, give an IV infusion of edetate calcium (EDTA) in 5% glucose or normal saline, 20 mg/kg every 6 hours for 5–7 days at a concentration of no more than 30 mg/mL. Give over an hour.
- Boluses of mannitol 250–500 mg/kg IV over 30–60 minutes may also be required for raised intracranial pressure while the above is given.

**Poisonous plants**
- Usually only small quantities are ingested.
- Recent reports describe nicotine poisoning by absorption through the skin in children who are tobacco pickers.

**Treatment**: For ingested poisonous plants this consists of activated charcoal and supportive therapy.

**Carbon monoxide poisoning**
- Toxic effects are due to hypoxia.

**Treatment**: Move the patient from the source and give them 100% oxygen as soon as possible (the half-life of carbon monoxide is 5 hours in room air, but only 1.5 hours in 100% oxygen). The patient may look pink but is hypoxaemic, so base the duration of oxygen treatment on other clinical signs of hypoxia rather than on cyanosis, which will be masked. For similar reasons, pulse oximeters will give falsely high readings. ABCD management according to APLS may be required.
- Cerebral oedema may develop.
- **Hyperbaric oxygen treatment may be helpful (if available).**

**Volatile substance abuse (‘sniffing’)**
This mainly occurs in the age range 11–17 years and is a group activity. Substances that are sniffed or sprayed into the respiratory system are numerous. The commonest are solvent-based adhesives (‘glue sniffing’), butane gas, cleaning fluids, aerosols and fire-extinguisher substances.

**Clinical features**
- Sorea around the mouth and nose.
- Smell of solvents on the clothes and breath.
- All of the features of ethyl alcohol intoxication, plus extreme disorientation, hallucinations and sudden ‘unexplained’ death
- Accidents can occur secondary to volatile substance abuse, for example falling from height, drowning, suffocation and inhalation of vomit.

**Management**
- Remove the child from the atmosphere of solvent.
- Admit them to hospital.
- Treat symptomatically.
- Arrange expert psychological and emotional support.

**Laboratory investigations in poisoning**
These are often expensive and/or very time consuming to perform. They should only be requested if the result will alter the management of the patient. Many hospitals in resource-limited countries will not have these facilities.

**Alcohol**
- Blood alcohol estimations are useful if:
  - there is an indication that methyl alcohol has been ingested
  - the patient is very drowsy or comatose and there is doubt whether sufficient alcohol has been ingested to explain the symptoms.
- Blood glucose levels should be measured in all cases of alcohol ingestion in children.
  - Do a blood glucose stick test first, and if this is low, a quantitative glucose analysis should be requested.

![Graph for N-acetylcysteine use in paracetamol poisoning. This Crown copyright material is reproduced by permission of the Medicines and Healthcare Products Regulatory Agency under delegated authority from the Controller of HMSO.](image-url)
Section 7.5

— If in doubt, give glucose 2–5mL/kg of 10% glucose IV if unable to drink or unconscious, otherwise give a sugary drink.

**Interpretation**
Peak blood levels of alcohol occur 30–60 minutes after ingestion.

**Iron**
Patients who have ingested iron should ideally have a plasma iron level estimated before desferrioxamine is given.

Serum levels of over 300 micrograms/dL are associated with moderate toxicity, levels of over 500 micrograms/dL with serious toxicity, and levels over 1 mg/dL with death.

**Interpretation**
Patients with acute iron poisoning have significant increase in plasma iron levels within 2 hours of over-dosage. Initial serum levels of less than 90 micromol/litre are supportive but not absolute evidence of mild poisoning. Normal serum iron levels are in the region of 10–30 micromols/L (80–180 micrograms/dL).

**Paracetamol**
Take blood samples at least 4 hours after ingestion of paracetamol.

**Interpretation**
A plasma level that falls above the treatment line at different times indicated in the graph of paracetamol level against time (see Figure 7.4.1) indicates moderate to severe poisoning. Treat with N-acetylcysteine. Lower thresholds for treatment are indicated if the patient is on enzyme-inducing drugs or alcohol is taken habitually.

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**7.5 Envenomation**

**BOX 7.5.1 Minimum standards**
- Mono- and polyspecific antivenoms.
- Chlorphenamine.
- Anticholinesterase (only if appropriate for the region).
- Analgesia.
- Prazosin (only if appropriate for the region).
- Heart failure treatment.

**Introduction**
Envenoming by snakes, scorpions, spiders or marine venomous animals is common in many areas of the tropics. Children are particularly at risk; they may be attracted to venomous creatures and do not recognise the danger that they represent. Envenoming is often more severe and more rapid in children because the ratio of the amount of venom to body weight is much higher.

A clear-cut history of envenoming is often not present. Some bites are not recognised at the time of the event; other children will be too young to explain what has happened. Envenoming should always be considered in any child with an unexplained illness, particularly if there is severe pain, swelling or blistering of a limb, or if the child is bleeding or shows signs of neurotoxicity.

**Prevention**
Discourage children from handling snakes, scorpions or spiders or touching marine animals. They should be taught to avoid putting their hands down holes, and to carefully check their shoes and clothing before dressing. Keeping grass short around dwellings, use of sensible footwear, keeping dwellings insect-free, and taking care when swimming can all help to prevent injury by venomous animals.

**Snakebite**
There are a large number of species of venomous snakes throughout the world. These can be divided into three main categories: vipers, elapids and sea snakes. The pattern of envenoming depends upon the biting species. Therefore clinicians need to know about the snakes present in the region in which they work. Only 50–70% of patients who are bitten by venomous snakes develop signs of envenoming.

Major clinical effects following snakebite can be categorised as follows:
- **Local effects:** pain, swelling or blistering of the bitten limb. Necrosis at the site of the wound may sometimes develop.
- **Systemic effects:**
  - Non-specific symptoms: vomiting, headache, collapse.
  - Painful regional lymph node enlargement indicating absorption of venom.
  - Specific signs: non-clotting of blood; bleeding from gums, old wounds and sores.
  - Neurotoxicity: ptosis, bulbar palsy and respiratory paralysis.
  - Shock: hypotension.
  - Rhabdomyolysis: muscle pains and black urine.

**Vipers** most commonly cause local swelling, shock, bleeding and non-clotting blood.

**Elapids** cause neurotoxicity and usually minimal signs at the bite site (with the exception of some cobras which also cause necrosis).

Sea snakes cause myotoxicity and subsequent paresis.

Exceptions to this general rule do occur. For example, some vipers cause neurotoxicity and some Australian elapids also cause non-clotting blood and haemorrhage.

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