THE UNIVERSITY OF WESTERN AUSTRALIA

DENT 3005:Introduction to Pharmacology

Introduction to toxicology

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DENT3005: assessment breakdown

Assessment #	Assessment Task	Weight %	Assessment Period/ date	Module assessed	Waiver
1	SAQ	50%	30/09/25 9AM – 11AM	General Medicine and Pharmacology: all lectures content	No
2	MCQ	50%	Main Campus: Semester 2 examination period	General Medicine and Pharmacology: all lectures content	No

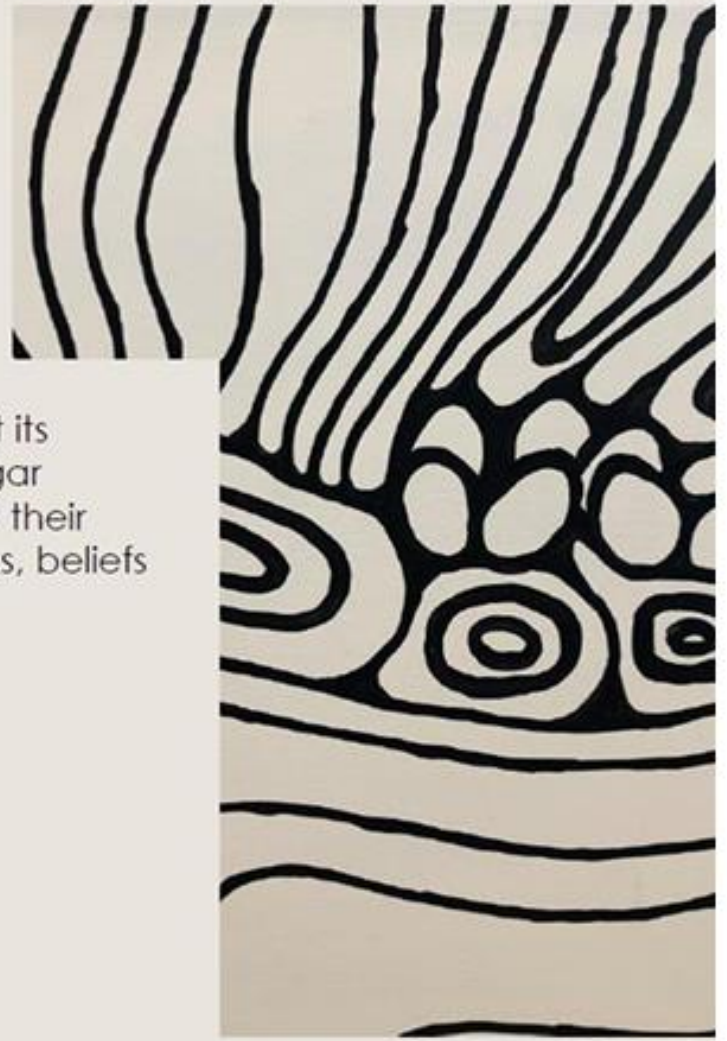
2025 DMD1 SEMESTER 2 TIMETABLE - Final

Wee	Date	Da	Start	Finish	Activ	Venue	Unit C	Unit Title	Module	Topic	Lecturer	Module Coordinator	Unit Co-ordir
Week 27	2-Jul-25	Wednesday	9:00	12:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	General Medicine	Medical history and extraoral exam; Cardiology; Respiratory medicine	Dr Magdalen Foo	Dr Magdalen Foo	Linh Truong
Week 27	2-Jul-25	Wednesday	13:00	15:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	General Medicine	Gastrointestinal tract; Renal Medicine; Liver Disease	Dr Magdalen Foo	Dr Magdalen Foo	Dr Linh Truong
Week 28	9-Jul-25	Wednesday	13:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Introduction to pharmacodynamics & pharmacokinetics	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 29	16-Jul-25	Wednesday	13:00	16:00	L	QE2P: [G16] Mary Lockett LT	DENT3005	General Medicine and Pharmacology	Pharmacology	Introduction to Toxicology, Ethics and Legalities, Infectious Disease in the Dental Setting	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 30	22-Jul-25	Tuesday	13:00	16:00	L	211 VLC	DENT3005	General Medicine and Pharmacology	General Medicine	Neurology, Haematology	Dr Magdalen Foo	Dr Magdalen Foo	Dr Linh Truong
Week 30	23-Jul-25	Wednesday	13:00	14:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Cardiovascular Drugs	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 30	23-Jul-25	Wednesday	14:00	15:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Respiratory Drugs	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 30	23-Jul-25	Wednesday	15:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Gastrointestinal Drugs	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 30	23-Jul-25	Wednesday	16:00	17:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Renal Drugs	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 32	6-Aug-25	Wednesday	13:00	15:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Hormones Drugs, Dermatological Drugs	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 32	6-Aug-25	Wednesday	15:00	16:00	P	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Practical 1 - Medical history	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 32	6-Aug-25	Wednesday	16:00	17:00	P	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Practical 2 - Drug history	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 32	8-Aug-25	Friday	13:00	17:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	General Medicine	Infectious diseases	A/Prof Omar Kujan	Dr Magdalen Foo	Dr Linh Truong
Week 33	11-Aug-25	Monday	13:00	15:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	General Medicine	Endocrinology I & II	Dr Janina Christoforou	Dr Magdalen Foo	Dr Linh Truong
Week 33	13-Aug-25	Wednesday	13:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Endocrine Drugs (I, II, III)	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 34	20-Aug-25	Wednesday	13:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Neurological & Psychotropic Medications	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 36	3-Sep-25	Wednesday	13:00	14:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Anaesthesia in the dental setting	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 36	3-Sep-25	Wednesday	14:00	15:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Pain Control	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 36	3-Sep-25	Wednesday	15:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Complementary Medicines, Special Populations	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 37	8-Sep-25	Monday	15:00	17:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	General Medicine	Rheumatology; Immunology	Dr Janina Christoforou	Dr Magdalen Foo	Dr Linh Truong
Week 37	9-Sep-25	Tuesday	8:00	9:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology					
Week 37	10-Sep-25	Wednesday	9:00	12:00	P	211 VLC	DENT3005	General Medicine and Pharmacology	General Medicine/Pharmacology	Emergency Medicine and practical	Dr Linh Truong	Dr Magdalen Foo	Dr Linh Truong
Week 37	10-Sep-25	Wednesday	13:00	15:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Immunomodulators, Antiinflammatories	Dr Linh Truong	Dr Magdalen Foo	Dr Linh Truong
Week 37	10-Sep-25	Wednesday	15:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Haematology Drugs	Dr Linh Truong	Dr Magdalen Foo	Dr Linh Truong
Week 37	10-Sep-25	Wednesday	16:00	17:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology					
Week 38	17-Sep-25	Wednesday	13:00	14:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Antiinfective Drugs	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 38	17-Sep-25	Wednesday	14:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	Pharmacology	Antiinfective II, Vacines	Dr Linh Truong	Dr Linh Truong	Dr Linh Truong
Week 39	24-Sep-25	Wednesday	13:00	14:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	General Medicine	Oncology	Dr Magdalen Foo	Dr Magdalen Foo	Dr Linh Truong
Week 39	24-Sep-25	Wednesday	14:00	16:00	L	G15 KJG Sutherland	DENT3005	General Medicine and Pharmacology	General Medicine	Oral Oncology (Head and Neck)	Dr Magdalen Foo	Dr Magdalen Foo	Dr Linh Truong
Week 40	30-Sep-25	Tuesday	8:00	12:00	A	HACKH: [G09] Fay Gale Studio	DENT3005	General Medicine and Pharmacology		In-semester assessment - SAQ	Dr Magdalen Foo	Dr Magdalen Foo	Dr Linh Truong
Week 41	10-Oct-25	Friday	16:00	18:00	A	206 CSSL	DENT3005	General Medicine and Pharmacology					

THE UNIVERSITY OF WESTERN AUSTRALIA

Acknowledgement of country

The University of Western Australia acknowledges that its campus is situated on Noongar land, and that Noongar people remain the spiritual and cultural custodians of their land, and continue to practise their values, languages, beliefs and knowledge.

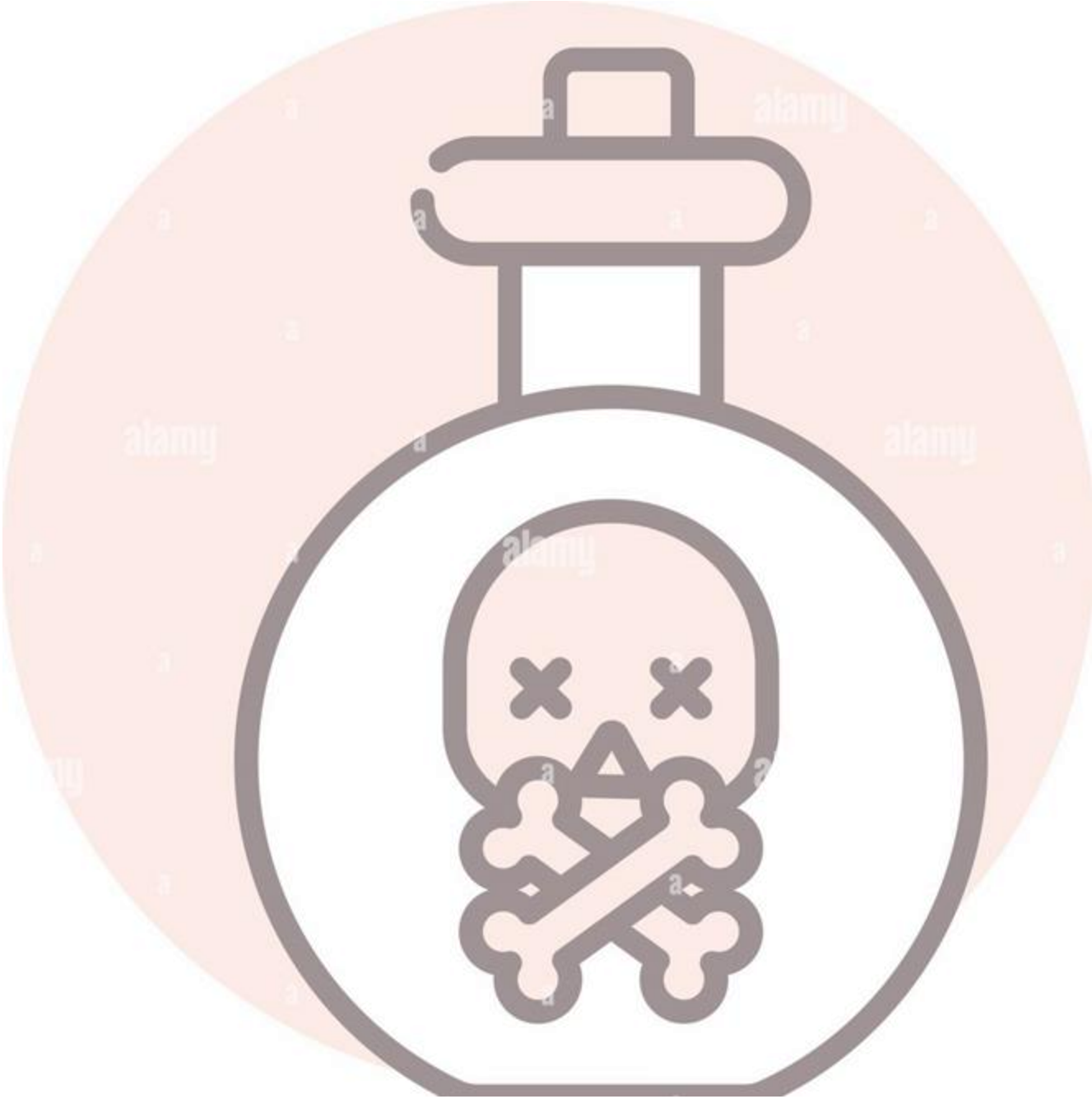


Artist: Dr Richard Barry Walley OAM

Learning Outcomes

Learning objectives

1. Define toxicology and its role in dental and healthcare settings
2. Identify key types of toxicological agents and exposure routes in dentistry
3. Understand the basic principles of toxicokinetic and dose-response relationships
4. Recognize clinical symptoms and emergency management of toxicity
5. Describe toxicological concerns related to dental materials and medications
6. Apply safety, ethical, and regulatory considerations in dental toxicology practice



What is toxicology

- Study of adverse effects from harmful agents (chemical, physical, biological)
- Integrates disciplines such as pharmacology, medicine, biology
- Helps assess risks and impacts on health and the environment
- Crucial for selecting safe dental materials and drugs
- Informs protocols for patient management and emergency response

Why is toxicology important for dentists?

- Exposure to chemicals, medications, and materials in dentistry
- Preventing and managing adverse reactions
- Understanding the risks of dental materials and local anaesthetics
- Occupational health risks for dental practitioners

Types of toxicology

- **Environmental toxicology:** impact of pollutants, chemicals in the environment
- **Clinical toxicology:** diagnosis and management of poisoning in patients
- **Forensic toxicology:** role in legal investigations
- **Occupational toxicology:** toxins in the workplace

Toxicological Agents and Classifications in Dentistry

- **Sources of toxicants**
  - Medications, food additives, pollutants
  - Household/workplace chemicals
  - Natural toxins (plants, microbes)
  - Dental materials (fluoride, amalgam, composites)
- **Types of toxicants**
  - **Local**: act at contact site (e.g., mucosa)
  - **Systemic**: act after absorption
  - **Direct-acting**: inherently reactive
  - **Bioactivation-dependent**: require metabolic conversion (e.g., CYP450)
- **Common dental toxicants**
  - Local anaesthetics (CNS/cardiovascular toxicity)
  - Dental materials (mercury spills)
  - Medications (overdose, ADRs)

Key factors influencing toxicity

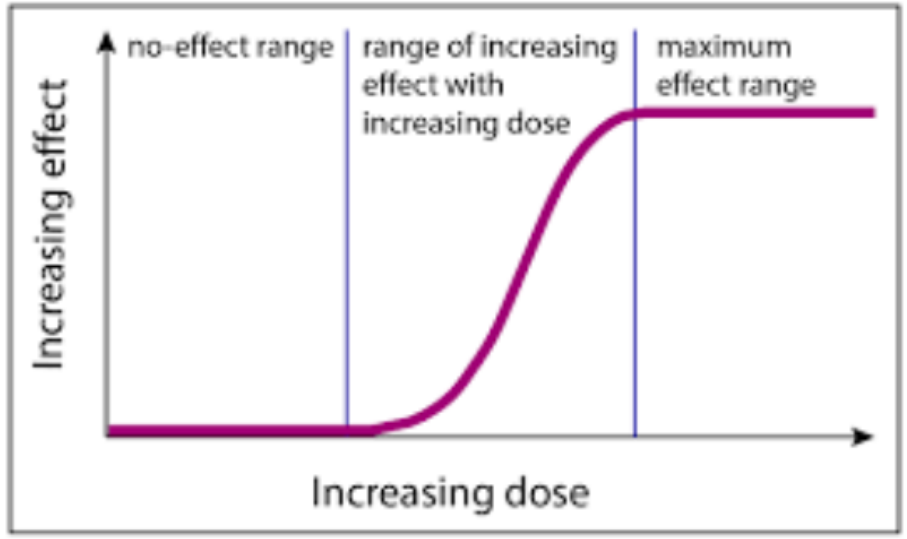
- **Dose:** the total quantity of exposure
- **Route:** how the substance enters the body (oral, dermal, etc.)
- **Duration:** how long exposure lasts (acute vs. chronic)
- **Frequency:** how often the exposure occurs
- **Latency:** time before symptoms appear
- **Chemical interactions:** may enhance or reduce toxicity

Toxicokinetic

- **Toxicokinetic Vs toxicodynamic**
  - Remember pharmacokinetic Vs pharmacodynamic?
  - Complementary concepts within toxicokinetic, under pharmacology
- **Toxicokinetic**
  - **A**bsorption, **D**istribution, **M**etabolism, **E**xcretion
- **Toxicodynamic**
  - Biological effects of toxins

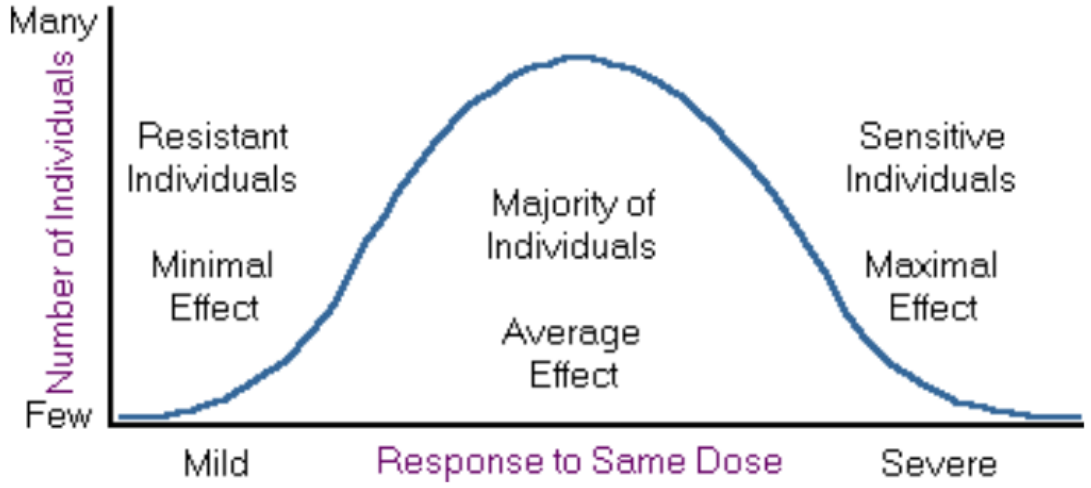
Dose-Response and Toxic Thresholds

- **“The dose makes the poison”** – all substances are toxic at high enough levels
- **Dose:** total amount of substance exposed to the individual
- **Dosage:** adjusts dose based on body weight (mg/kg)
- **Toxic dose:** minimum amount that causes harm
- **Threshold dose:** the lowest dose at which effects begin to appear
- **NOAEL**
  - **N**o-**O**bserved-**A**dverse-**E**ffect **L**evel
  - Useful in evaluating safe exposure



Biological variability & response

- Populations show a range of responses to a toxicant
- Most people respond similarly; some are highly sensitive or resistant
- Dose-response curves often follow a bell-shaped pattern
- Variability influenced by genetics, age, health status
- Important for risk prediction and personalized care



Dose fractionation

- Dividing a large dose into smaller parts reduces toxicity
- Reduces peak concentration and allows metabolism/elimination
- Common in chemotherapy and pain management
- Paracetamol dosing is a clinical example
- Helps prevent overdose and adverse effects

Deviations from typical dose-response

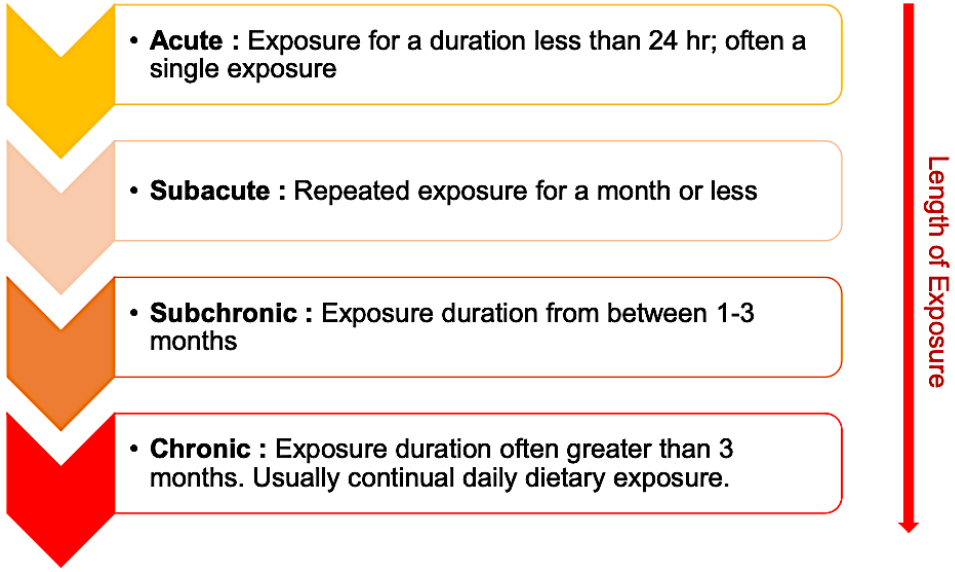
- Some individuals exhibit atypical or extreme responses
- Idiosyncratic responses due to genetic traits (e.g., G6PD deficiency)
- Hypersensitivity reactions involve immune responses (e.g., allergies)
- May occur at low doses or after previous exposure
- Important for identifying and managing rare drug reactions

Toxicant exposure routes & dental relevance

- **Major routes of exposure**: ingestion, inhalation, skin contact, injection
- **Route influence**: affects speed and severity of toxic effect
- **Dental relevance**
  - Accidental ingestion of materials
  - Skin exposure to chemicals
- **Risk mitigation**: use of personal protective equipment (PPE)
- **Emergency response**: knowledge of exposure routes guide actions

Duration & frequency of exposure

- **Dental relevance**
  - Acute exposure during procedures (e.g. chemical spills, vapours)
  - Chronic low-level exposure to mercury, disinfectants, and other agents
- **Occupational health implications**
  - Emphasizes need for chemical hygiene and ventilation
  - Use of PPE and proper handling procedures to reduce long-term risk
- **Key takeaway:** duration and frequency matter – monitor both to ensure staff and patient safety



Organ specific toxicity

- **Target organs**: kidneys, liver, nervous system
- **Influencing factors**: enzyme presence, transport mechanisms, tissue susceptibility
- **Toxicant accumulation**: poor detoxification can lead to damage
- **Examples of toxicants**
  - Lead: neurotoxicity
  - Aminoglycosides: renal toxicity
- **Importance**: predict systemic effects of dental drugs
- **Clinical implications**
  - Identifying target organs helps in selecting safer alternatives
  - Informs medical history and drug choice
  - Monitoring essential for high-risk drugs

Chemically induced liver injury

- Liver is a primary site for drug metabolism and detoxification
- High exposure due to blood from GI tract
- Contains enzymes that may activate or detoxify chemicals
- Accumulation of toxic metabolites leads to liver injury
- Key contributor to drug failure in clinical trials

Review

Clinical application in dentistry

- **Clinical symptoms of toxicity in dental patients**
  - Acute toxicity: immediate symptoms, e.g., nausea, dizziness
  - Chronic toxicity: long-term effects, e.g., organ damage
  - Allergic reactions: skin rashes, swelling, difficulty breathing
- **Management of toxicity in dental practice**
  - Emergency protocols: immediate actions during poisoning
  - Antidotes and treatment options
  - Prevention and risk management strategies
- **Specific toxicological concerns in dental materials**
  - Amalgam fillings: mercury toxicity and public concerns
  - Eugenol and other chemicals: risks of exposure

Case examples: Local anaesthetics

- Commonly used anaesthetics (lignocaine, articaine, etc.)
- Symptoms of overdose (e.g. seizures, arrhythmias)
- Risk factors and management in case of toxicity
  - E.g. lignocaine toxicity
  - Overdose or inappropriate administration
  - Symptoms: CNS depression, seizures, hypotension
  - Prevention
    - Correct LA technique
    - Appropriate dose for appropriate patient

Case examples: paracetamol overdose

- Safe at recommended doses
  - Dangerous in overdose
  - Overdose leads to liver necrosis and failure
- Symptoms: nausea, liver tenderness, increased liver enzymes
- N-acetylcysteine replenishes glutathione for detoxification
- Early treatment prevents long-term damage

Case example: Mercury poisoning

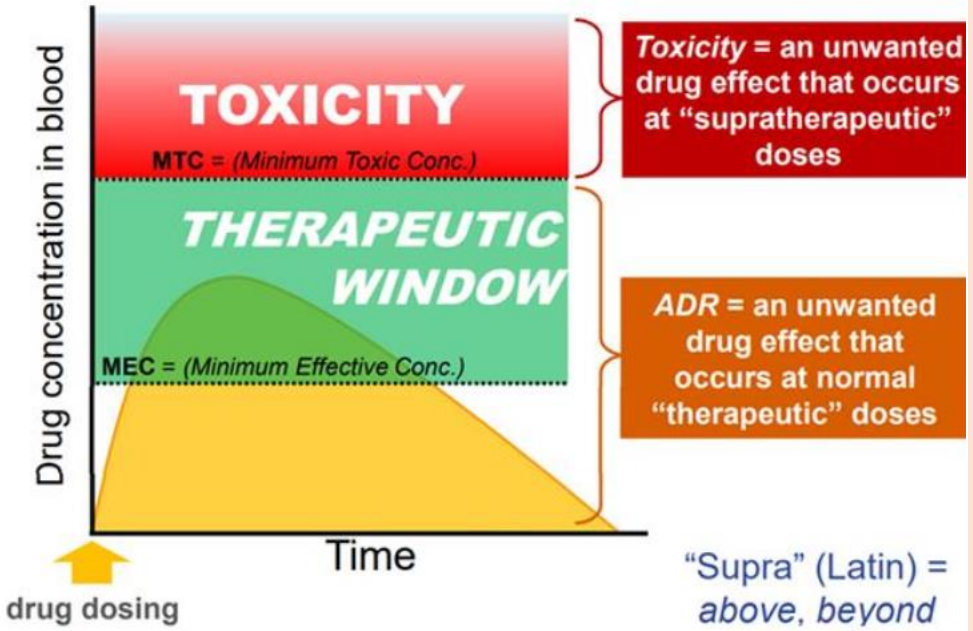
- Background: exposure risk, sources of mercury in dentistry
- Symptoms: tremors, memory problems, irritability
- Prevention
  - Appropriate material handling
  - Staff training
- Management
  - Mercury spill kit

Feature	Tetracycline Teeth Staining	Dental Fluorosis	Molar Incisor Hypomineralization (MIH)
Cause	Systemic administration of tetracycline antibiotics during tooth development (especially 2nd trimester to 7 years of age)	Excessive fluoride intake during enamel formation (typically <8 years old)	Disruption in enamel mineralization due to systemic factors (e.g., childhood illness, medications, hypoxia)
Affected Teeth	All developing teeth at the time of exposure (can be generalized)	Symmetrical involvement of most or all teeth	Permanent first molars and incisors; asymmetrical presentation
Timing of Developmental Disruption	In utero to early childhood (depending on tetracycline exposure)	Enamel formation period in early childhood	Typically around birth to age 3
Key Clinical Appearance	- Intrinsic discoloration (yellow, brown, or grey) - Horizontal banding if exposure was time-limited	- White opaque spots to brown stains - Pitting in severe cases - Symmetrical	- Demarcated opacities (white, yellow, or brown) - Post-eruptive enamel breakdown - Rapid caries
Tooth Surface Texture	Smooth enamel surface, but color is intrinsic	May be smooth or rough; can have pitted areas in severe forms	Chalky, porous enamel; often rough or broken down
Severity	Varies with dosage and timing of tetracycline	Depends on dose and duration of fluoride exposure	Varies by severity of hypomineralization and post-eruptive breakdown
Management	- Mild: Bleaching, microabrasion - Moderate: Composite veneers - Severe: Crowns or ceramic veneers	- Mild: No treatment or microabrasion - Moderate-severe: Composite restorations, veneers	- Remineralization strategies - Sealants - Composite or stainless-steel crowns for molars - Close monitoring and preventive care
Prevention	Avoid tetracycline use in pregnant women and young children	Monitor fluoride intake in young children	Minimize systemic insults during early childhood (not always preventable)

Review

Adverse drug reaction (ADR)

- Occur at **normal therapeutic doses**
- Include **side effects**, **allergic reactions**, and **toxicities**
- **Major cause** of hospital admissions and patient harm
- **Not the same** as expected side effects – accurate identification is critical
- Managed under **pharmacovigilance**
  - Monitors, reports, and prevents ADRs
  - Supports **drug safety** and regulatory action
- **Clinical responsibility**: early recognition and reporting improve patient outcomes



Type A adverse drug reactions (ADR)

- **Predictable**: based on the drug's known pharmacological action
- **Dose-dependent**: severity increases with higher doses
- **Common**: can occur in virtually any patient
- **Recognizable**: often easily identified by prescribers
- **Preventable**: managed by dose adjustment or switching drugs
- **Identified early**: usually detected during premarketing trials
- **Example**: insulin-induced hypoglycaemia – monitor diabetic patients during dental procedures

Type B adverse drug reaction

- **Less common**: account for ~10–15% of ADRs
- **Unrelated site**: occur at locations distant from drug's intended action
- **Unpredictable**: often in genetically or immunologically susceptible individuals
- **Types:** *idiosyncratic vs allergic*
- **Delayed recognition**: often identified post-marketing
- **Example**: HLA-related hypersensitivity reactions
- **Clinical importance**: serious and require prompt reporting and investigation

Drug hypersensitivity

- **Immune response**: caused by hypersensitivity to drugs
- **Variable severity**: ranges from mild rashes to life-threatening anaphylaxis
- **Commonly affected systems**: skin, respiratory, GI tract, blood vessels
- **Mechanism**: drugs act as haptens, bind to proteins → become antigenic
- **Risk factors**
  - Immune system activation
  - Dose and duration of exposure
  - Genetic predisposition (e.g., HLA alleles)
  - Gender differences
- **Prior exposure**: typically required, but 'first dose' reactions can occur
- May be due to non-medical environmental exposures (e.g., penicillin in food)
- **Clinical importance**: early recognition and response are critical in dental settings

Classification of drug allergies

- Immediate reactions: IgE-mediated (e.g., anaphylaxis)
- Delayed reactions: T-cell-mediated (e.g., rash)
- Timing of reaction informs diagnosis and management
- Prior exposure usually required but not always
- Classification helps prevent future occurrences

Review

Medication safety & dental material regulations

- **Medication-related harm in Australia**
  - ~250,000 hospital admissions/year
  - $1.4 billion AUD in healthcare costs
  - ~50% of incidents are preventable
- **Clinical priorities**
  - Cautious prescribing and clear communication
  - Regular medication reviews
- **Regulation of dental materials**
  - Governed by AS/NZS Standards
  - Overseen by the Therapeutic Goods Administration (TGA)
  - Emphasis on safe handling and disposal of toxic substances

Environmental & drug toxicity in dentistry

- **Environmental toxicity**
  - Pollution sources: waste disposal, chemical runoff
  - Emphasis on green dentistry: sustainable materials and eco-friendly practices
  - Goal: Reduce environmental footprint of dental clinics
- **Dental drug toxicity**
  - Commonly used drugs: sedatives, analgesics, antibiotics
  - Risks: side effects, toxicities, interactions, contraindications
  - Importance of safe prescribing and patient-specific considerations

Safety practices for dental professionals

- **Personal protective equipment (PPE)**
  - Use gloves, masks, and eye protection consistently
  - Prevents cross-contamination and occupational exposure
- **Safe handling of chemicals & materials**
  - Follow manufacturer guidelines
  - Ensure proper storage, ventilation, and disposal
  - Minimize exposure to hazardous substances
- **Safe injection & needle practices**
  - Use single-use needles
  - Avoid recapping; dispose in puncture-proof containers
  - Reduces risk of needle-stick injuries and infection transmission
- **Overall importance**
  - Protects both dental professionals and patients
  - Reinforces professionalism and quality of care

Special population

- **Paediatric toxicology in dentistry**
  - Special considerations for children: age-related factors in toxicity
  - Dosing and Safety: safe prescribing and administration
  - Managing paediatric emergencies
- **Geriatric toxicology in dentistry**
  - Elderly population and drug metabolism: age-related changes in toxicology
  - Polypharmacy: risks of drug interactions in older patients
  - Managing geriatric patients safely
- **Other considerations**
  - Renal function, liver function, pregnancy etc.

The role of dental practitioners

- **Recognizing toxicity symptoms**
  - Identify early signs of adverse reactions or material exposure
  - Act promptly to prevent complications
- **Patient education**
  - Explain risks of dental materials and prescribed drugs
  - Instruct on safe use, storage, and what to do in case of a reaction
- **Referral and emergency response**
  - Know when to contact poison control centres or refer to specialists
  - Ensure timely and appropriate care beyond the dental setting

Legal & ethical considerations

- **Informed consent**
  - Clearly explain treatment risks, materials, and medications
  - Ensure patient understanding and voluntary agreement
- **Record keeping**
  - Document all toxicological exposures and patient responses
  - Maintain accurate records for legal and clinical accountability
- **Patient rights & legal responsibilities**
  - Respect patient autonomy and right to safe care
  - Comply with legal standards and regulatory guidelines
  - Be prepared to manage or refer cases involving toxicity

Review

References

- Ritter JM, Flower RJ, Henderson G, Loke YK, MacEwan D, Robinson E, editors. *Rang & Dale's pharmacology*. 10th ed. Edinburgh: Elsevier; 2023
- Becker DE, Reed KL. *Pharmacology and Therapeutics for Dentistry*. 7th ed. St. Louis: Elsevier; 2017.
- Bullock S, Manias E. *Fundamentals of pharmacology*. 8th ed. Frenchs Forest, NSW: Pearson Australia; 2017
- Stringer JL. *Basic concepts in pharmacology*. 6th ed. New York (US): McGraw Hill Medical; 2022 Feb 18