Legionnaires' disease (p.176) is commonly transmitted via cooling water in **air conditioning** systems or **hot water** supplies. Hyperchlorination has been attempted to eradicate the organism from contaminated water sources but has been largely ineffective[6,7] and is no longer recommended. Other disadvantages of using chlorine-based systems at these temperatures and concentrations are corrosion of the plumbing system[7] and the production of potentially carcinogenic byproducts.[8] Effective disinfection can be achieved by raising and maintaining the water temperature above 50°, ultraviolet light, and copper-silver ionisation.

Haemodialysis patients are exposed to large quantities of municipal drinking water as it is used for the production of **dialysis** fluids and may also be used for dialyser rinsing and reuse. Many of the chemical substances in the water, such as calcium, sodium, aluminium, chloramines, fluoride, copper, zinc, sulfates, and nitrates are potentially dangerous for dialysis patients, and can lead to acute or chronic poisoning. There is also a microbiological risk associated with the control of bacterial growth in the water treatment and distribution system. Contaminants are therefore removed by water purification systems. Water is pretreated with activated carbon filters to remove chlorine and its derivatives and other suspended particles, and the hardness of the water is decreased with sodium exchange cationic resins, which remove calcium and magnesium. The final purification process then involves the removal of dissolved salts, bacteria, and endotoxins by reverse osmosis. Reverse osmosis membranes need to be regularly disinfected with chemical agents (such as hypochlorite and peracetic acid), heat, or ozone.[9]

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3. D'Aquino M, Teves SA. Lemon juice as a natural biocide for disinfecting drinking water. *Bull Pan Am Health Organ* 1994; **28:** 324–30.
4. Dadswell JV. Managing swimming, spa, and other pools to prevent infection. *Commun Dis Rep* 1996; **6** (review 2): R37–R40.
5. WHO. Guidelines for safe recreational waters: volume 2—swimming pools, spas, and similar recreational environments (draft August 2000). Geneva: WHO, 2000.
6. Kurtz JB, *et al.* Legionella pneumophila in cooling water systems: report of a survey of cooling towers in London and a pilot trial of selected biocides. *J Hyg (Camb)* 1982; **88:** 369–81.
7. Helms CM, *et al.* Legionnaires' disease associated with a hospital water system: a five-year progress report on continuous hyperchlorination. *JAMA* 1988; **259:** 2423–7.
8. Morris RD, *et al.* Chlorination, chlorination by-products, and cancer: a meta-analysis. *Am J Public Health* 1992; **82:** 955–63.
9. Pontoriero G, *et al.* The quality of dialysis water. *Nephrol Dial Transplant* 2003;**18** (suppl 7): vii21–vii5.

Hand hygiene

Hospital-acquired infections, including those due to multidrug-resistant pathogens, such as meticillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Staph. aureus*, and vancomycin-resistant enterococci, are a major problem in health care facilities.[1] Hand hygiene is one of the most important factors in preventing such infections, as it prevents transmission of pathogens by contact and the faecal-oral route. However, healthcare workers frequently do not wash their hands, and compliance rarely exceeds 40%.[2] A randomised study[3] to compare the efficacy of an alcohol-based solution for hand rubbing with hand washing with a medicated soap in reducing bacterial hand contamination during routine patient care found that the alcohol-based solution was significantly more effective (83% reduction versus 58%). The authors considered that the difference in efficacy might have been due to the duration of hand washing. Participants rubbed or washed their hands for about 30 seconds, but the recommended duration for hand washing is 30 seconds to 1 minute, a time that was adhered to in less than 35% of instances.

Authorities recommend[1,2] that alcohol-based hand rubs should replace hand washing as the standard for hand hygiene in all situations in which the hands are not visibly soiled. The basis for this is that hand rubbing requires less time, is microbiologically more effective, and is less irritating to skin than traditional hand washing with soap and water. The CDC in the USA advises[4] hand washing with a non-antimicrobial or antimicrobial soap and water when hands are visibly dirty or contaminated with proteinaceous material, blood, or other body fluids and if exposure to *Bacillus anthracis* is suspected or proven. Alcohols, chlorhexidine, iodophores, and other antiseptic agents are not recommended for *B. anthracis* contamination as they have poor activity against the spores. If hands are not visibly soiled, an alcohol-based hand rub may be used. Decontamination of the hands with an antiseptic hand rub or hand wash should occur before direct contact with patients, and before putting on sterile gloves when inserting catheters or other invasive devices that do not require a surgical procedure. Decontamination of the hands should also occur after contact with a patient's intact or non-intact skin, body fluids, mucous membranes, and wound dressings if hands are not visibly soiled. Hands should be decontaminated if moving from a contaminated body site to a clean body site during patient care, after contact with inanimate objects (including medical equipment) in the immediate vicinity of the patient, and after removing gloves. When performing surgical procedures hand hygiene with either an antimicrobial soap or an alcohol-based hand rub with persistent activity is recommended before putting on sterile gloves.

The CDC[4] considers that the best antimicrobial efficacy can be achieved with alcohol (ethanol), isopropyl alcohol, and propyl alcohol, as their activity is broad and they are fast acting. Ethanol at high concentrations is the most effective treatment against non-enveloped viruses, whereas propyl alcohol seems to be more effective against the resident bacterial flora. Combinations of alcohols may have a synergistic effect. The antimicrobial efficacy of chlorhexidine (2 to 4%) and triclosan (1 to 2%) is both lower and slower. Bacterial resistance may occur, although the risk is higher for chlorhexidine than triclosan. Even if used in conjunction with hand washing, they are still less effective than the alcohols. Plain soap and water has the lowest efficacy of all.

1. Trampuz A, Widmer AF. Hand hygiene: a frequently missed lifesaving opportunity during patient care. *Mayo Clin Proc* 2004; **79:** 109–16.
2. Widmer AF. Replace hand washing with use of a waterless alcohol hand rub? *Clin Infect Dis* 2000; **31:** 136–43.
3. Girou E, *et al.* Efficacy of handrubbing with alcohol based solution versus standard handwashing with antiseptic soap: randomised clinical trial. *BMJ* 2002; **325:** 362–6.
4. CDC. Guideline for hand hygiene in health-care settings: recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR* 2002; **51** (RR-16): 1–45. Also available at: http://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf (accessed 15/03/06)

Injection site and catheter care

The need to disinfect the skin before injection is controversial.[1] Routine skin preparation of the injection site by swabbing with antiseptic has been reported to be both ineffective and unnecessary.[2,3] Central venous and arterial catheters, however, require the application of strict aseptic technique and injection site antisepsis to reduce the chance of infection.[4] Disinfection of catheter insertion sites with aqueous chlorhexidine 2% has been reported to be associated with fewer local and systemic infections than site preparation with either 10% povidone-iodine solution or 70% isopropyl alcohol,[5] although this has been challenged.[6] A subsequent study reported lower rates of catheter colonisation and catheter-related infection with an alcoholic solution of chlorhexidine 0.25% and benzalkonium chloride 0.025% than with povidone-iodine 10%.[7] In a study in preterm infants, technique had greater influence on bacterial counts at injection sites than the antiseptic used; chlorhexidine 0.5% in isopropyl alcohol and aqueous povidone-iodine 10% were equally effective, but cleansing with alcoholic chlorhexidine for 30 seconds or for two 10-second periods was more effective than cleansing for 5 or 10 seconds.[8]

The use of catheters impregnated with antiseptics or antibacterials has also been studied. Catheters impregnated with chlorhexidine and sulfadiazine silver on the external luminal surface, appear to be effective in reducing both catheter colonisation and related bloodstream infection in high-risk patients when used within 14 days.[9] Central venous catheters impregnated with minocycline and rifampicin have been reported to be associated with a lower infection rate than standard silicone catheters[10] and those impregnated with chlorhexidine and sulfadiazine silver.[11]

Guidelines have been produced for the prevention of infection associated with both peripheral intravascular and central venous catheterisation.[12-14]

1. Ayliffe GAJ, *et al. Chemical disinfection in hospitals.* 2nd ed. London: PHLS, 1993.
2. Dann TC. Routine skin preparation before injection: an unnecessary procedure. *Lancet* 1969; **ii:** 96–8.
3. Liauw J, Archer GJ. Swabaholics? *Lancet* 1995; **345:** 1648.
4. Shepherd A, Williams N. Care of long-term central venous catheters. *Br J Hosp Med* 1994; **51:** 598–602.
5. Maki DG, *et al.* Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. *Lancet* 1991; **338:** 339–43.
6. Segura M, Sitges-Serra A. Intravenous catheter sites and sepsis. *Lancet* 1991; **338:** 1218.
7. Mimoz O, *et al.* Prospective, randomized trial of two antiseptic solutions for prevention of central venous or arterial catheter colonization and infection in intensive care unit patients. *Crit Care Med* 1996; **24:** 1818–23.
8. Malathi I, *et al.* Skin disinfection in preterm infants. *Arch Dis Child* 1993; **69:** 312–16.
9. Veenstra DL, *et al.* Efficacy of antiseptic-impregnated central venous catheters in preventing catheter-related bloodstream infection: a meta-analysis. *JAMA* 1999; **281:** 261–7.
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11. Darouiche RO, *et al.* A comparison of two antimicrobial-impregnated central venous catheters. *N Engl J Med* 1999; **340:** 1–8.
12. DoH. Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters. *J Hosp Infect* 2001; **47**(suppl): S47–S67. Also available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4005481?IdcService=GET_FILE&dID=14080&Rendition=Web (accessed 27/08/08)
13. O'Grady NP, *et al.* Guidelines for the prevention of intravascular catheter-related infections. *MMWR* 2002; **51** (RR-10): 1–29. Also available at: http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf (accessed 15/03/06)
14. NICE. Infection control: prevention of healthcare-associated infections in primary and community care (June 2003). Section 5: central venous catheterisation. Available at: http://www.nice.org.uk/nicemedia/pdf/Infection_control_fullguideline.pdf (accessed 27/08/08)

Pre-operative skin disinfection

Skin preparation with antiseptics before surgery is generally carried out in an attempt to reduce the risks of surgical infection (see p.195), but the evidence base for the practice is conflicting. The CDC recommends[1] pre-operative cleaning of skin at the incision site with either iodophores (e.g. povidone-iodine), alcohol-containing products, or chlorhexidine gluconate. While alcohol is considered to be the most effective and rapidly acting skin antiseptic, there are no appropriate studies to assess comparative efficacy. Furthermore, an analysis[2] of randomised studies comparing the use of pre-operative skin antiseptics with no antiseptics and studies comparing different skin antiseptics, found that there was insufficient evidence to conclude whether pre-operative skin antiseptics were effective in preventing postoperative surgical wound infection.

1. Mangram AJ, *et al.* CDC Hospital Infection Control Practices Advisory Committee. Guideline for prevention of surgical site infection, 1999. *Am J Infect Control* 1999; **27:** 97–132. Also available at: http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/SSI.pdf (accessed 15/03/06)
2. Edwards PS, *et al.* Preoperative skin antiseptics for preventing surgical wound infections after clean surgery. Available in The Cochrane Database of Systematic Reviews; Issue 3. Chichester: John Wiley; 2004 (accessed 15/03/06).

Wound disinfection

Antiseptic preparations are widely used to treat or prevent superficial infections and wounds, but their usefulness on broken skin and wounds has been questioned.[1] For further information on wound care, see p.1585. Chlorine-releasing antiseptic solutions are generally regarded as irritant and although there is little direct evidence in patients there is concern that they may delay wound healing. Cetrimide,[2] tosylchloramide sodium,[3] hydrogen peroxide 3%,[4] iodophores,[4] and sodium hypochlorite solutions[2] are all reported to be cytotoxic *in vitro* or in *animal* models. Long-term or repeated use of these antiseptics for wound cleaning should probably be avoided. Chlorhexidine is relatively non-toxic.[2,3]

1. Brown CD, Zitelli JA. A review of topical agents for wounds and methods of wounding: guidelines for wound management. *J Dermatol Surg Oncol* 1993; **19:** 732–7.
2. Thomas S, Hay NP. Wound cleansing. *Pharm J* 1985; **2:** 206.
3. Brennan SS, *et al.* Antiseptic toxicity in wounds healing by secondary intention. *J Hosp Infect* 1986; **8:** 263–7.
4. Lineweaver W, *et al.* Topical antimicrobial toxicity. *Arch Surg* 1985; **120:** 267–70.

Acridine Derivatives

Acridina, derivados.

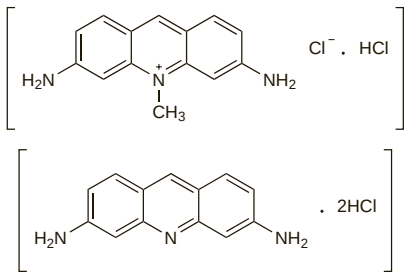
Description. Acridine derivatives are a group of quinoline antimicrobial dyes structurally related to acridine.

Acriflavinium Chloride *(rINN)*

Acriflavine; Acriflavine Hydrochloride; Acriflavinii Chloridum; Acriflavinii Dichloridum; Acriflavinium, Chlorure d'; Akriflaviniumchlorid; Cloruro de acriflavinio. A mixture of 3,6-diamino-10-methylacridinium chloride hydrochloride and 3,6-diaminoacridine dihydrochloride.

Акрифлавиния Хлорид

CAS — 8063-24-9; 65589-70-0.
ATC — R02AA13.
ATC Vet — QG01AC90; QR02AA13.



NOTE. The nomenclature is confusing. Acriflavinium Chloride is *rINN* but also the *BP* name for Acriflavinium Monochloride (see below).

Acriflavinium Monochloride

Acriflavinii monochloridum; Acriflavinio, monocloruro de; Acriflavinium, monochlorure d'; Akriflavinio monochloridas; Akriflaviniummonoklorid; Akriflaviniummonokloridi; Euflaviini; Euflavin; Euflavine; Euflavinum; Neutral Acriflavine; Neutroflavin. A mixture of 3,6-diamino-10-methylacridinium chloride and 3,6-diaminoacridine monohydrochloride. The latter is usually present to the extent of between 30 and 40%.

CAS — 68518-47-8.
ATC — D08AA03.
ATC Vet — QD08AA03.

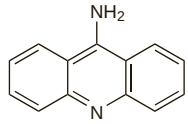
NOTE. The nomenclature is confusing. Although the *BP* name was Acriflavinium Chloride this is also *rINN* for a related compound (see above).

Aminoacridine Hydrochloride *(BANM, rINNM)*

Aminacrine Hydrochloride *(USAN)*; Aminoacridine, Chlorhydrate d'; Aminoacridini Hydrochloridum; Hidrocloruro de aminoacridina; NSC-7571. 9-Aminoacridine hydrochloride monohydrate.

Аминоакридина Гидрохлорид

$C_{13}H_{10}N_2,HCl,H_2O$ = 248.7.
CAS — 90-45-9 (aminoacridine); 134-50-9 (anhydrous aminoacridine hydrochloride).
ATC — D08AA02.
ATC Vet — QD08AA02.



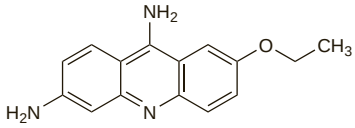
(aminoacridine)

Ethacridine Lactate *(BANM, rINNM)*

Acrinol; Aethacridinium Lacticum; Etakridiinilaktaatti; Etakridinlaktat; Etakridin-laktát; Etakridino laktatas; Etakrydyny mleczan; Éthacridine, lactate d'; Ethacridini lactas; Ethakridin-laktát; Lactato de etacridina; Lactoacridine. 6,9-Diamino-2-ethoxyacridine lactate.

Этакридина Лактат

$C_{15}H_{15}N_3O,C_3H_6O_3$ = 343.4.
CAS — 442-16-0 (ethacridine); 1837-57-6 (ethacridine lactate); 6402-23-9 (ethacridine lactate monohydrate).
ATC — B05CA08; D08AA01.
ATC Vet — QB05CA08; QD08AA01.



(ethacridine)

Pharmacopoeias. *Chin.*, *Eur.* (see p.vii), and *Jpn* describe the monohydrate.

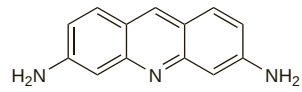
Ph. Eur. 6.2 (Ethacridine Lactate Monohydrate). A yellow crystalline powder. Sparingly soluble in water; very slightly soluble in alcohol; practically insoluble in dichloromethane. A 2% solution in water has a pH of 5.5 to 7.0. Protect from light.

Proflavine Hemisulfate

Proflavine Hemisulphate *(pINNM)*; Hemisulfato de proflavina; Neutral Proflavine Sulphate; Proflavine, Hémisulfate de; Proflavini Hemisulfas. 3,6-Diaminoacridine sulphate dihydrate.

Профлавина Гемисульфат

$(C_{13}H_{11}N_3)_2,H_2SO_4,2H_2O$ = 552.6.
CAS — 92-62-6 (proflavine).



(proflavine)

Profile

The acridine derivatives are slow-acting antiseptics. They are bacteriostatic against many Gram-positive bacteria but less effective against Gram-negative bacteria. They are ineffective against spores. Their activity is increased in alkaline solutions and is not reduced by tissue fluids.

The acridine derivatives have been used for the treatment of infected wounds or burns and for skin disinfection, although they have been largely superseded by other antiseptics or suitable antibacterials. Prolonged treatment may delay healing. They have also been used for the local treatment of ear, oropharyngeal, and genito-urinary infections.

Aminoacridine is reported to be non-staining and is used as the hydrochloride as eye drops in the treatment and prophylaxis of superficial eye infections.

Ethacridine lactate is included in some preparations for the treatment of diarrhoea. It has also been given by extra-amniotic injection for the termination of pregnancy (p.2004) but other methods are usually preferred.

Other acridine derivatives covered elsewhere in *Martindale* include mepacrine (p.836), which is used in the treatment of giardiasis, and pyronaridine (p.612), which is used to treat malaria. Amsacrine (p.681) is a 9-anilinoacridine drug that is used in the treatment of adult leukaemias. Other acridine derivatives are also under investigation as anticancer drugs because of the ability of the acridine chromophore to intercalate DNA and inhibit topoisomerase enzymes.

Hypersensitivity to acridine derivatives has been reported.

◊ References.

1. Wainwright M. Acridine—a neglected antibacterial chromophore. *J Antimicrob Chemother.* 2001; **47:** 1–13.
2. Denny WA. Acridine derivatives as chemotherapeutic agents. *Curr Med Chem* 2002; **9:** 1655–65.

Preparations

BPC 1973: Proflavine Cream.

Proprietary Preparations (details are given in Part 3)
Austral.: Aminopt; ***Ger.:*** Metifex; Neochinosol; Rivanol; Uroseptol†; ***India:*** Emcredil; Vecredil; ***Pol.:*** Rivanol; Rivanolum; Rivel; Rywanol; ***Turk.:*** Rivanol.

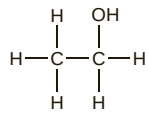
Multi-ingredient: ***Arg.:*** Carnot Topico; Nene Dent; Otocuril; ***Austral.:*** Medijel; ***Austria:*** Dermowund; ***Braz.:*** Acridin; Cystex; Senol†; ***Chile:*** Molca; ***Cz.:*** Tannacomp†; ***Fr.:*** Chromargon; Pyorex; ***Ger.:*** Anaesthesin-Rivanol; Nordapanin N†; Otolitan N mit Rivanol†; Tannacomp; ***Hong Kong:*** Burn Cream†; Medijel; ***Hung.:*** Glycosept; ***India:*** Anaebell†; Emscab; ***Israel:*** Medijel; ***Malaysia:*** Burnol Plus; Medijel; ***NZ:*** Medijel; ***Pol.:*** Septalan; ***S.Afr.:*** Achromide; Daromide; Vagarsol; ***Singapore:*** Burnol Plus; Medijel; ***Spain:*** Antigrietun; Hepro; ***Switz.:*** Euproctol N; Flavangin†; Haemocortin; Haemolan; Tyrothricin; ***Thai.:*** Burnol Plus; Flavinol; ***UK:*** Iglu; Medijel; ***USA:*** Alasulf; Deltavac; DIT1-2.

Alcohol ⊗

Aethanolum; Alcool; Alkol; Etanol; Etanol (96%); Etanol bezwodny; Etanoli; Etanolis; Éthanol; Ethanol; Ethanolum; Ethyl Alcohol.

Алкоголь; Этанол

C_2H_5OH = 46.07.
CAS — 64-17-5.
ATC — D08AX08; V03AB16; V03AZ01.
ATC Vet — QD08AX08; QV03AB16; QV03AZ01.



NOTE. The following terms have been used as 'street names' (see p.vi) or slang names for various forms of alcohol:

Booze; Drinks; Grog; Juice; Jungle juice; Liq; Liquor; Lunch head; Moonshine; Piss; Sauce; Schwillins.

Pharmacopoeias. Various strengths are included in *Br.*, *Chin.*, *Eur.* (see p.vii), *Int.*, *Jpn*, *US*, and *Viet.* Also in *USNF.*

In *Martindale* the term alcohol is used for alcohol 95 or 96% v/v.

Ph. Eur. 6.2 (Ethanol, Anhydrous; Ethanolum Anhydricum; Ethanol BP 2008). It contains not less than 99.5% v/v or 99.2% w/w of C_2H_5OH at 20°. A colourless, clear, volatile, flammable, hygroscopic liquid; it burns with a blue, smokeless flame. B.p. about 78°. Miscible with water and with dichloromethane. Protect from light.

The BP 2008 gives Absolute Alcohol and Dehydrated Alcohol as approved synonyms.

Ph. Eur. 6.2 (Ethanol (96 per cent)). It contains not less than 95.1% v/v or 92.6% w/w and not more than 96.9% v/v or 95.2% w/w of C_2H_5OH at 20°, and water. A colourless, clear, volatile, flammable, hygroscopic liquid; it burns with a blue, smokeless flame. B.p. about 78°. Miscible with water and with dichloromethane. Protect from light.

The BP 2008 gives Alcohol (96 per cent) as an approved synonym.

BP 2008 (Dilute Ethanols). The monograph describes several dilute alcohols containing between 20 and 90% v/v of C_2H_5OH, and one of these, ethanol (90%), is also known as rectified spirit.

USP 31 (Alcohol). It contains not less than 92.3% w/w or 94.9% w/v and not more than 93.8% w/w or 96.0% w/v of C_2H_5OH at 15.56°. A clear, colourless, mobile, volatile liquid with a characteristic odour and burning taste; it is flammable. B.p. about 78°. Miscible with water and with almost all other organic solvents. Store in airtight containers. Protect from light.

USP 31 (Dehydrated Alcohol). It contains not less than 99.5% v/v or 99.2% w/w of C_2H_5OH (sp. gr. not more than 0.7962 at 15.56°). Store in airtight containers. Protect from light.

USNF 26 (Diluted Alcohol). It contains 48.4 to 49.5% v/v or 41 to 42% w/w of C_2H_5OH. Store away from fire in airtight containers.

Alcoholic strength. This is expressed as a percentage by volume of alcohol. It was previously often expressed in terms of *proof spirit*. Proof spirit contained about 57.1% v/v or 49.2% w/w of C_2H_5OH, and was defined as 'that which at the temperature of 51°F weighs exactly twelve-thirteenths of an equal measure of distilled water'. Spirit of such a strength that 100 volumes contained as much ethyl alcohol as 160 volumes of proof spirit was described as '60 OP' (over proof). Spirit of which 100 volumes contained as much alcohol as 40 volumes of proof spirit was described as '60 UP' (under proof).

An alternative method of indicating spirit strength was used on the labels of alcoholic beverages in the UK when the strength was given as a number of degrees, proof spirit being taken as 100°. In the USA alcoholic strength is expressed in degrees, the value of which is equal to twice the percentage by volume. Thus 70° proof (old UK system) is equivalent to 40% v/v, and therefore to 80° proof (USA system).

Adverse Effects

Adverse effects of alcohol arise chiefly from the intake of alcoholic beverages. The concentration of alcohol in the blood producing a state of intoxication varies between individuals.

- Low concentrations (up to 180 mg per 100 mL) of alcohol may result in impaired vision, reaction time, and coordination and emotional lability.
- At low to moderate concentrations (180 to 350 mg per 100 mL), alcohol acts as an apparent stimulant; depression of cortical function causes loss of judgement, slurred speech, diplopia, blurred vision, ataxia, lack of coordination, blackouts, sweating, tachycardia, nausea, vomiting, and incontinence. Alcohol inhibits the release of antidiuretic hormone resulting in enhanced diuresis. Acidosis (especially in children), hypoglycaemia, and hypokalaemia may occur.
- High concentrations (350 to 450 mg per 100 mL) of alcohol result in cold clammy skin, hypothermia, hypotension, stupor, coma, dilated pupils, and depressed or absent tendon reflexes. Severe hypoglycaemia, convulsions, respiratory depression, and metabolic acidosis may occur. Cardiac arrhythmias such as atrial fibrillation and AV block have been recorded.

The median lethal blood-alcohol concentration is generally estimated to be about 400 to 500 mg per 100 mL. Death may occur at lower blood-alcohol concentrations due to inhalation of vomit during unconsciousness.

Chronic excessive consumption of alcohol may cause damage to many organs, particularly the brain and the