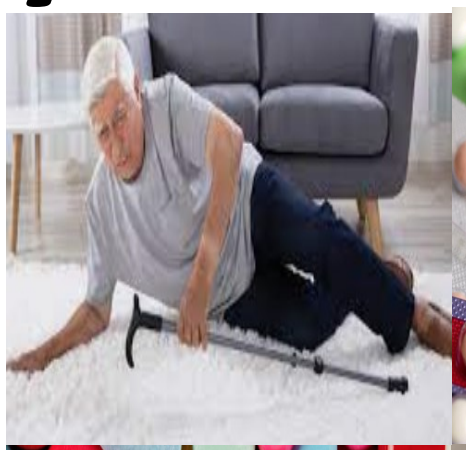
Falls and Pharmacology

Jack Miller BSc(PT), Dip MT(NZ), MClSc, DPT, FCAMPT

Advanced Physiotherapy Practitioner

jack@keyclinskills.ca

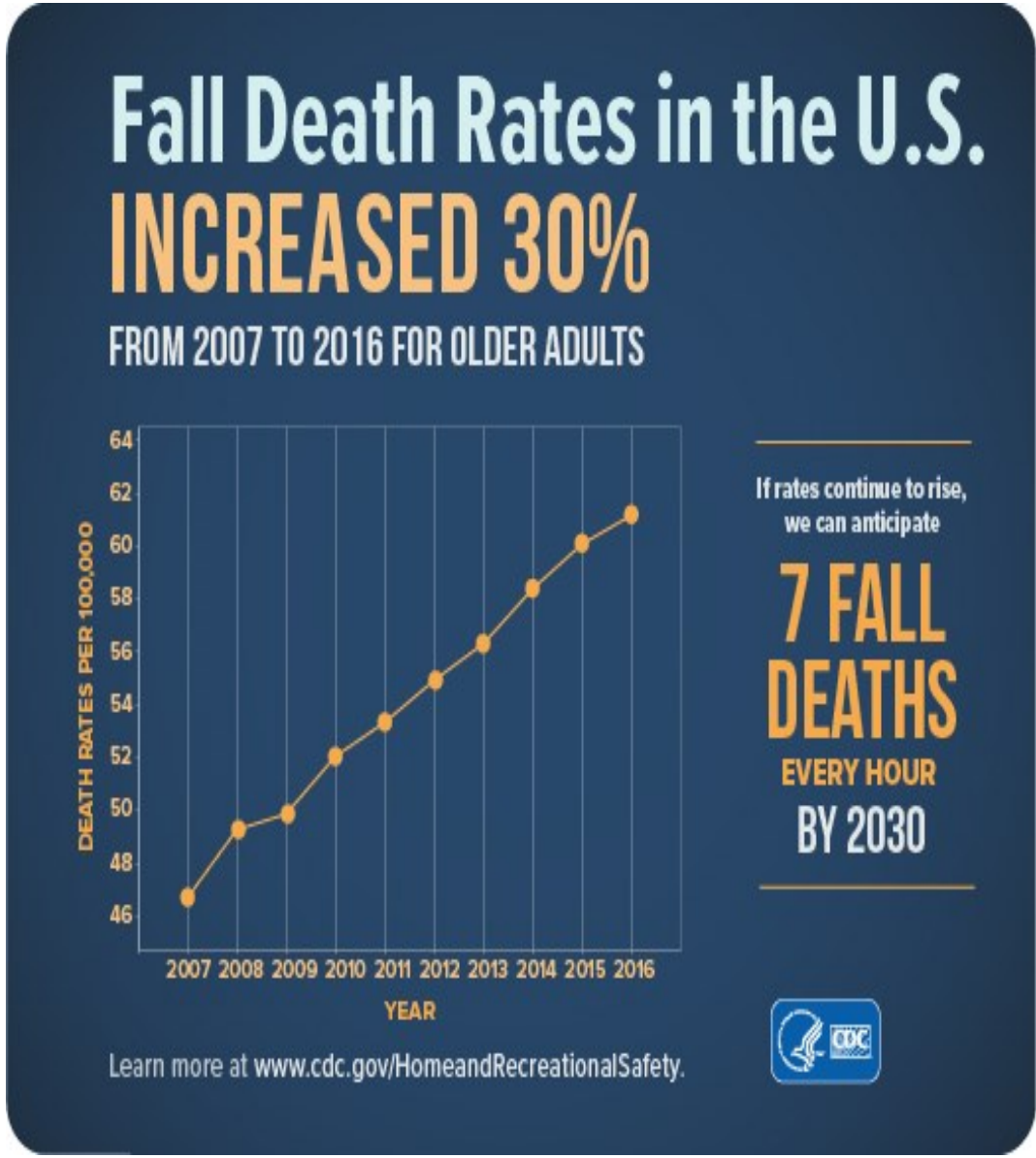



Risk of falls in general population

KEY CLINICAL SKILLS

- Female
- Low BMI
- Age > 80
- Previous falls
- Difficulty rising from sitting
- Anxiety
- Depression

- Reduced leg muscle strength
- Impaired balance
- Impaired postural reflexes
- Impaired vision
- Impaired cognition
- **Use of sedatives**



Pirker 2017

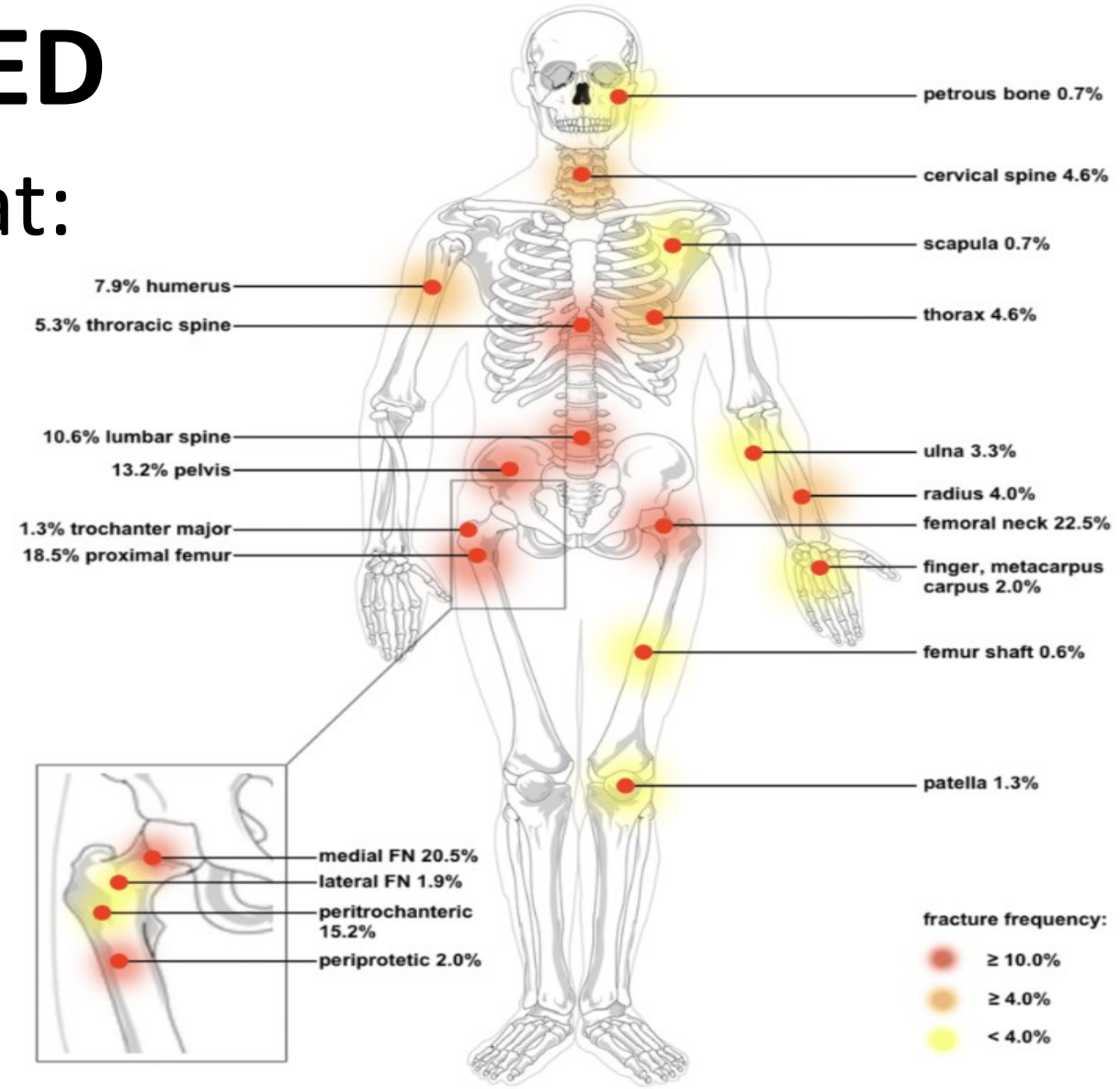
Falls related fractures

Retrospective study of ED

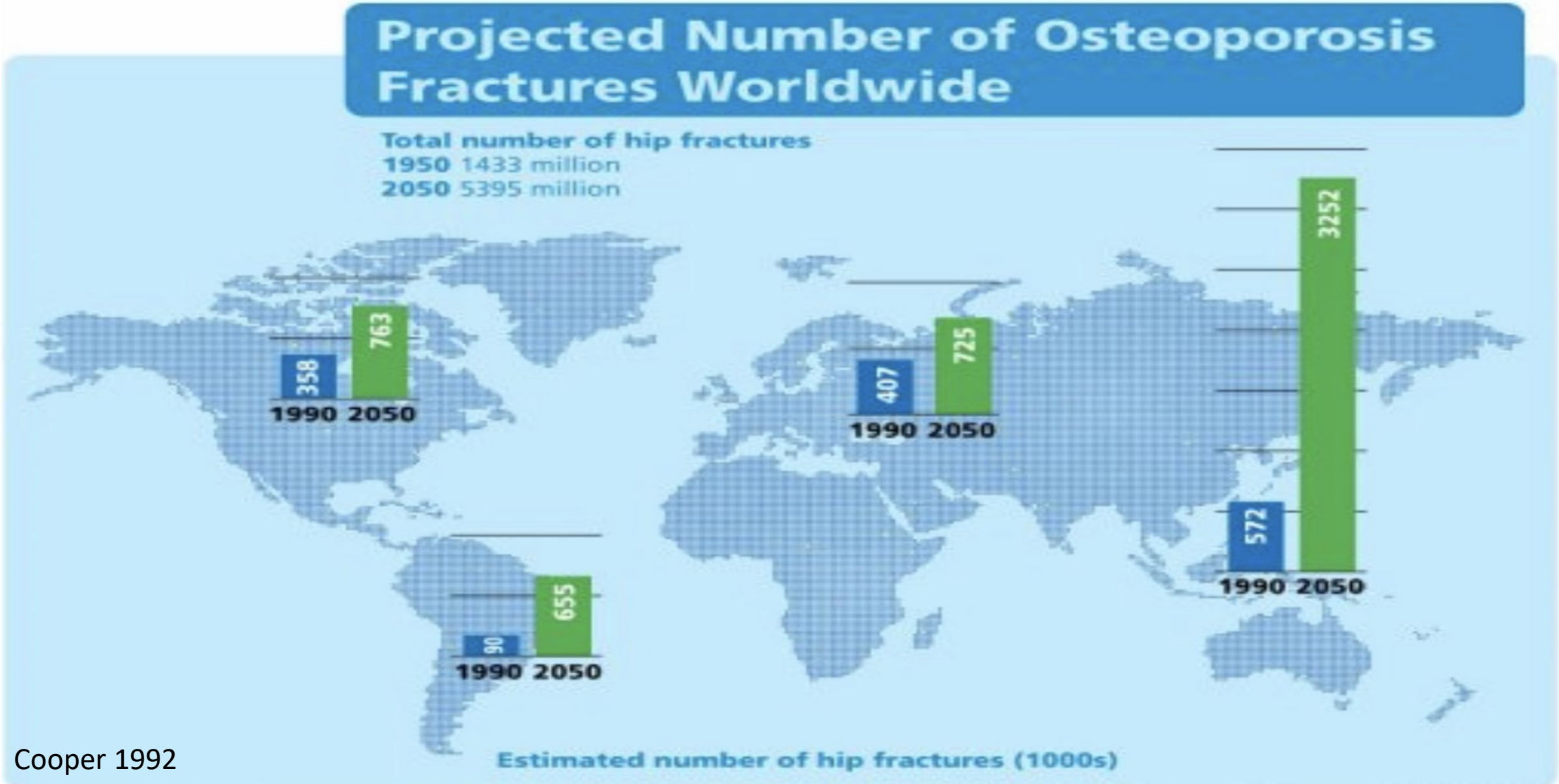
Over 10% of fractures occur at:

- Femoral neck
- Proximal femur
- Thoracic spine
- Lumbar spine
- Pelvis

Muhlenfeld 2021



Incidence of fractures



Cooper 1992

Post THA & TKA falls risk factors:

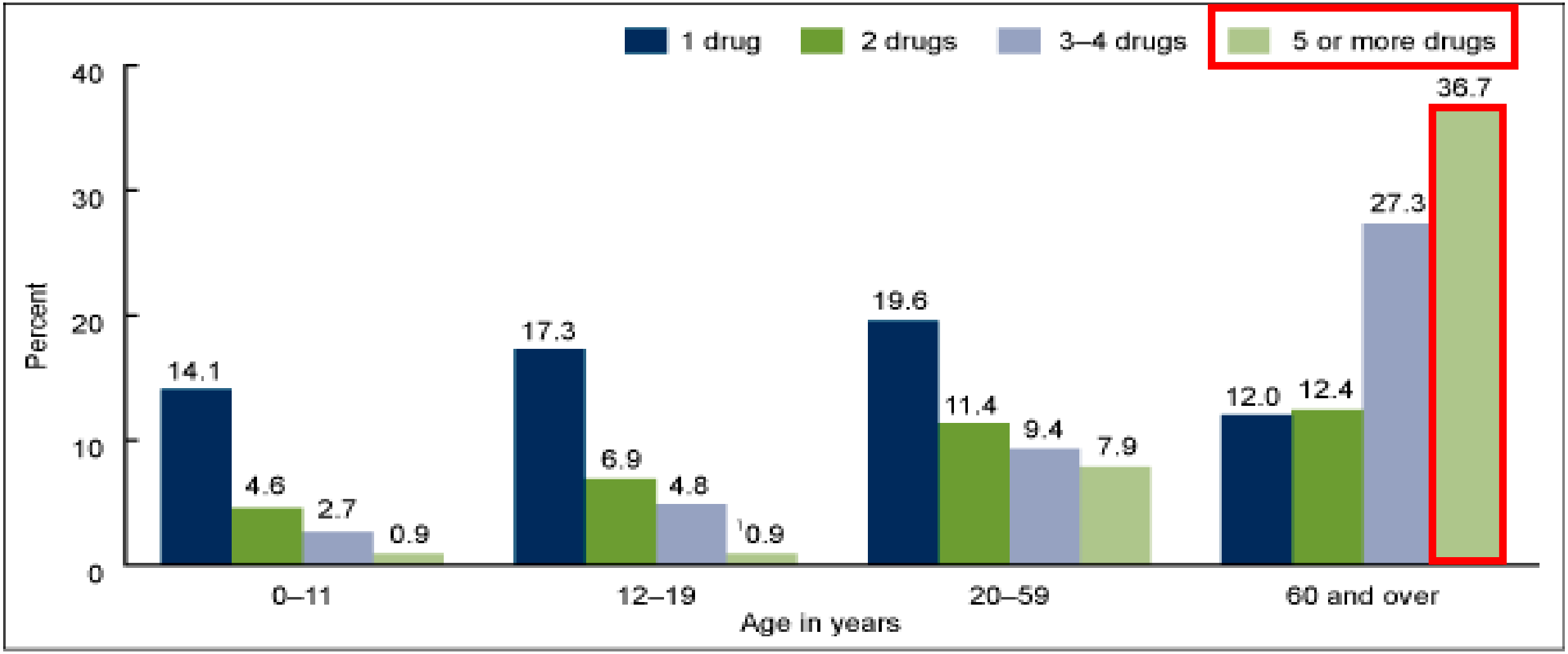
KEY CLINICAL SKILLS

Systematic Review & Meta-analysis

- 12 studies of 1,292,689 subjects
  1. **Medications**
  2. Psychiatric diseases
  3. Living alone
  4. Prior TKA
  5. Falls history
  6. Female

Lo 2019

Polypharmacy and age



[1]Estimate is unstable; the relative standard error is greater than 30%.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey.

A drug by any other name

Chemical name

- Identifies the chemical elements found in the drug
- Used by researchers

Generic Name

- The universally accepted name of a drug
- Often have a common suffix i.e. Lidocaine, Procaine
- Used by Physicians, Pharmacists

Brand "Trade" name

- Name trademarked by drug manufacturer
- Used by the public

Chemical name	Generic name	Trade name
Acetoamino-phenol	Parace-temol	Tylenol
Acetylsalicylic acid	Aspirin	Disprin
1-1 dimethylbi-guanide	Metformin	Gluco-phage
Aminpbenzyl-penicillin	Ampicillin	Roscillin

Mechanism of drug action

Receptors

A site on the cell with which an agonist binds to bring about change

1. **Affinity**
   - The ability of a drug to bind to a receptor
2. **Efficacy**
   - Ability of a drug to produce a response after binding to the receptor

Mechanism of drug action

KEY CLINICAL SKILLS

Agonist

- A drug that produces a physiological effect on the receptor to which it binds
- i.e. Morphine activates opioid receptors to produces analgesia

Antagonist

- Binds to a receptor to block activation
- i.e. Nalaxone blocks opioid receptors without giving analgesia

Adverse drug reactions

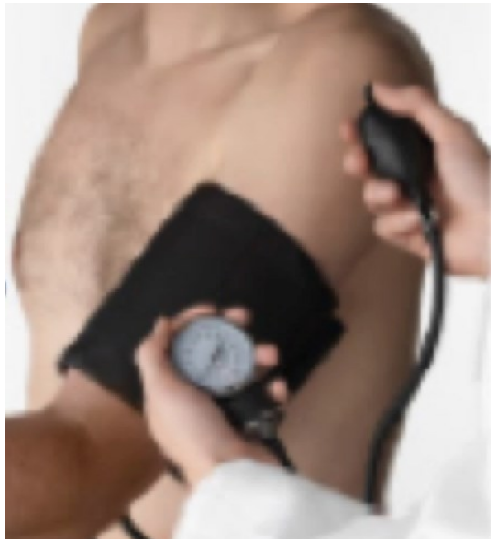
- **Side effects**
  - Predictable, common & occur in many people
- **Toxic effects**
  - Seen at higher does of drug
- **Intolerance**
  - Exaggerated responses in specific individuals
- **Iatrogenic diseases**
  - Persistence of toxic effects when drug stopped
- **Dependence**
  - Can range from psychological to physical addiction
- **Teratogenicity**
  - Ability of drug to cause fetal abnormalities
- **Carcinogencity**
  - Ability of a drug to cause cancer

The “big 3”

The three most common comorbidities in Physiotherapy

1. Hypertension
2. Arthritis
3. Depression

Boissonault 1999

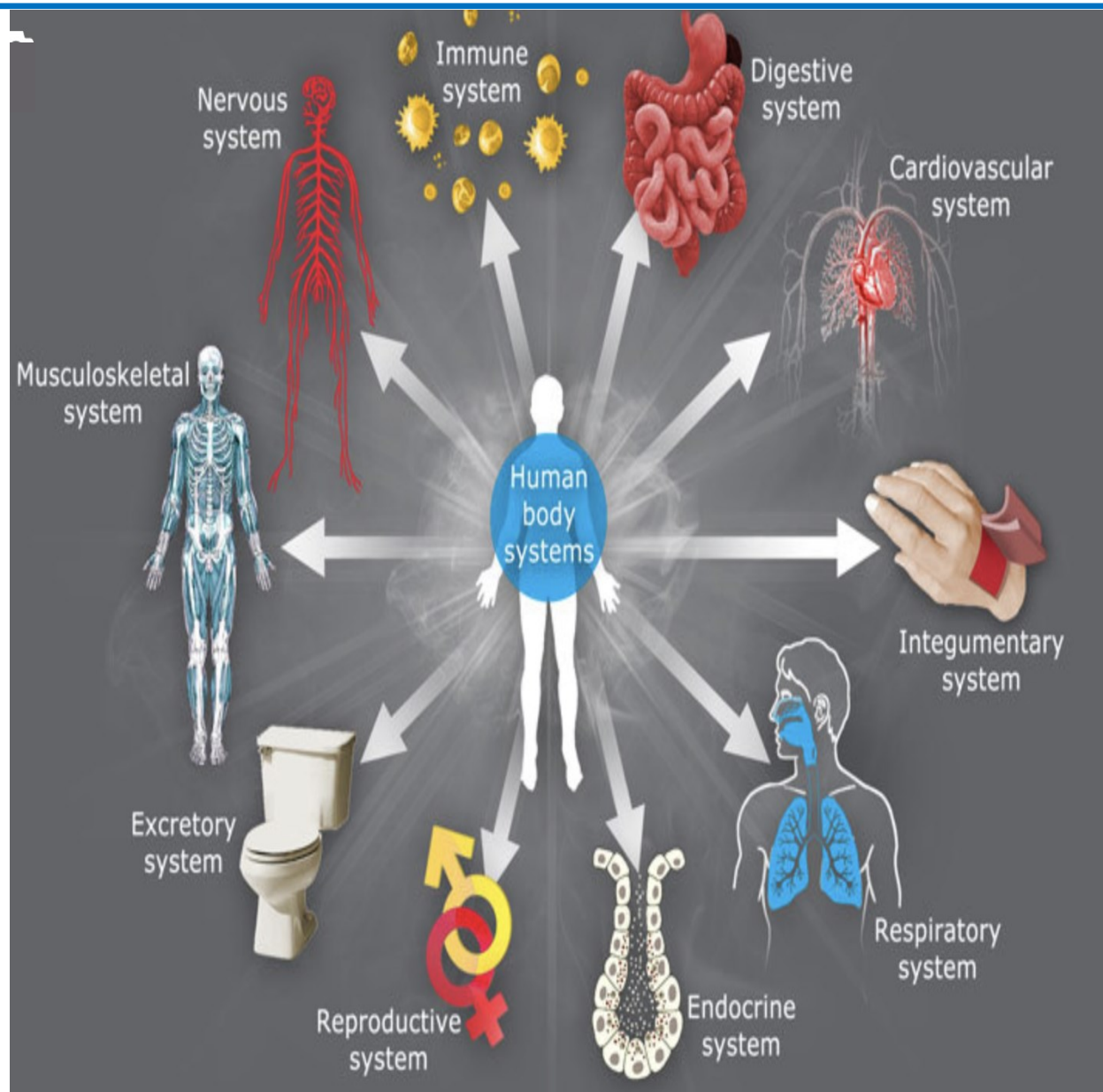


Pharmacology for Physiotherapists

KEY CLINICAL SKILLS

Systems approach

1. Introduction to pharmacology
2. Cardio-vascular & renal systems
3. CNS & ANS systems
4. Musculoskeletal system
5. Hematology system
6. GI & respiratory systems
7. Endocrine system
8. Immune system
9. Complimentary & recreational drugs
10. Reference & cheat sheets



Pharmacology for Physiotherapists

Cardiovascular system

Renal system

KEY CLINICAL SKILLS

Cardiovascular medications

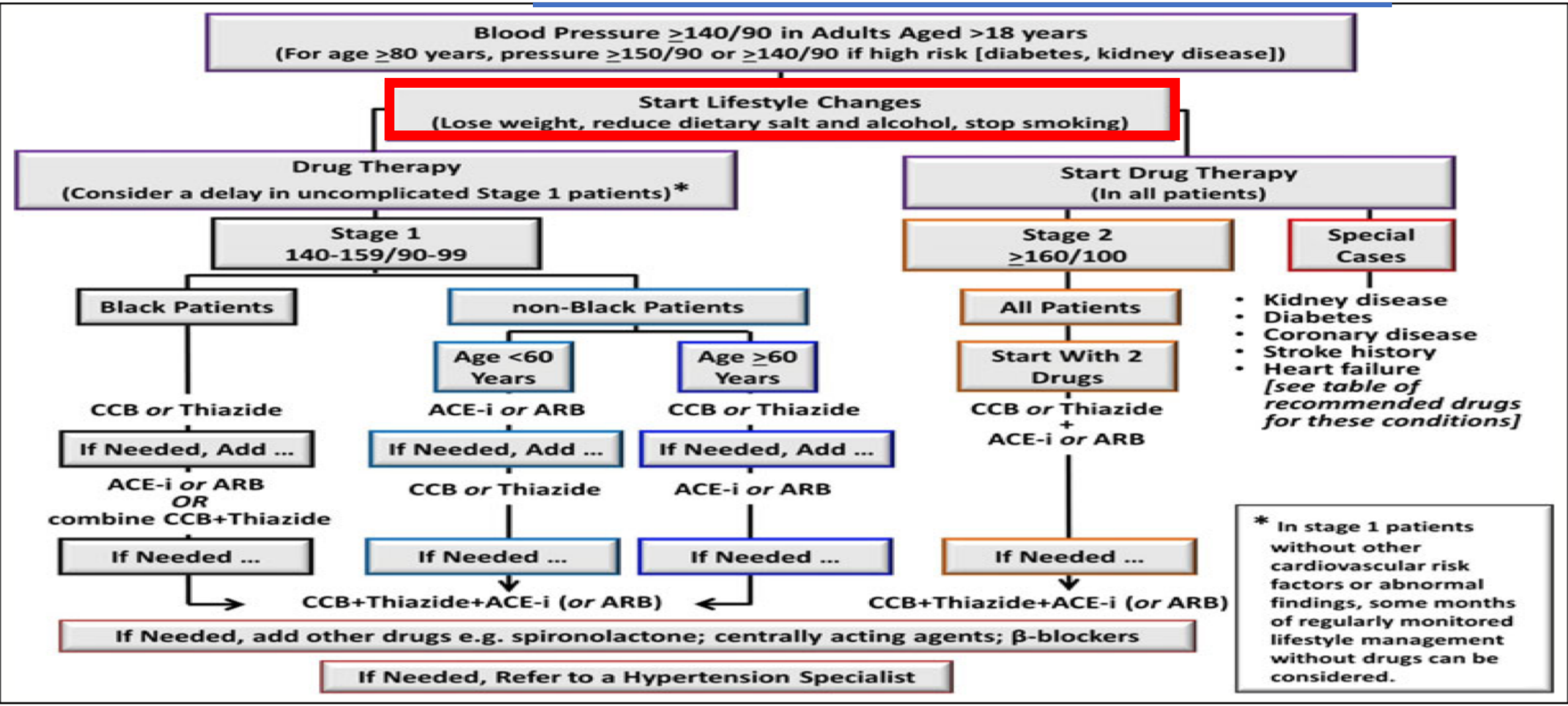
KEY CLINICAL SKILLS

Diseases

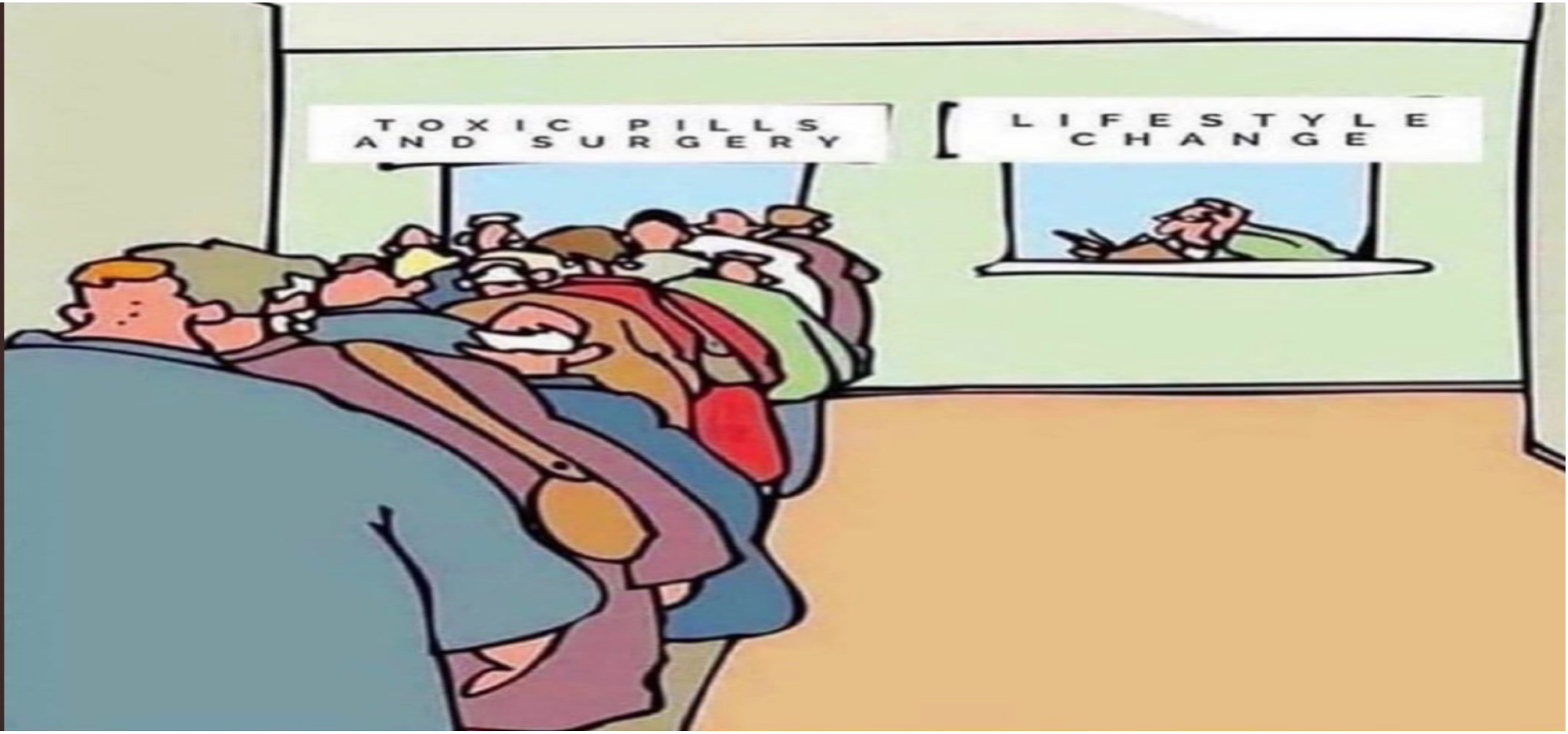
- Hypertension
- Angina pectoris
- Arrhythmias
- Heart failure
- Shock
- Cerebral ischemia
- Peripheral vascular disease
- Coagulation
- Hyper-lipidemia

Hypertension CP Guidelines

(Am Soc Hypertension 2014)



Reality



Hypertension

Survey of 1812 US Physiotherapists

- 75% reported > 25% of case load had hypertension
- 69% see a new patient with HT > once / week
- 30% see a new patient with HT daily
- 14.8% measured BP on first assessment

Serevin 2020

Diuretics

- Increase formation & excretion of urine
- Direct effect on BP by reducing blood volume
- Often first line meds in hypertension

Thiazide diuretics:

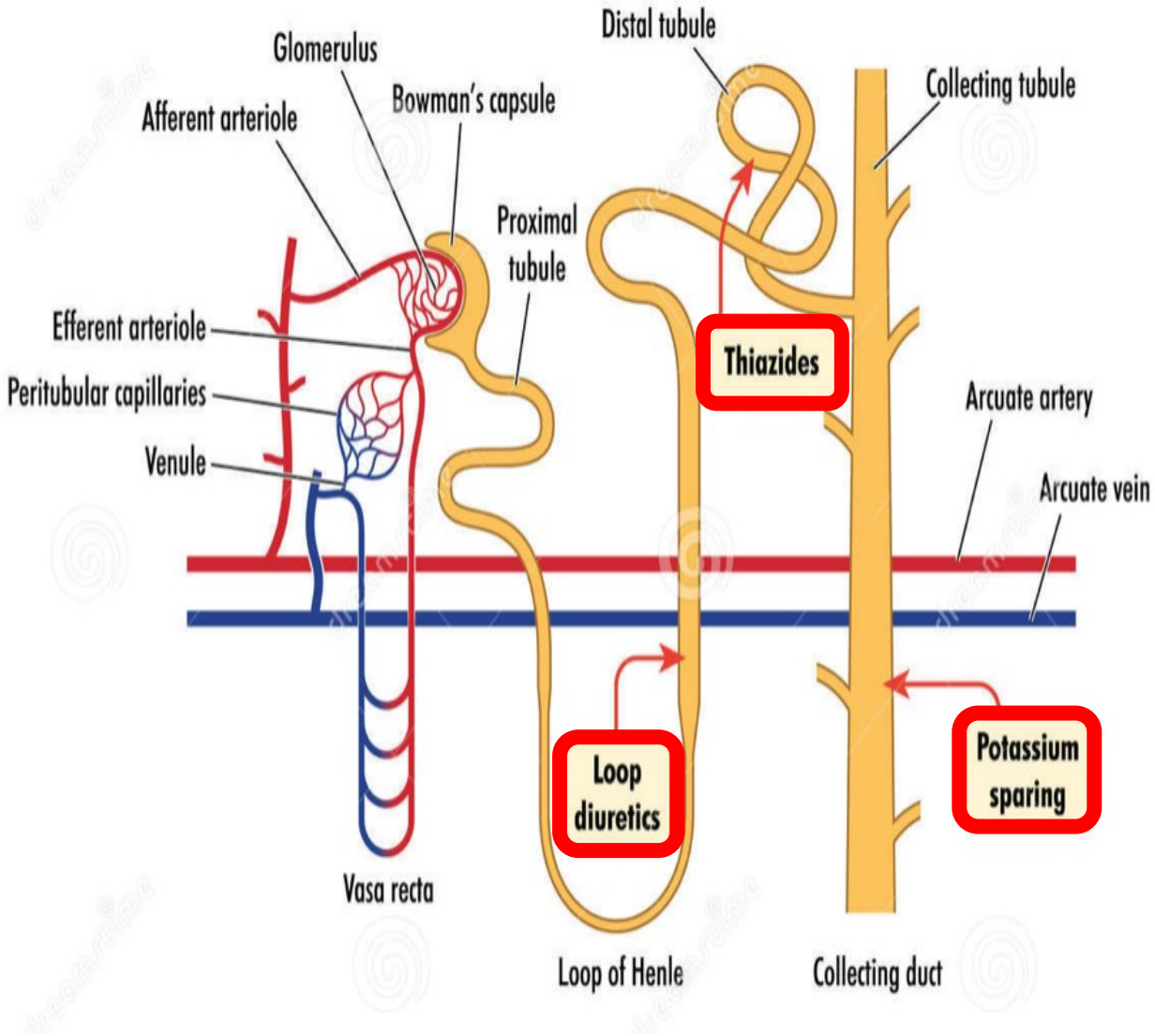
- Reducing edema & blood volume in patients with normal renal function

Loop diuretics:

- Used in CHF

Potassium sparing diuretics:

- Used in CHF with other diuretics



Adverse Effects Diuretics

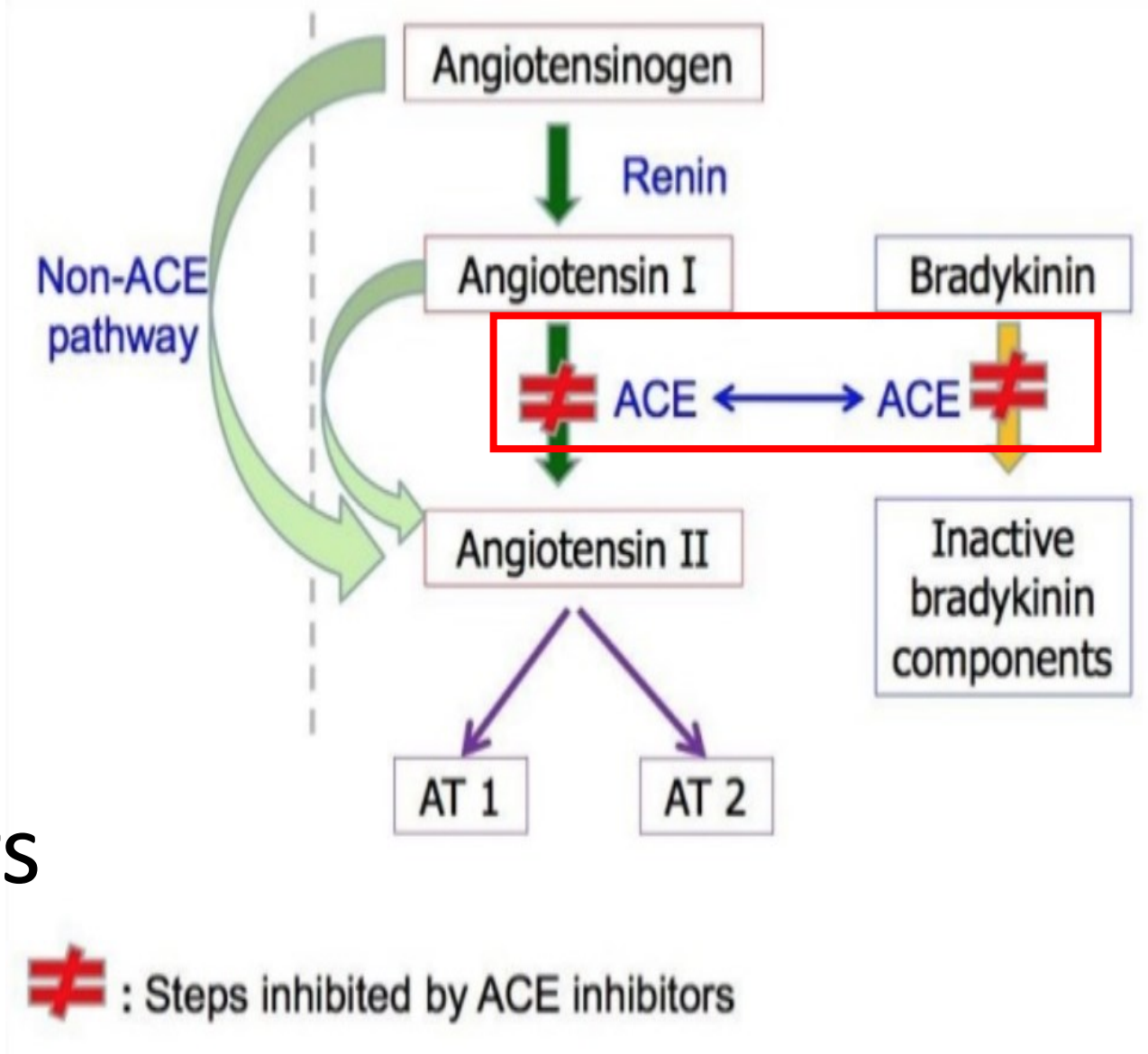
- Weakness
- Dizziness
- Fatigue
- Muscle cramps
- Headache
- Dehydration
- Arrhythmia
- Metabolic alkalosis
- Hypokalemia
- Hypo-magnesia
- Erectile dysfunction
- Hyperglycemia
- Pancreatitis
- Hyperlipidemia
- Hypokalemia
- Hyperuricemia
- Dose-related hearing loss
- Nervousness
- Rash
- Breast tenderness
- Erectile dysfunction
- Increased hair growth in females
- Decreased libido
- GI upset

Angiotensin Converting Enzyme (ACE)

Angiotensin II powerful vasoconstrictor

Medications

- (ACE) Inhibitors
- Angiotensin II receptor blockers
- Calcium channel blockers



(ACE) Inhibitors

Generic name	Trade name
Benazepril	Lotensin
Captopril	Capoten
Cilazapril	Inhibace
Enalapril	Vasotec
Fosinopril	Monopril
Lisinopril	Prinivil, Zestril
Quinipril	Accupril
Ramipril	Altace

Adverse effects:

- **Cough**
- Acute renal failure
- Proteinuria
- Taste alteration
- Edema
- Rash
- Hypernatremia
- Contraindicated in pregnancy

Adrenergic receptors

KEY CLINICAL SKILLS

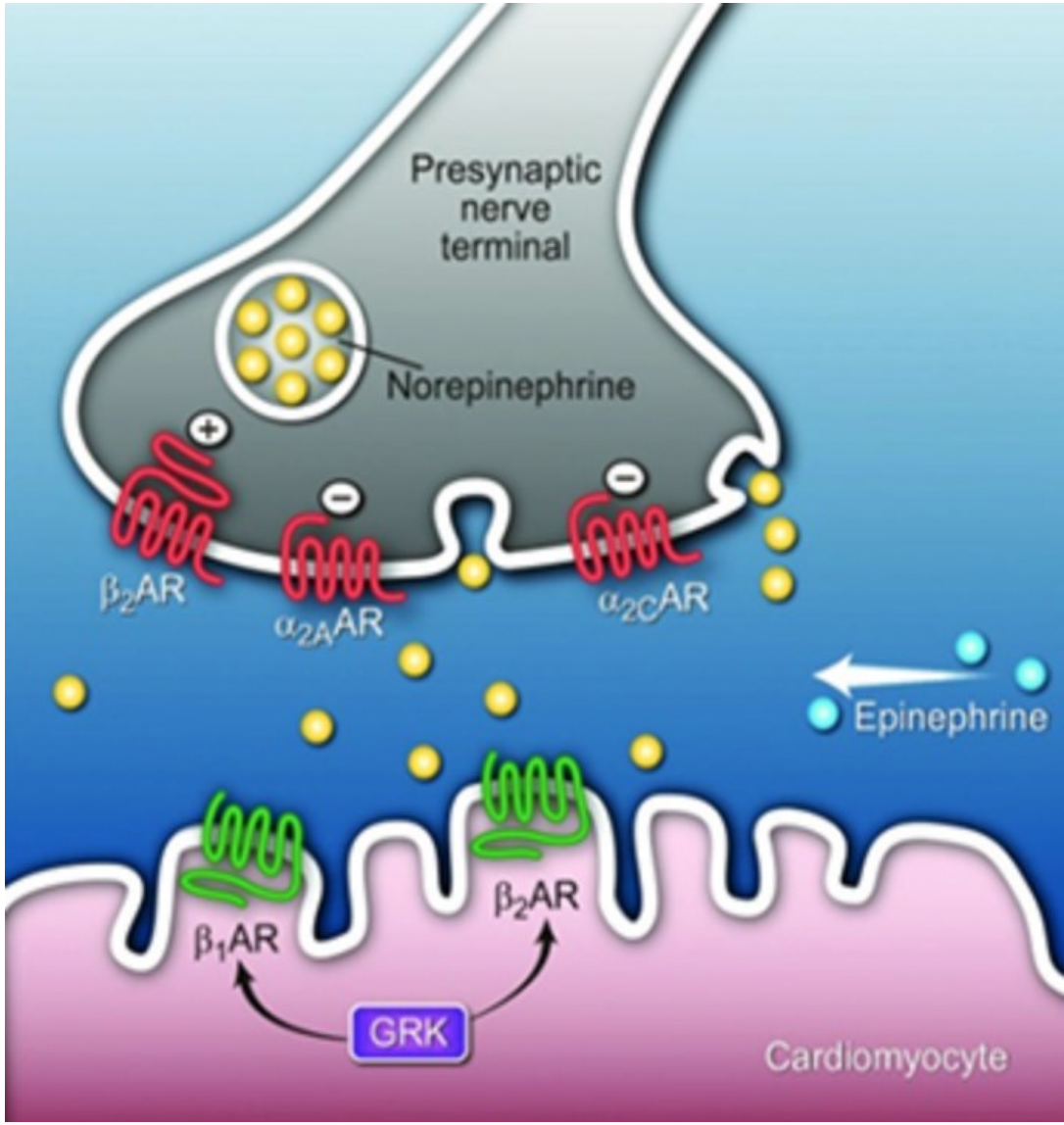
Adrenergic Receptor	Location	Action
Alpha 1	Smooth muscles of arteries & veins	Increase cardiac contraction
Alpha - 2	Sympathetic nerve varicosities	Inhibition of norepinephrine release
	CNS	Inhibition of sympathetic output
Beta - 1	Sino-arterial node	Increased HR
	Atrial & ventricular muscle	Increased conduction velocity & contractibility
	Atrio-ventricular node & Purkinje fibers	Increased conduction velocity
Beta - 2	Smooth muscle of arteries & veins	Relaxation

Beta blockers

Reduce:

- Cardiac output
  - Cardiac rate
  - Force of contraction
- Sympathetic tone
- Myocardial O_2 demand

Generic name	Trade name
Atenolol	Noten
Bisoprolol	Bicor
Carvedilol	Dialtrend, Dilasig
Labetalol	Presolol, Trandate
Metoprolol	Betaloc, Minax, Toprol
Nebivolol	Nebilet
Oxprenolol	Corbeton
Pidolol	Barbloc
Propanolol	Deralin, Inderal



Beta blockers

KEY CLINICAL SKILLS

Indications:

- Angina pectoris
- Atrial fibrillation
- Congestive heart failure
- Essential tremor
- Hypertension
- Migraine prophylaxis
- Mitral valve prolapse

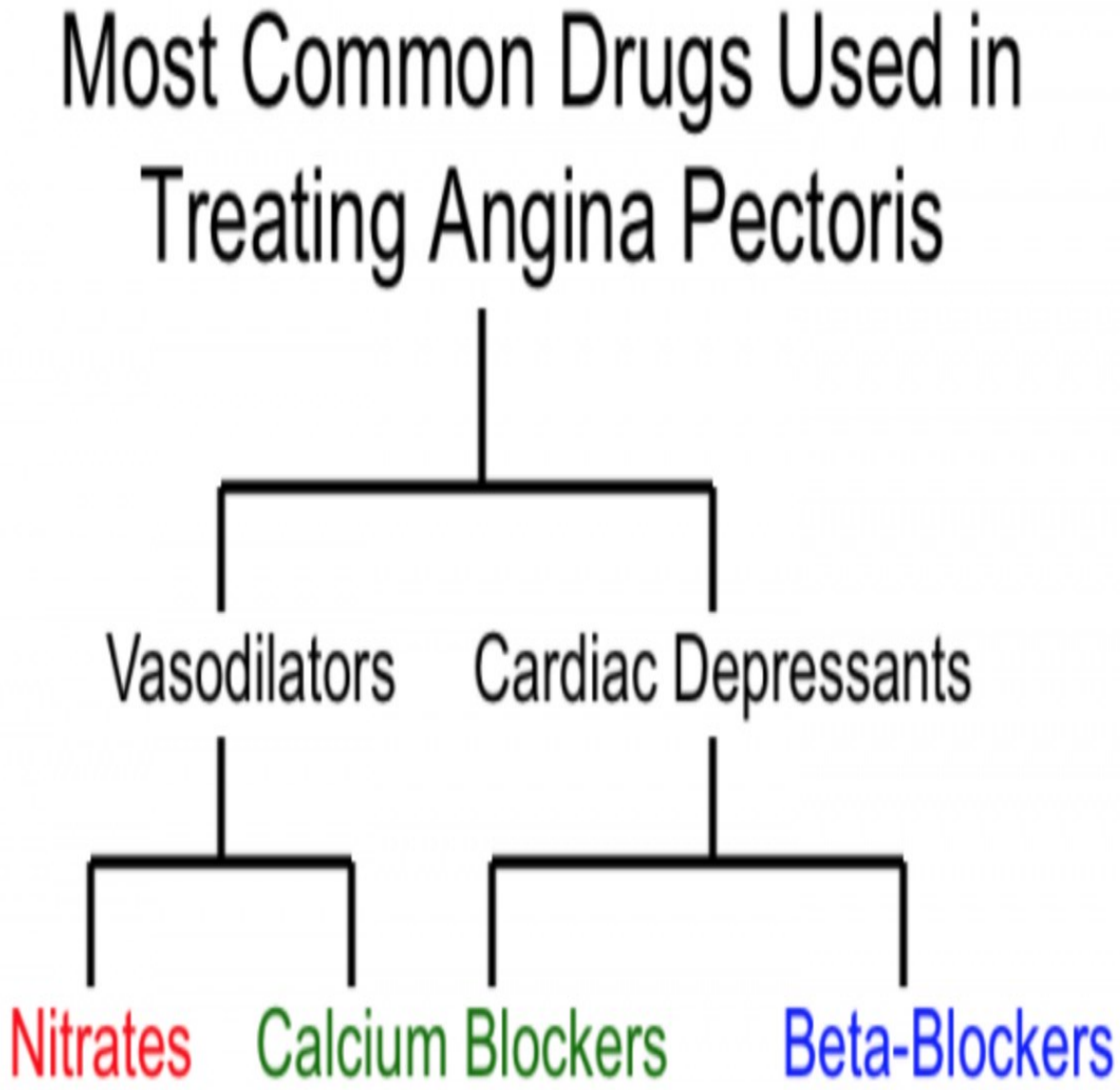
Adverse effects:

- Hypotension
- Lethargy
- Depression
- Bradycardia
- GI upset
- Congestive heart failure

Angina pectoris

3 Sub-types:

1. Stable
   - Predictable
   - With exertion/stress
2. Unstable
   - Unpredictable
   - Severe pain longer lasting
3. Variant
   - Occurs at night or rest



Organic nitrates

Produce general & cardiac vasodilation

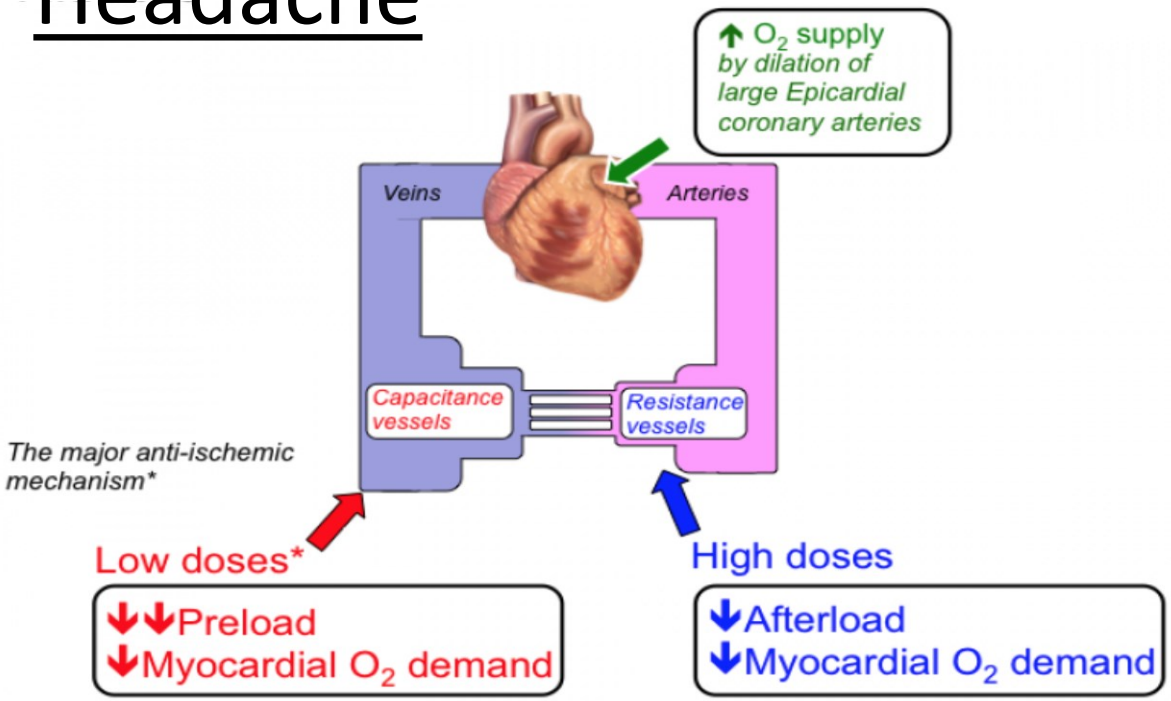
- Nitroglycerin
- Isosorbide dinitrate
- Isosorbide mononitrate

Decrease:

- Amount of blood returning to heart (cardiac pre-load)
- Pressure to pump blood out (vascular resistance)

Adverse effects:

- Nausea
- Dizziness
- Headache
- Orthostatic hypotension



Cardiac Arrhythmia

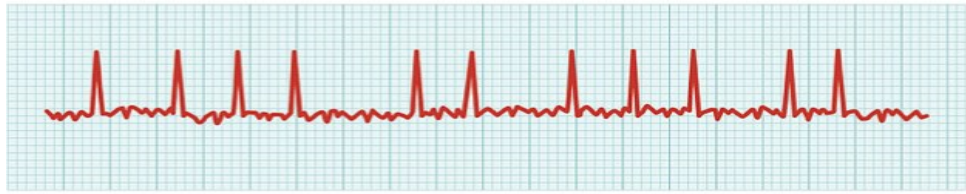
An abnormality of the rate, rhythm, conduction or site of origin of the cardiac impulse

- Result in impaired cardiac pumping ability
- Classified by location of origination in the heart

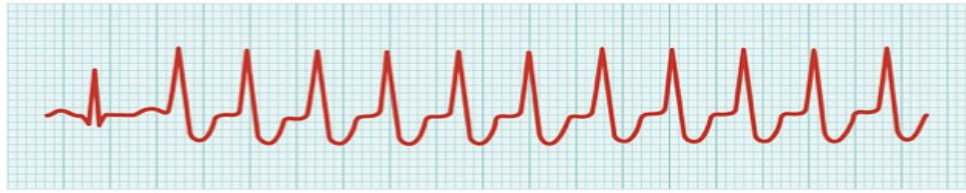
Associated with:

- CVAs
- Cardiac failure
- 80% of cardiac deaths

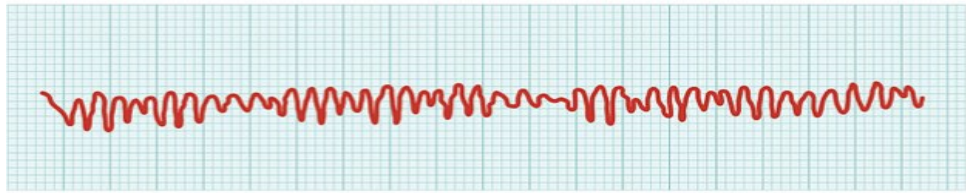
Second-degree (partial) block



Atrial fibrillation



Ventricular tachycardia



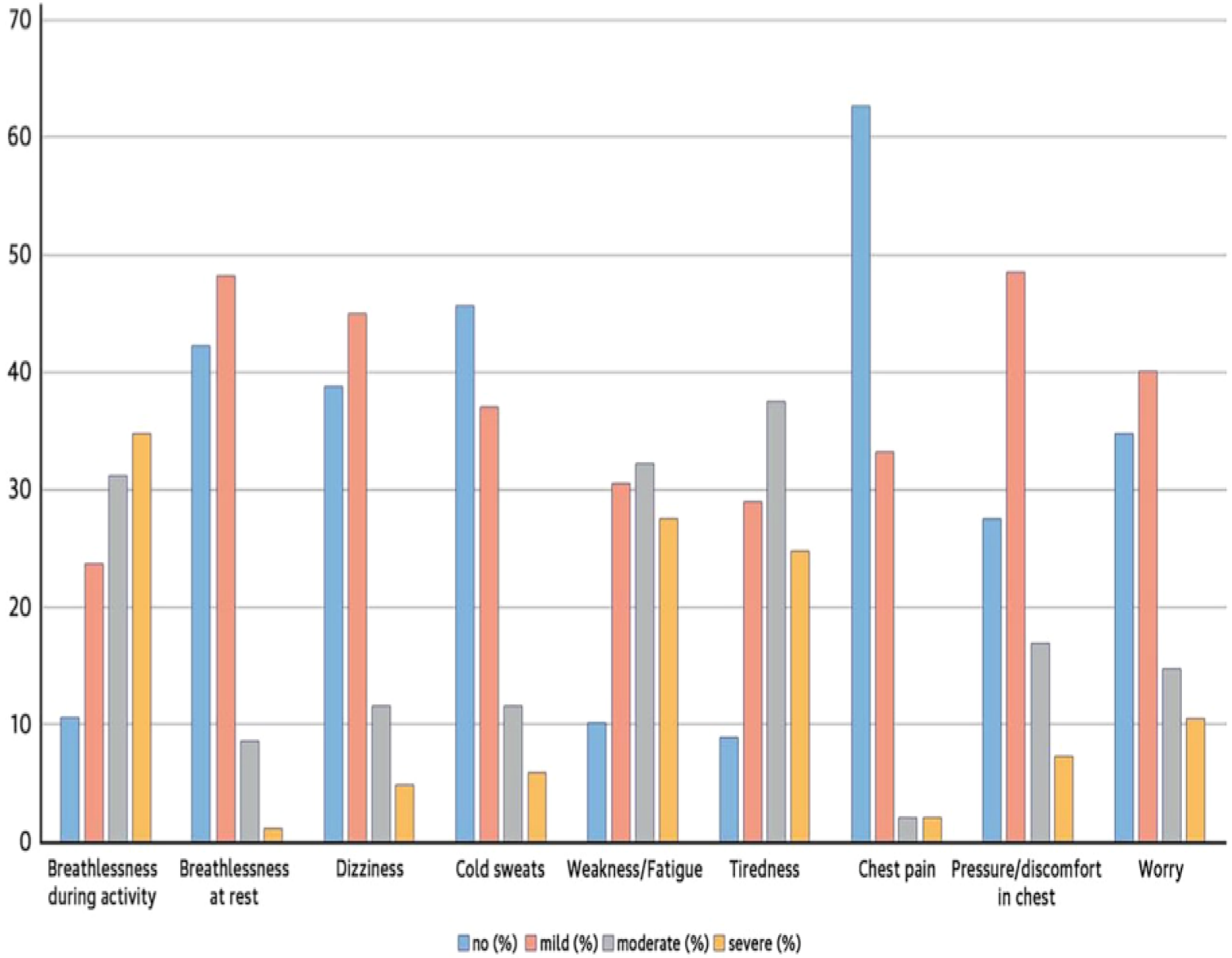
Ventricular fibrillation

Cardiac Arrhythmia

KEY CLINICAL SKILLS

Symptoms of Arrhythmia

- Fatigue
- Dizziness
- Lightheadedness
- Shortness of breath
- Syncope
- Palpitations
- Angina

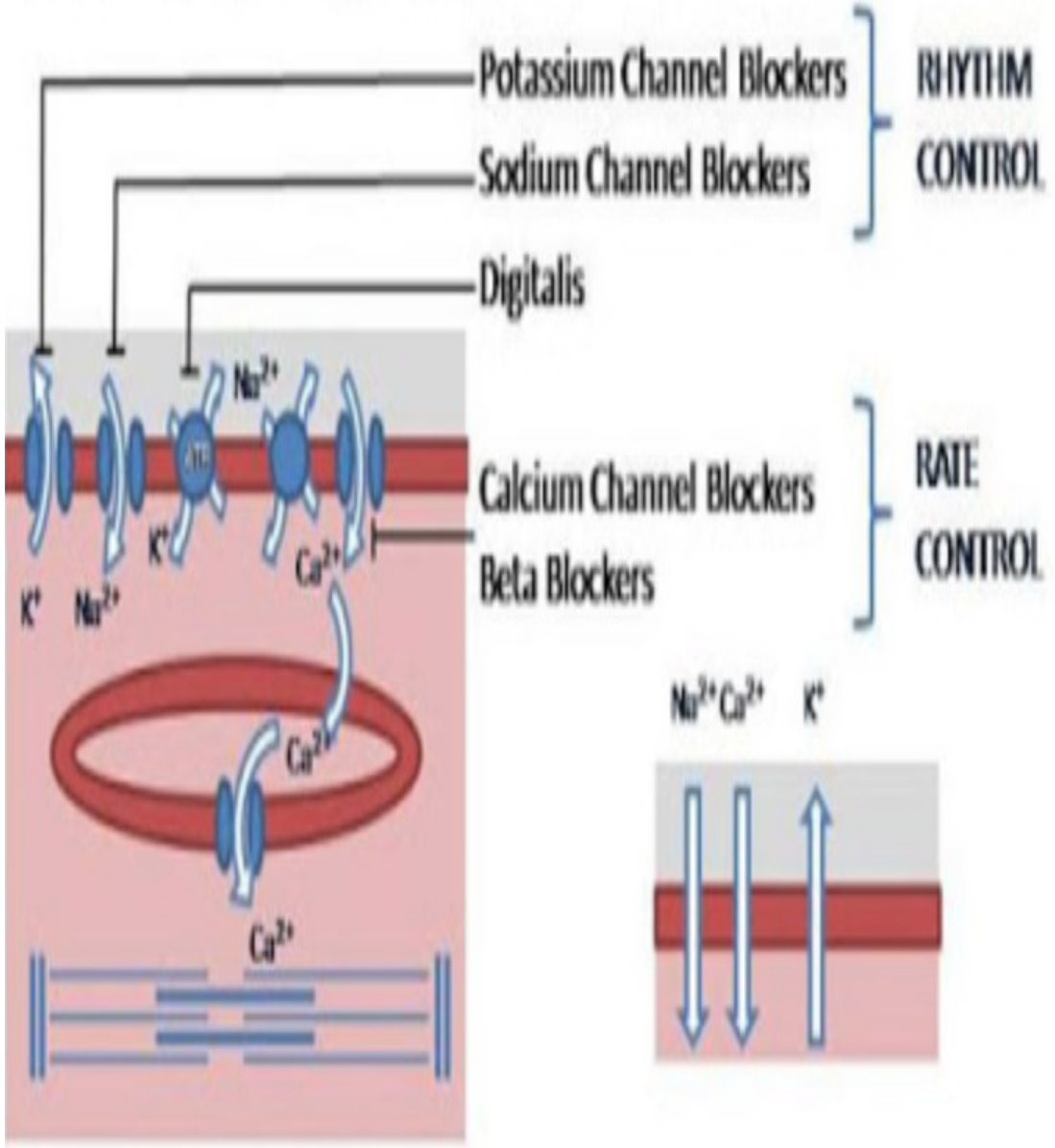


Charitakis 2017

Antiarrhythmic medications

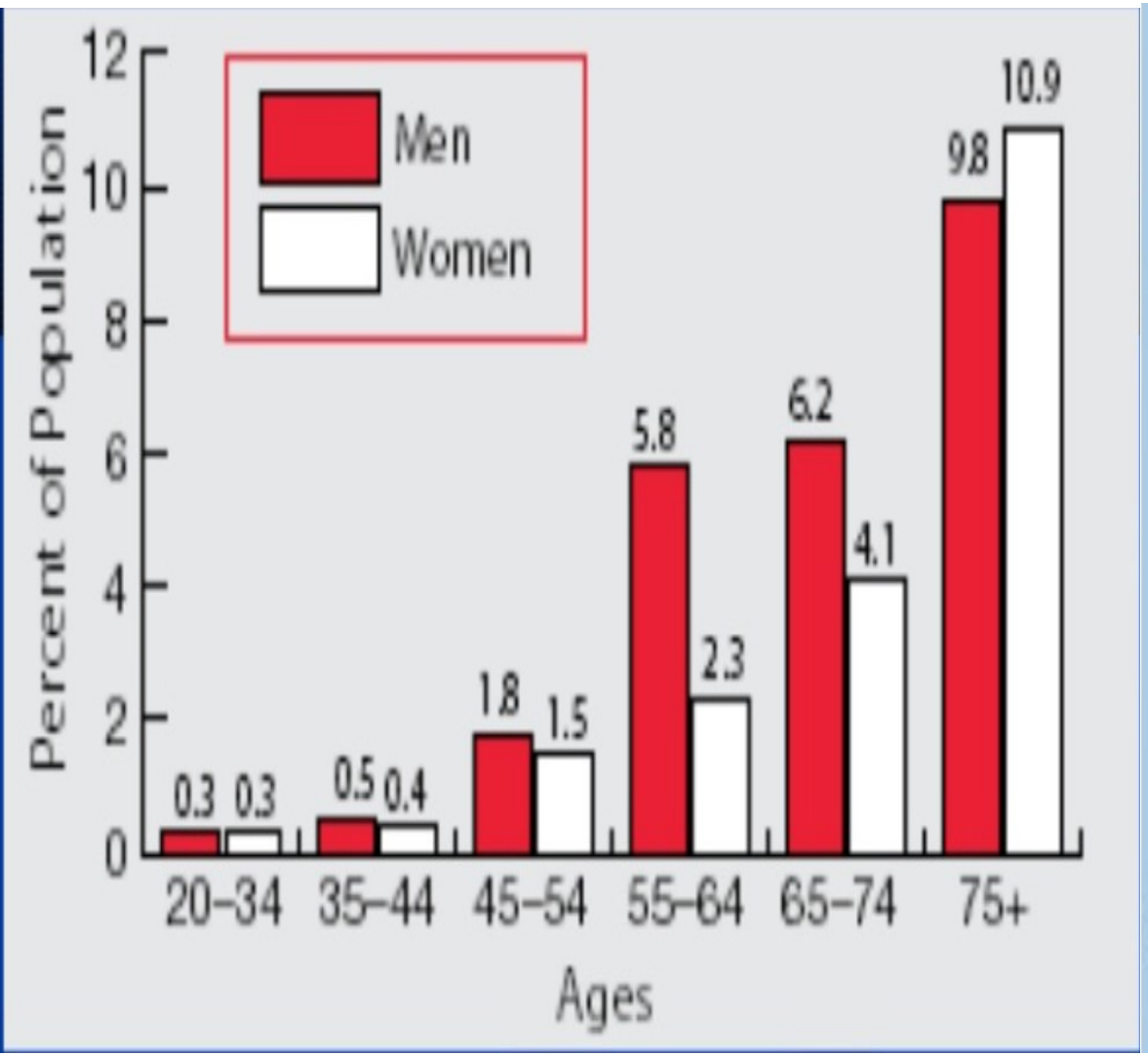
Adverse effects:

- Dizziness
- Peripheral vasodilation
- Broncho restriction
- Headaches
- Bradycardia
- Tendency to increase rhythm disturbances
  - (helps one kind but aggravates other rhythm disturbances)

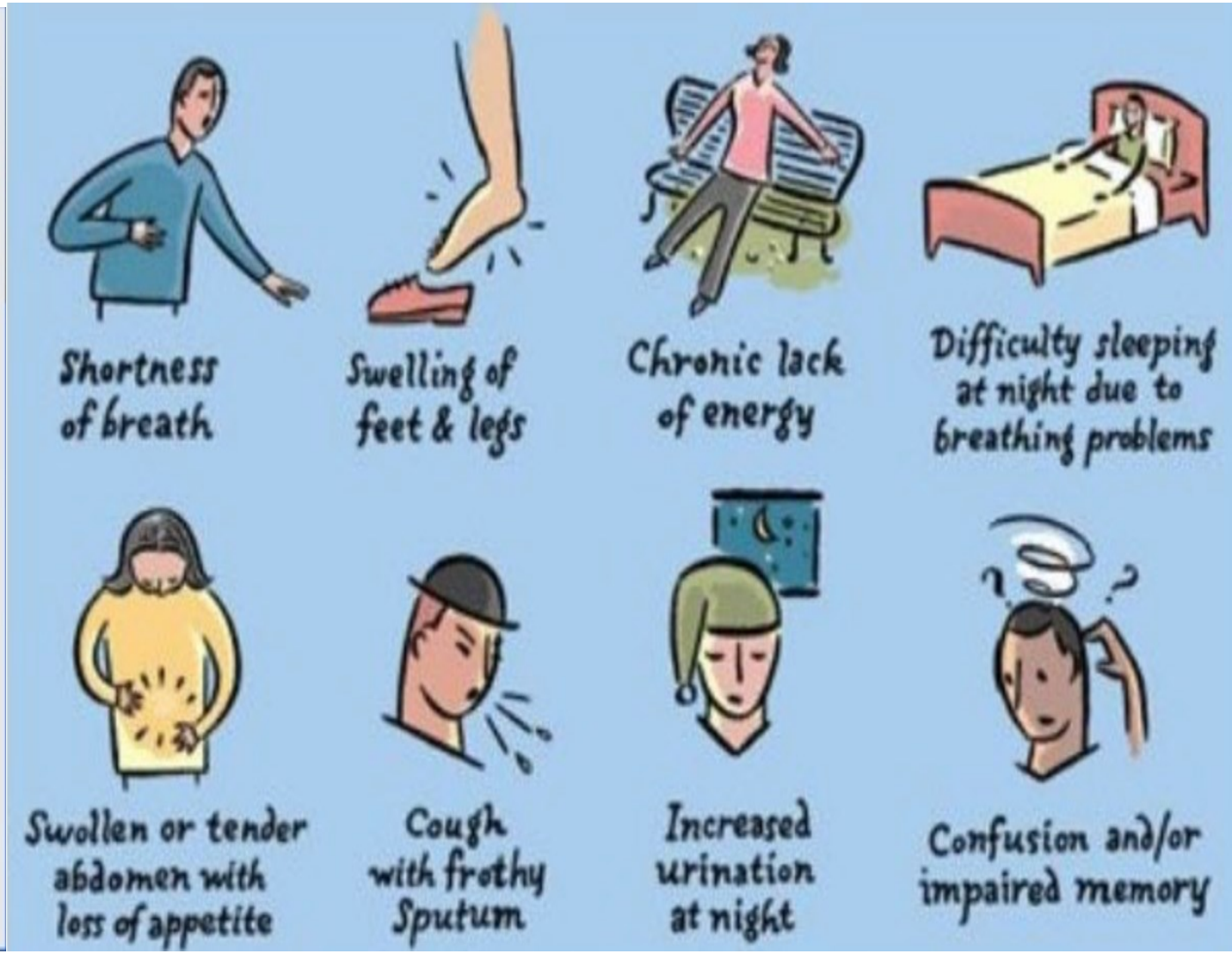


Congestive heart failure

Prevalence USA



Signs & Symptoms



Congestive heart failure drugs

Agents that increase myocardial contraction force

- Digitalis

Agents that decrease cardiac workload

- ACE inhibitors
- Angiotensin II receptor blockers
- Beta adrenergic blockers
- Diuretics
- Vasodilators

Signs & symptoms of digitalis toxicity

Cardiac

- Sinus bradycardia
- Ventricular arrhythmias
- Atrio-ventricular block
- Atrial arrhythmias

Non-Cardiac

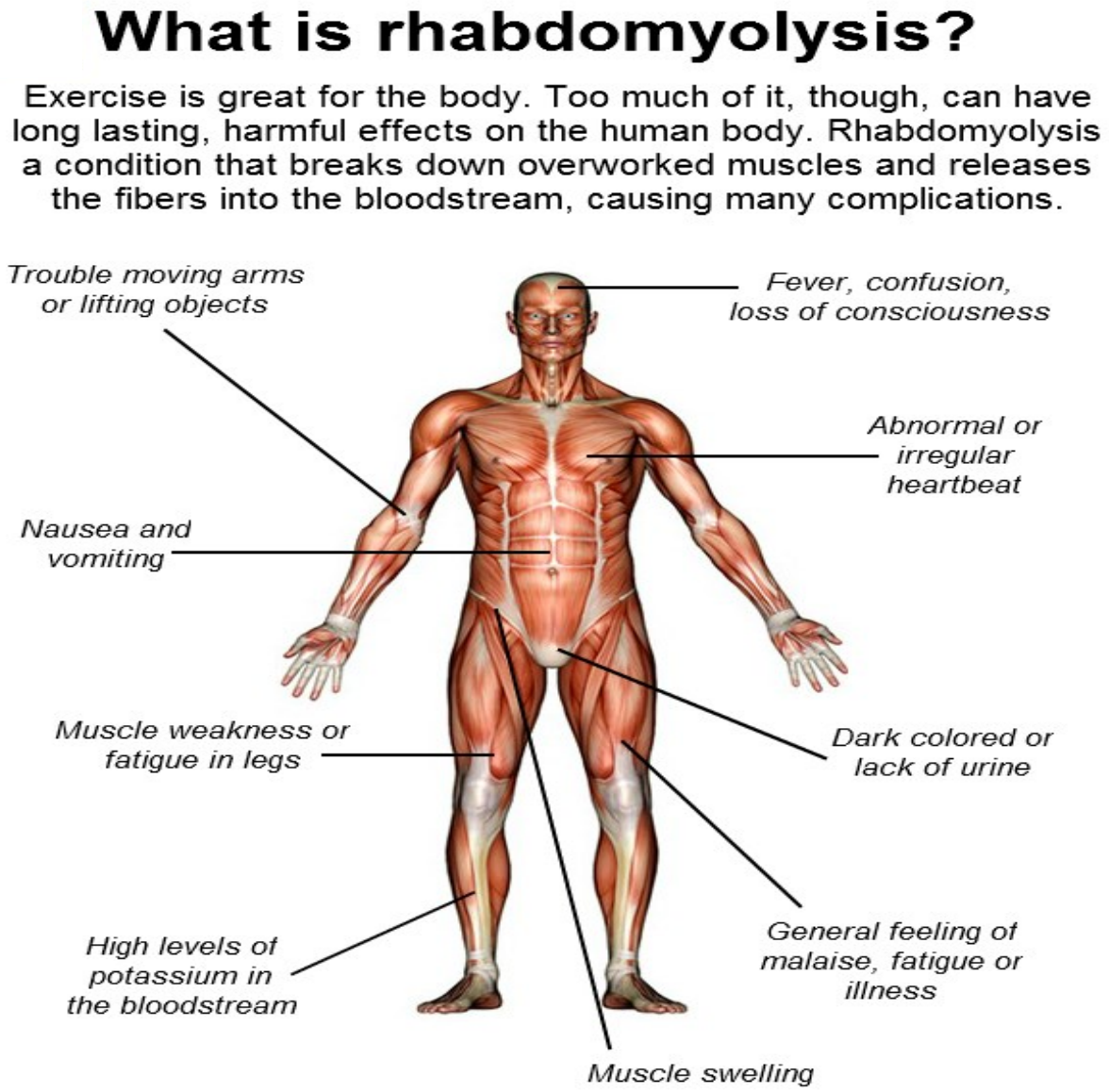
- Visual disturbances
- Fatigue
- Weakness
- Confusion
- Psychosis
- Anorexia
- GI upset

Hyperlipidemia

Over 22% of North Americans over the age of 45+ are taking cholesterol lowering statin drugs.

Side effects include:

- Muscle pain and damage
- Neurological side effects
- Liver/kidney damage
- Digestive problems
- Rash or flushing
- Increased blood sugar or type 2 diabetes
- Sexual dysfunction



Clotting disorders

Antiplatelets

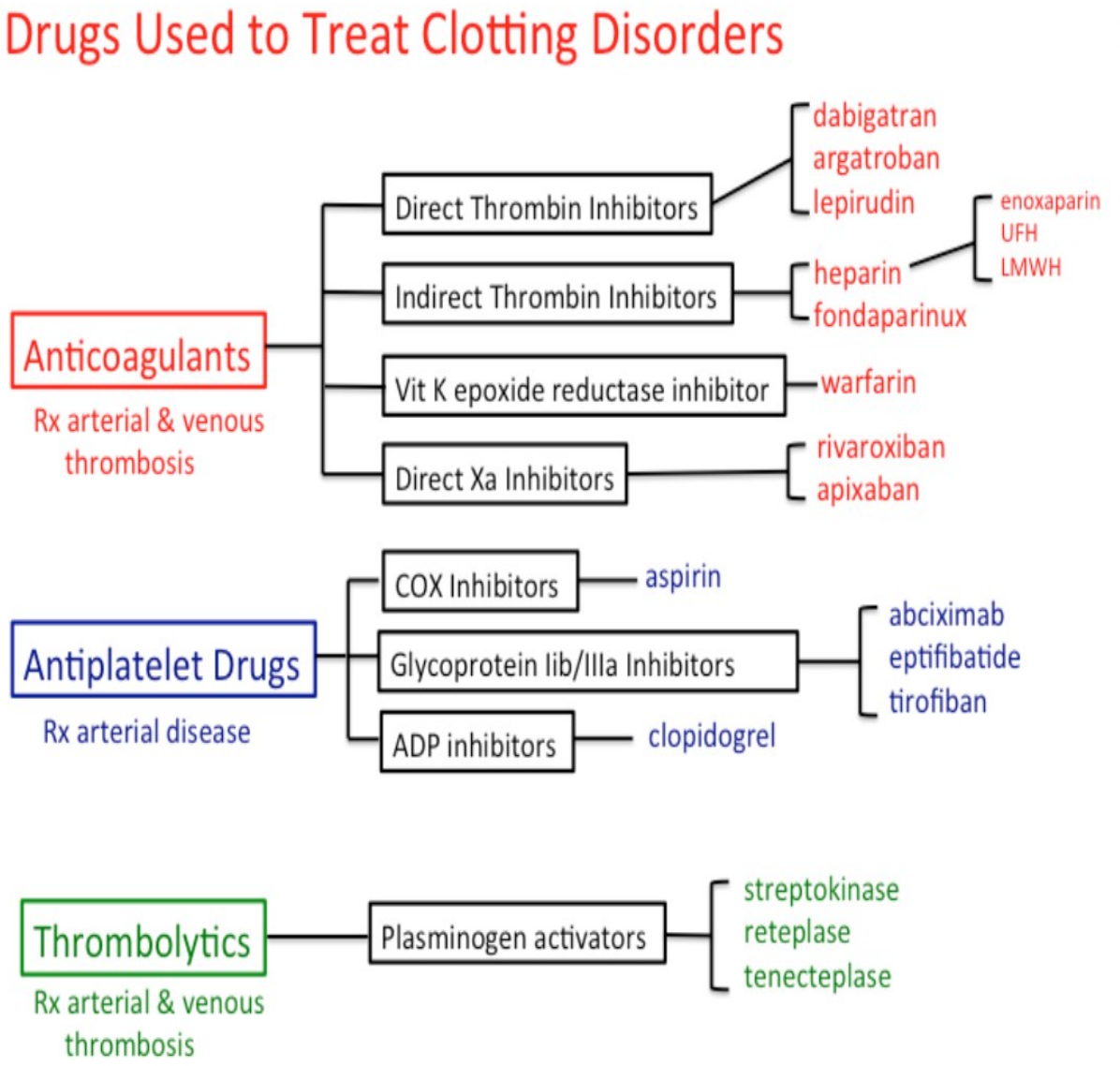
- Inhibit platelet aggregation & platelet-inducing clotting
- Used primarily to prevent arterial thrombus formation

Anticoagulants

- Inhibit synthesis & function of clotting factors
- Used primarily to prevent and treat venous thromboembolism

Thombolytics

- Facilitate clot dissolution
- Used to reopen occluded vessels in arterial & venous thrombosis



Clotting disorders

Anti-coagulant medications		
Class	**Generic name**	**Trade name**
Anti-platelets	ASA	Aspirin
	Clodogrel	Plavix
	Ticlopidine	Ticlid
	Abciximab	ReoPro
	Eptifibatide	Integrilin
	Tirofiban	Aggrastat
	Dipyridamole	Persantine
	Anistreplase	Eminase
	Streptokinase	Streptase
	Urokinase	Abbokinase

Ciccone 2007

Adverse Effects:

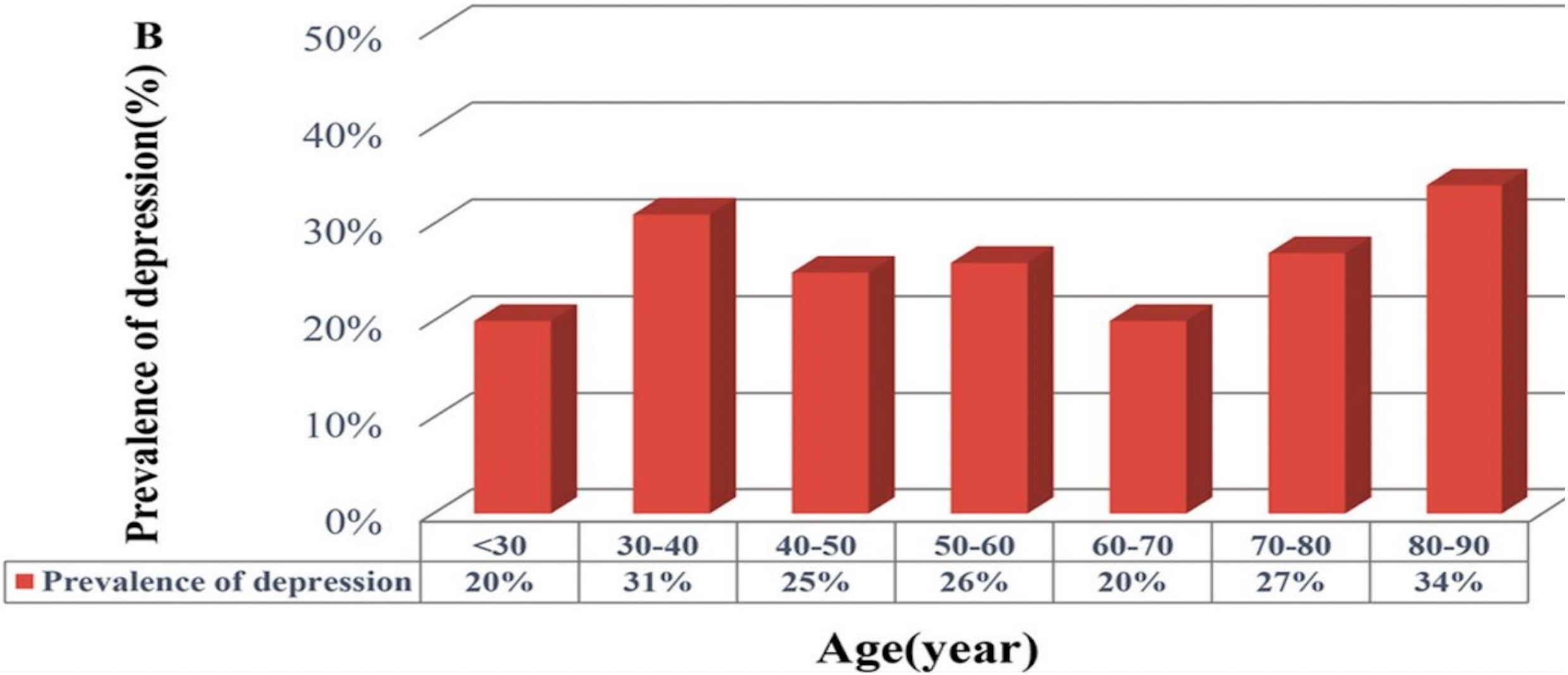
- Dizziness
- Nausea
- Bleeding
- Headache
- GI upset
- GERD
- Vomiting
- Gastric ulceration
- Skin rashes
- Neutropenia
- Thrombo-cytopenia
- Palpitations

Pharmacology for Physiotherapists

Central & Autonomic Nervous Systems

KEY CLINICAL SKILLS

Depression



Wang 2017

Depression Screening

KEY CLINICAL SKILLS

Two Questions to ask:

1. Over the past 2 weeks have you ever felt down, depressed or hopeless?
2. Over the past 2 weeks, have you felt little pleasure or interest in doing things?

Sensitivity 96%

Specificity 57%

Pignone 2002

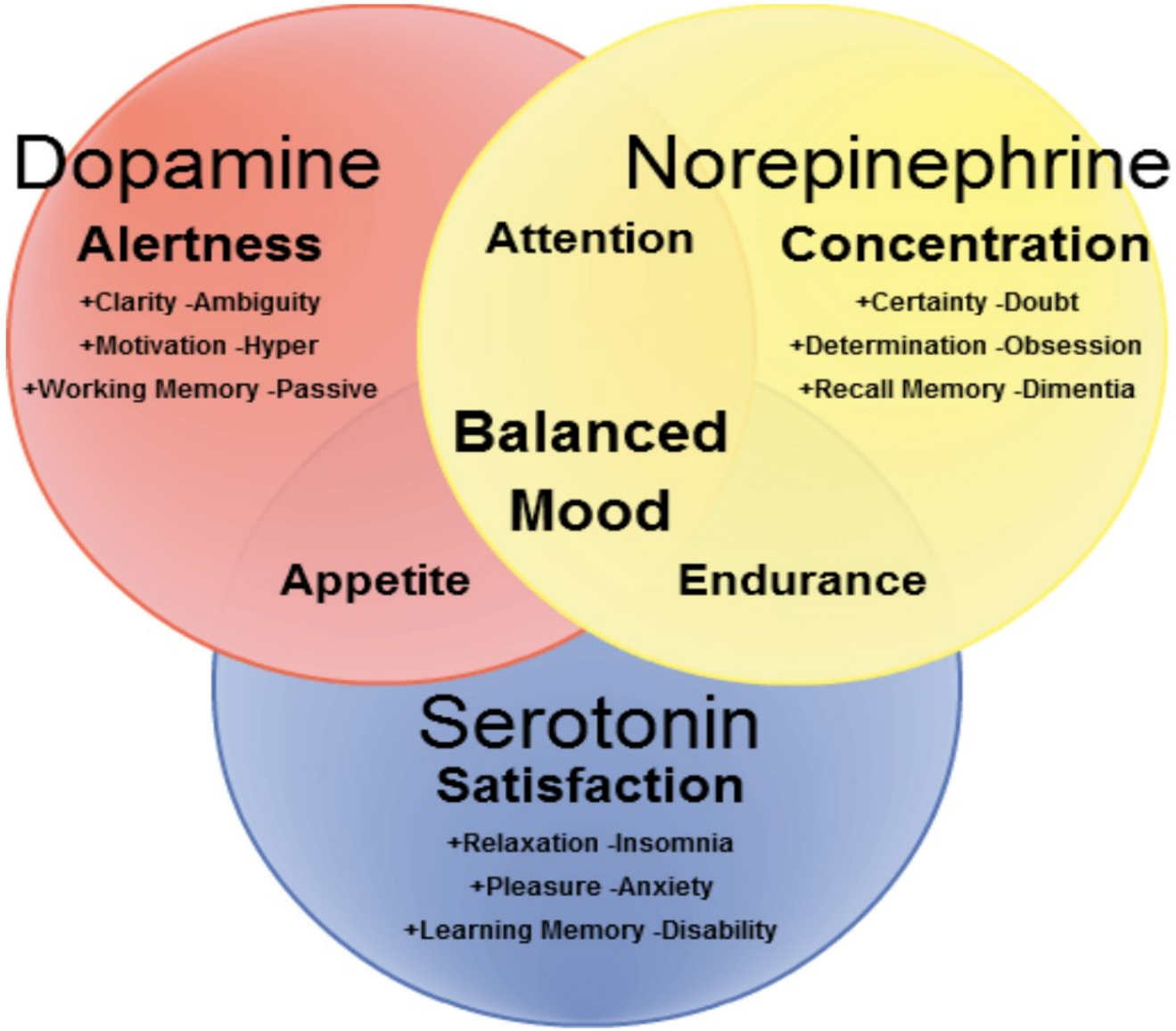
Other questions:

- How are things at work?
- How are things at home?
- We all have stress in our lies.
- Has your stress level increased lately?
- How are you handling it?

Depression

Currently considered to be related to disturbance in CNS neurotransmitters:

- Serotonin
- Norepinephrine
- Dopamine



Presenting complaints

- Apathy
- Malaise
- Vague abdominal pains
- “Stressed out”
- Sleep problems
- Sexual dysfunction
- Lack of libido
- GI complaints (constipation, diarrhea)

DSM IV 2000

- Chronic pain
- Joint pains
- Headaches
- Fatigue

Antidepressants

KEY CLINICAL SKILLS

Tricyclics

- Work by blocking re-uptake of amine neurotransmitters

MOA inhibitors

- Reduce enzyme that removes amine neurotransmitters

Adverse responses

- Sedation
- Seizures
- Confusion
- Orthostatic hypotension
- Tremors
- Cardiac arrhythmias
- Constipation
- Anticholinergic effects
- Weight gain
- Loss of libido
- Urinary retention

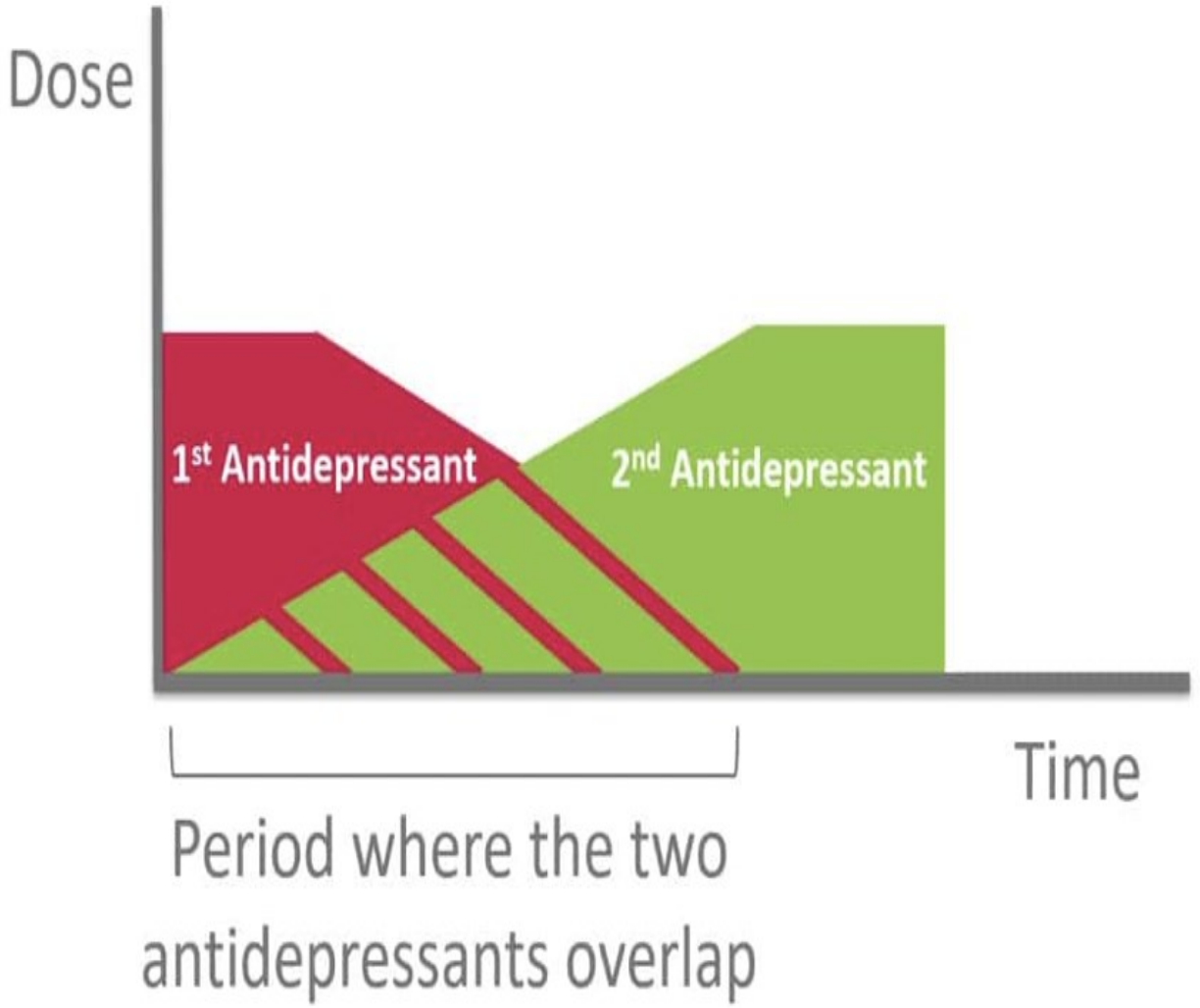
Antidepressants “Second generation”

Work by blocking reuptake of monoamines

Much fewer adverse effects than tricyclics & MOA inhibitors

Adverse effects:

- Seizures
- Insomnia
- Agitation
- Anxiety
- Tremors



Pharmacology for Physiotherapists

Musculoskeletal system

KEY CLINICAL SKILLS

Oral analgesics

Salycylates

- ASA
- Aspirin
- Bufferin
- Excedrin

Acetaminophen

- Paracetemol
- Tylenol

NSAIDs

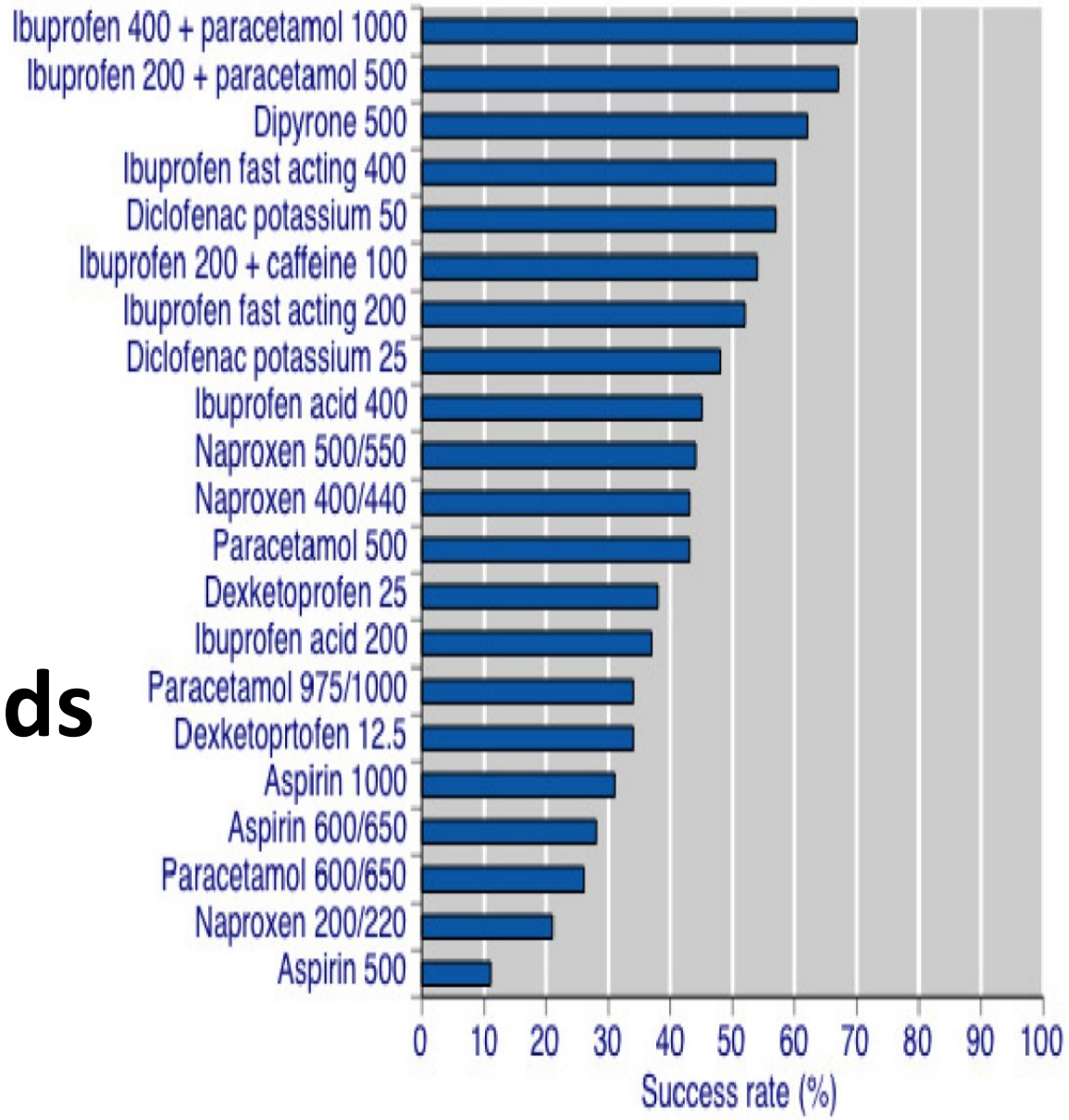
Ibuprophen

Naproxen

Gabapentanoids

Neurontin

Lyrica

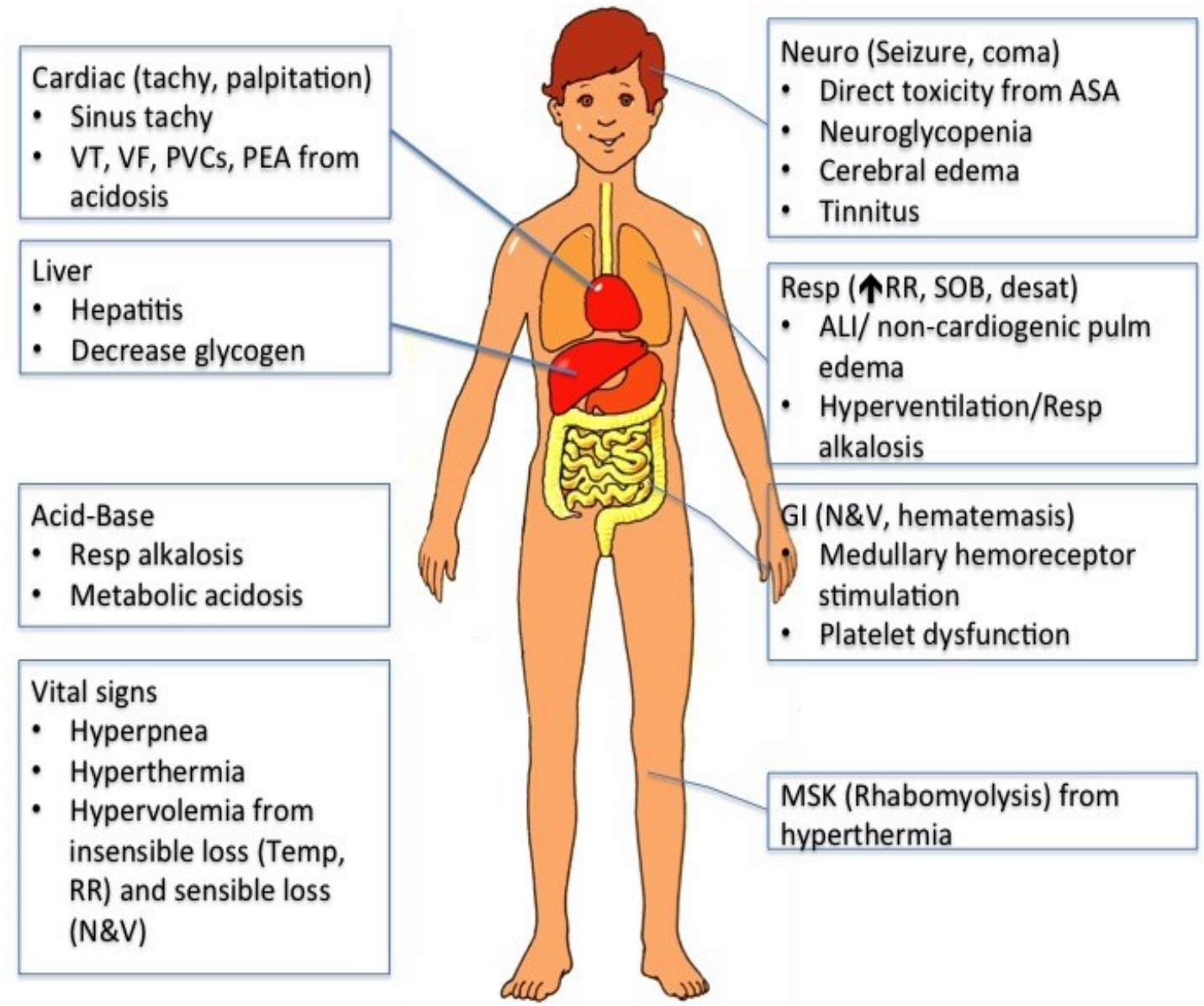


Salicilate overdose

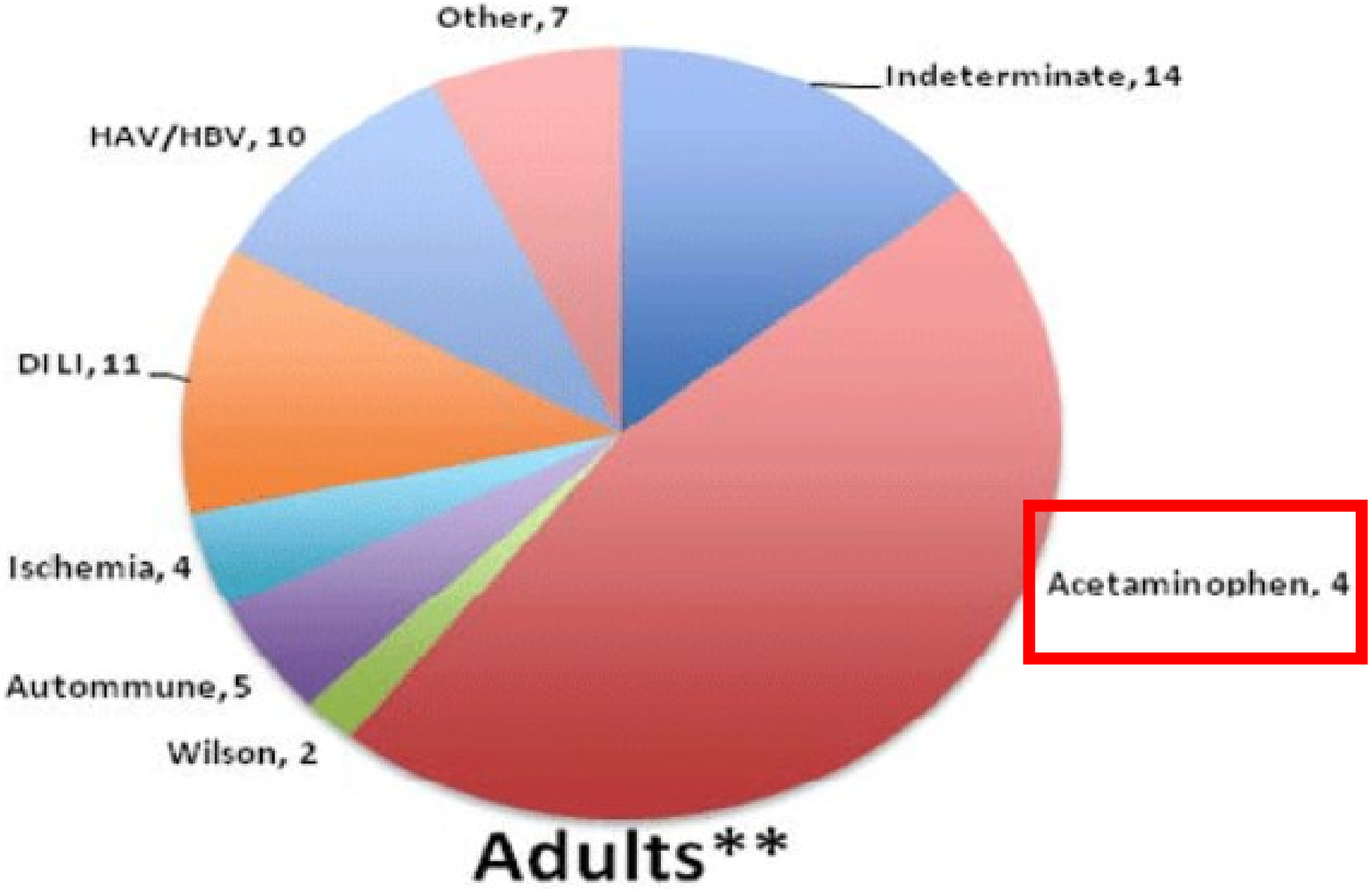
KEY CLINICAL SKILLS

Symptoms

- Restlessness
- Irritability
- Excessive & unorganized talking
- Fear & nervousness
- Deafness
- Confusion
- Excited mood
- Hallucinations
- Drowsiness
- Diplopllia
- Seizures
- Burning in throat
- Vomiting
- Decreased urination



Tylenol hepatotoxicity



Gabapentinoids

Gabapentin (Neurontin)

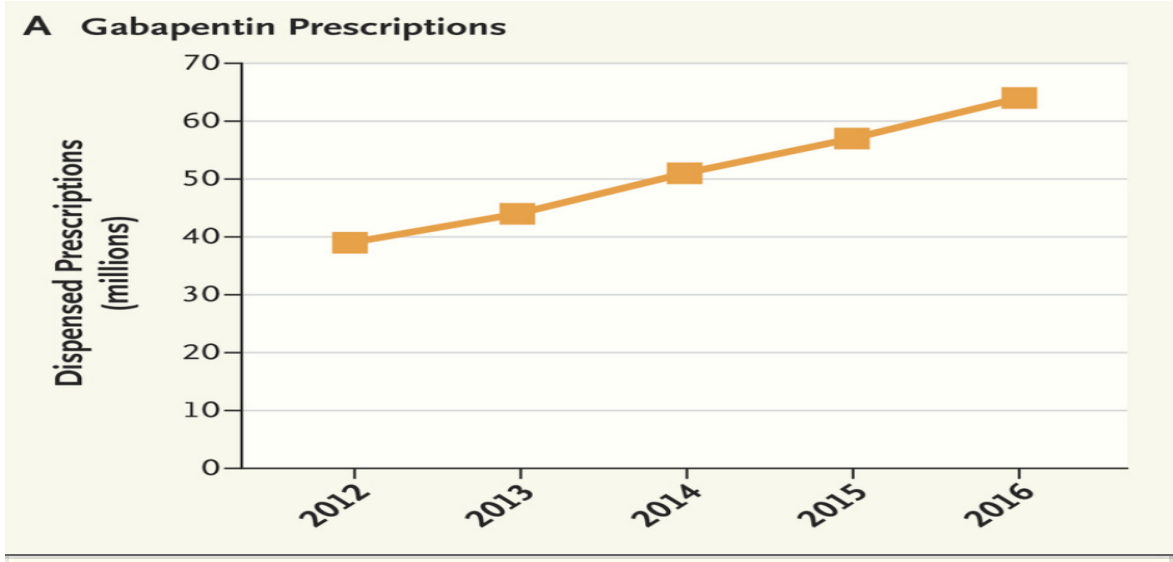
Pregabalin (Lyrica)

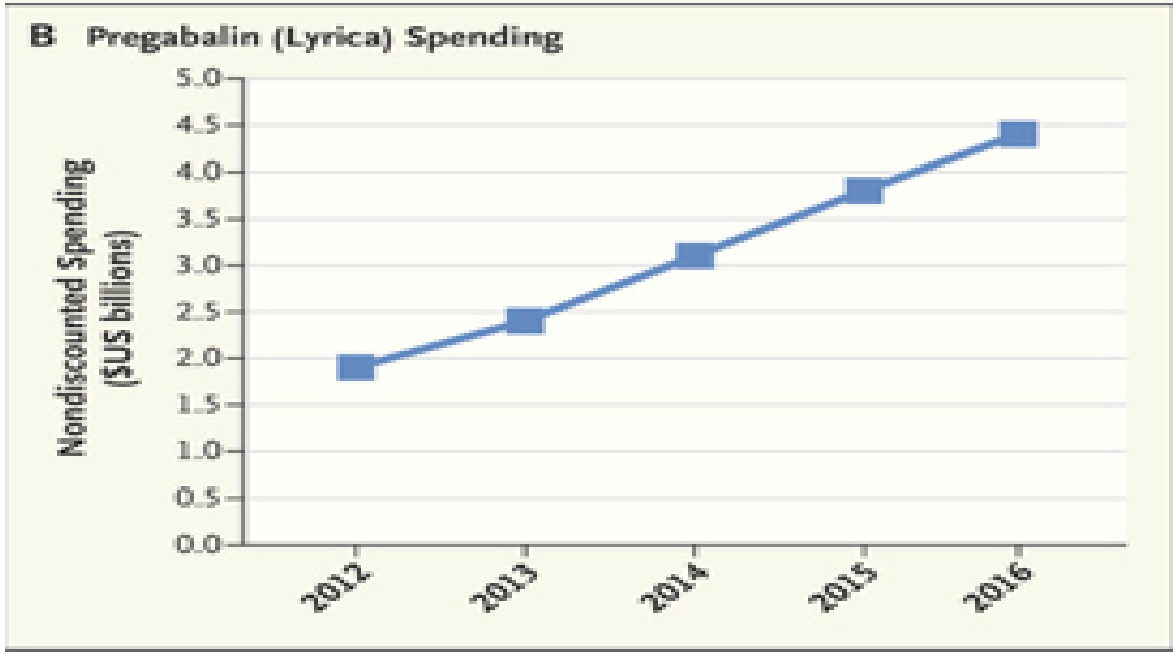
- Anticonvulsant
- Analgesic

Used in treatment of:

- Neuropathic pain
- Fibromyalgia
- Restless leg syndrome

Among top 15 drugs globally in terms of revenue



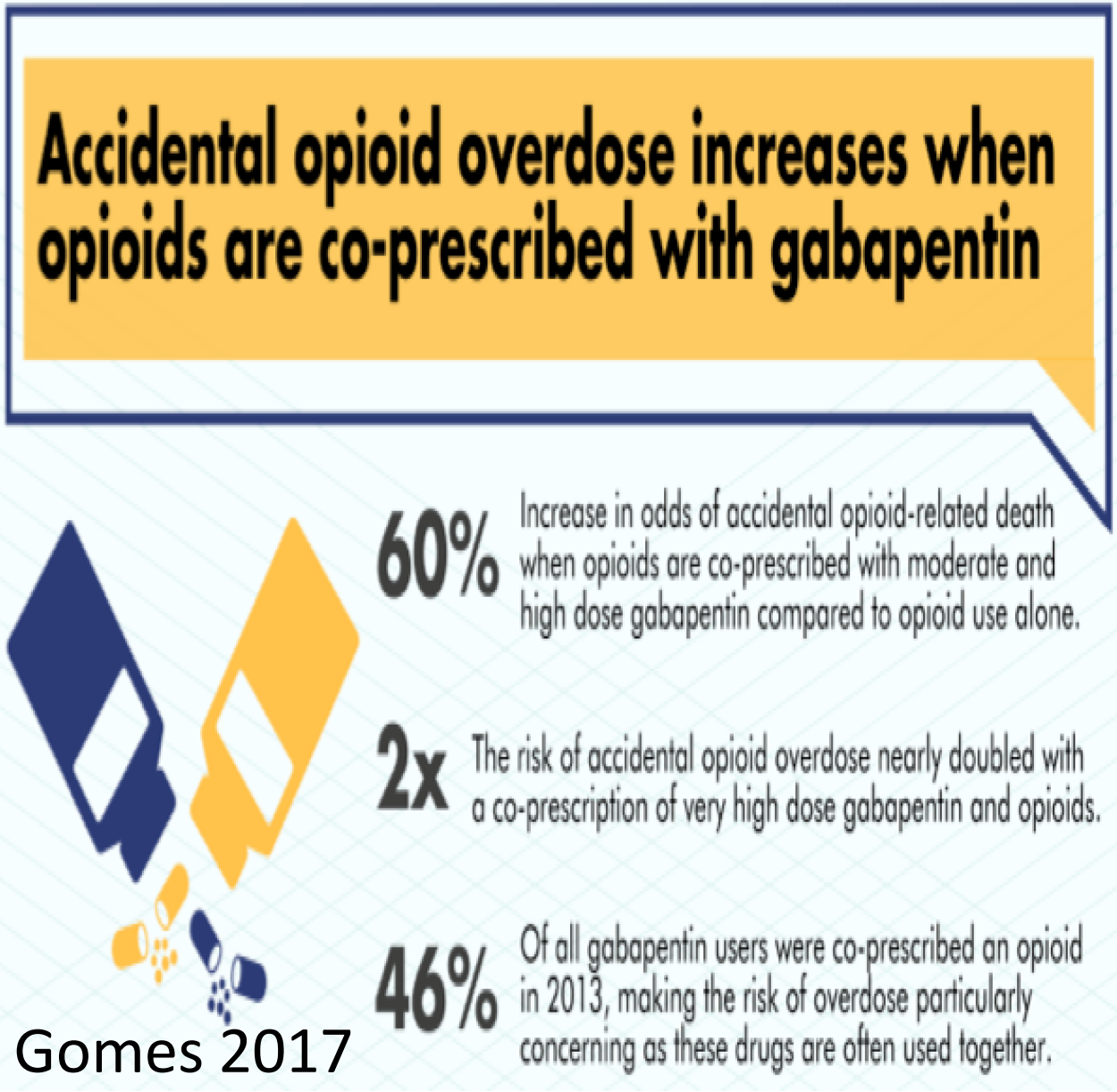


Gabapentinoids

Adverse effects:

- Seizures (on withdrawal)
- Risk of suicidal behaviours
- Head/body injuries
- Road traffic incidents

Molero 2019



Gomes 2017

Opioid analgesics

Natural opium alkaloids

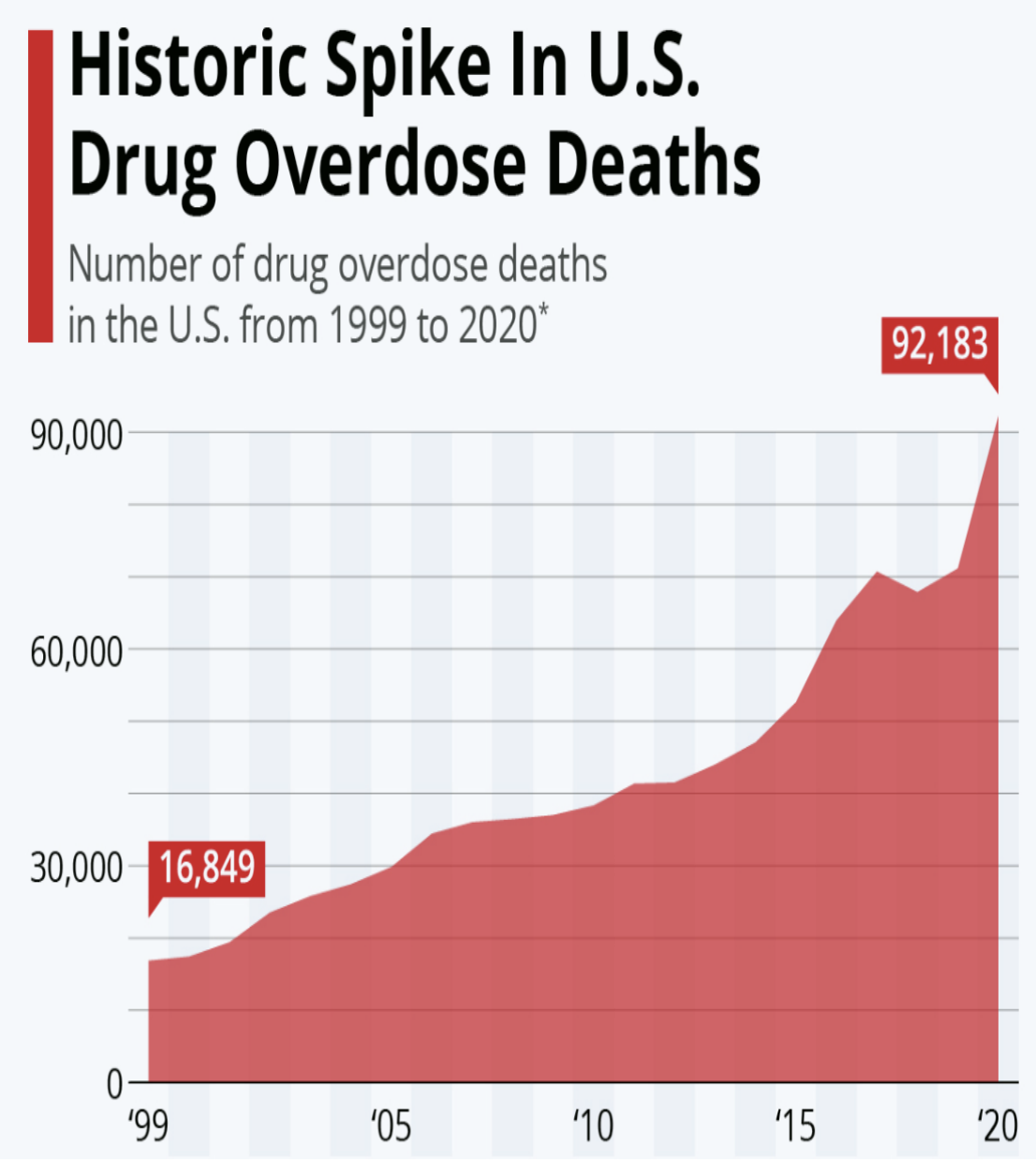
- Opium
- Morphine

Semi-synthetic opiods

- Heroin
- Oxymorphone
- Pholcodein

Synthetic opioids

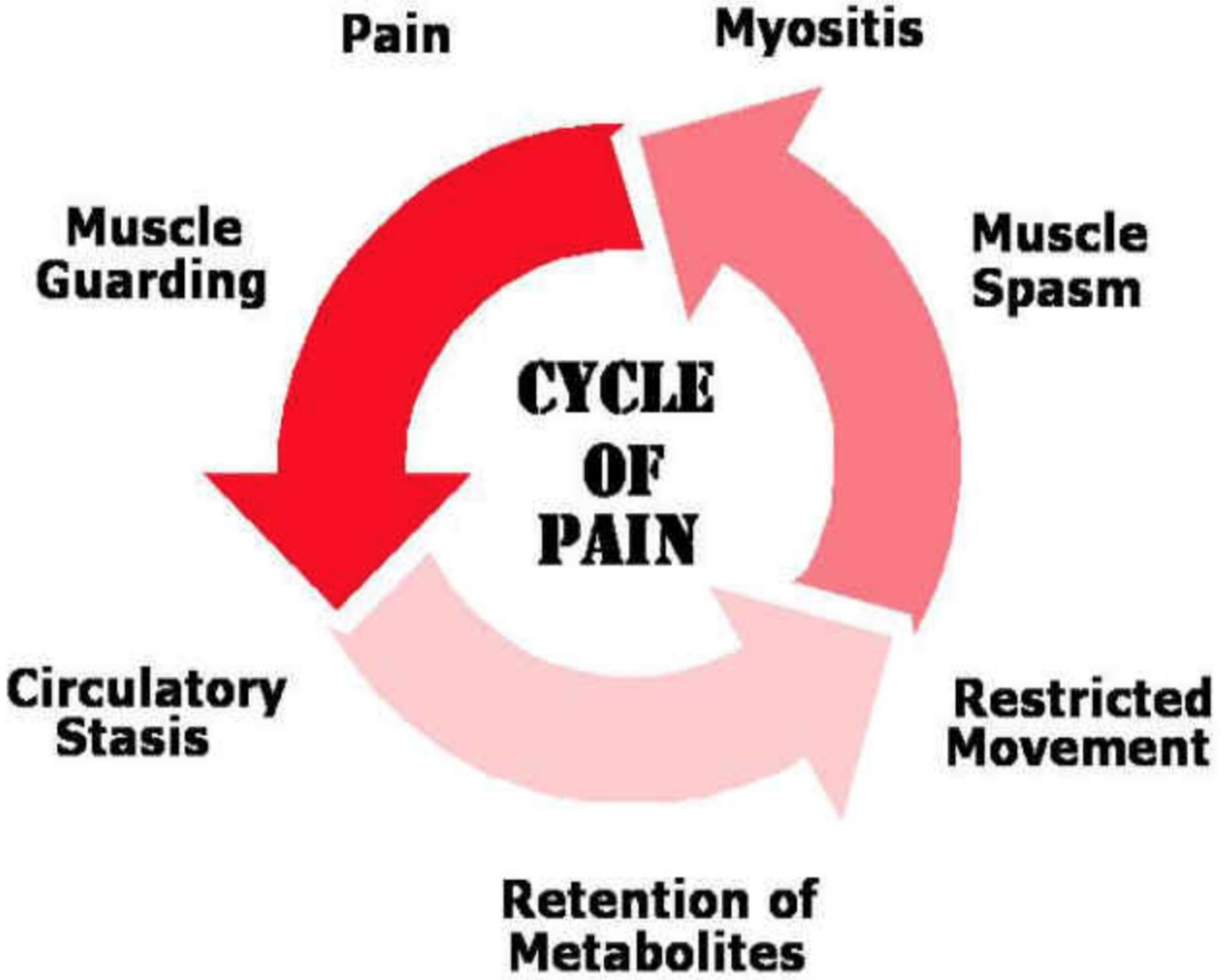
- Pethidine
- Fentalyn
- Methadone
- Tramadol



Increased muscle tone

Secondary to:

- Acute MSK injury
  - Cervical injury from MVC
- Visceral disease
  - Appendicitis
- Inflammatory response
  - Rheumatoid disease
- Psychological factors
  - Fear
- Electrolyte imbalance
  - Cramps



Muscle relaxants

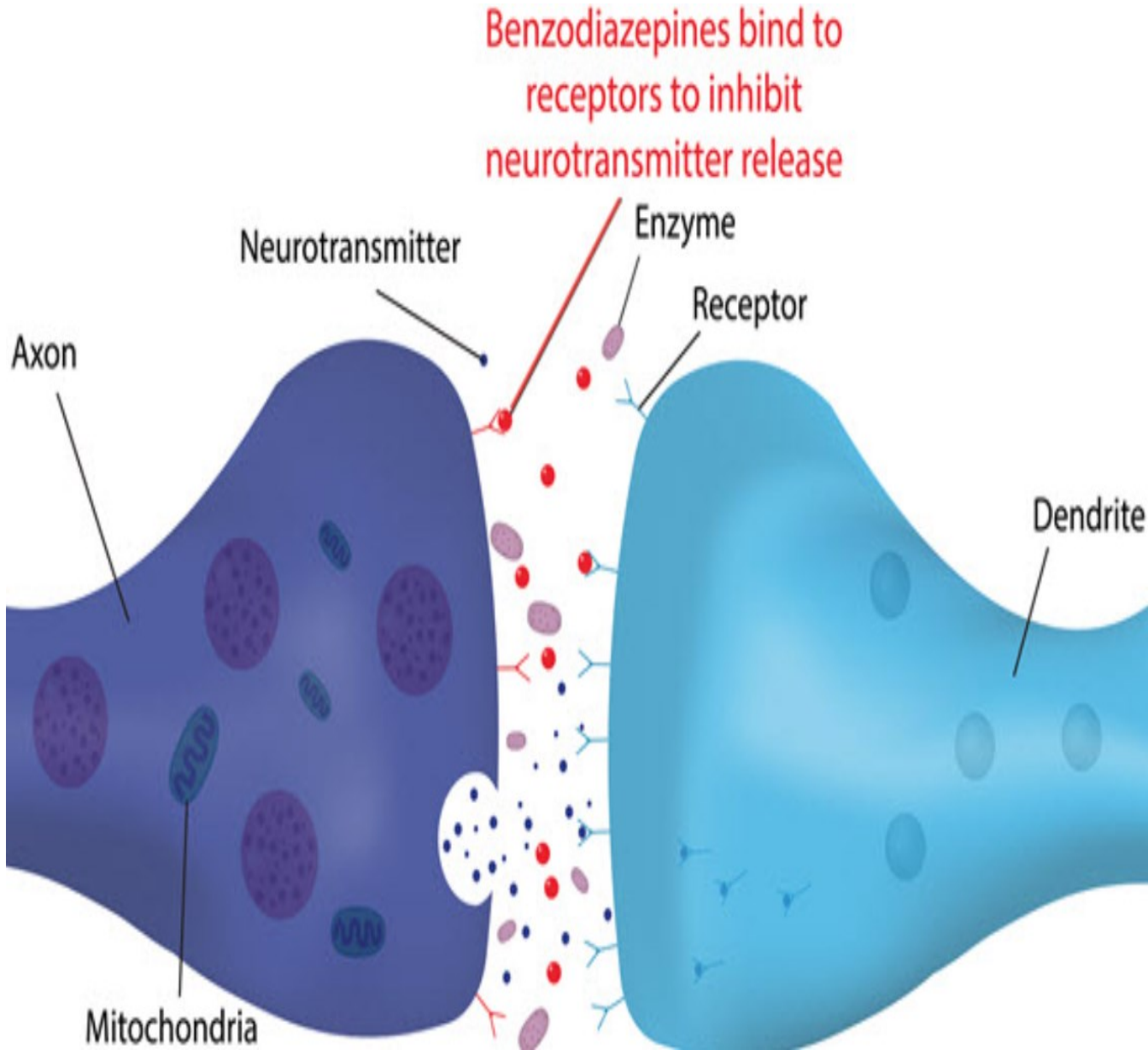
Centrally acting

Benzodiazepames

- Depress spinal polysynaptic reflexes
- Primarily used in outpatient setting

Examples:

- Diazepam
- Baclophen
- Mephenesin



Muscle relaxants

KEY CLINICAL SKILLS

Generic name	Trade name	Adverse effects
Baclophen	Baclophen	Drowsiness Confusion
Datrolene Sodium	Dantrium	Generalized muscle weakness Hepatotoxicity
Diazepam	Valium Xanax	Sedation
Gabapentin Pre-agabalin	Neurontin Lyrica	Sedation
Trizanine	Halcion	Sedation Dizziness Dry mouth

Osteoporosis incidence

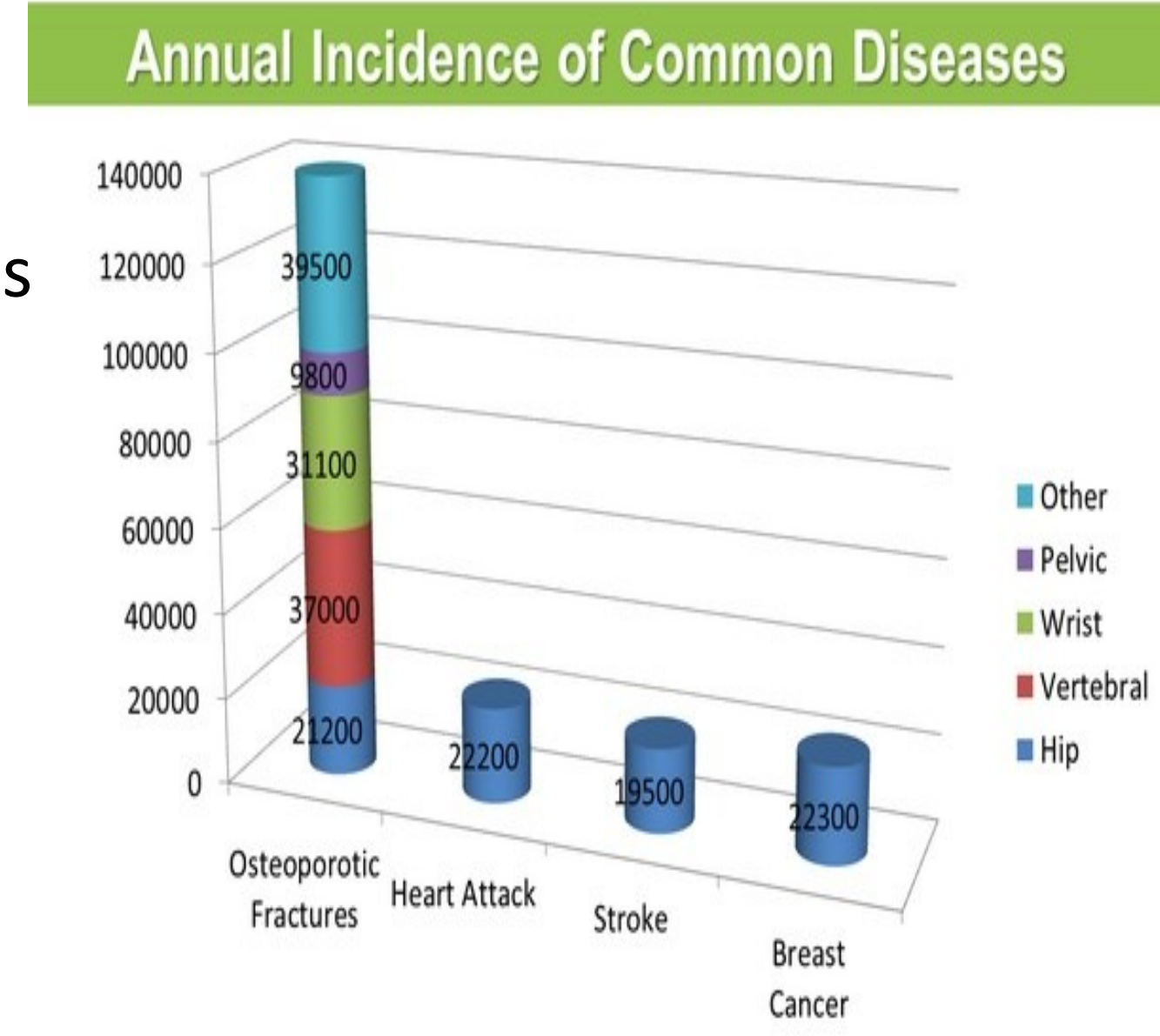
Primary osteoporosis

- Age-related disorder
- Reduced density of bone mass
- Increased risk of fracture
- Age and estrogen related

Secondary osteoporosis

Other causes:

- Hyperparathyrodism
- Malabsorbtion
- Multiple myeloma



Medications contributing to osteoporosis

Anticoagulants

Long-term high dose heparin

- Increase osteoclast activity
- Decreased osteoblast activity

Long-term oral anticoagulants

- i.e. Warfarin
- Antagonist to Vitamin K

Antiepileptic drugs

- i.e Phenytoin
- Converts Vitamin D into metabolites

Loop diuretics

- i.e. Furosemide
- Decrease serum calcium

Gonadal-releasing hormone agonists

- i.e. Goselin, Leuprolide, Nafarelin

Gluco-corticosteroids

- i.e Prednisone
- Alter calcium absorption & elimination leading to secondary hyperparathyroidism
- Inhibitory effect on sex hormone production
- Direct inhibition of osteoblast function

Medication treatment of osteoporosis

KEY CLINICAL SKILLS

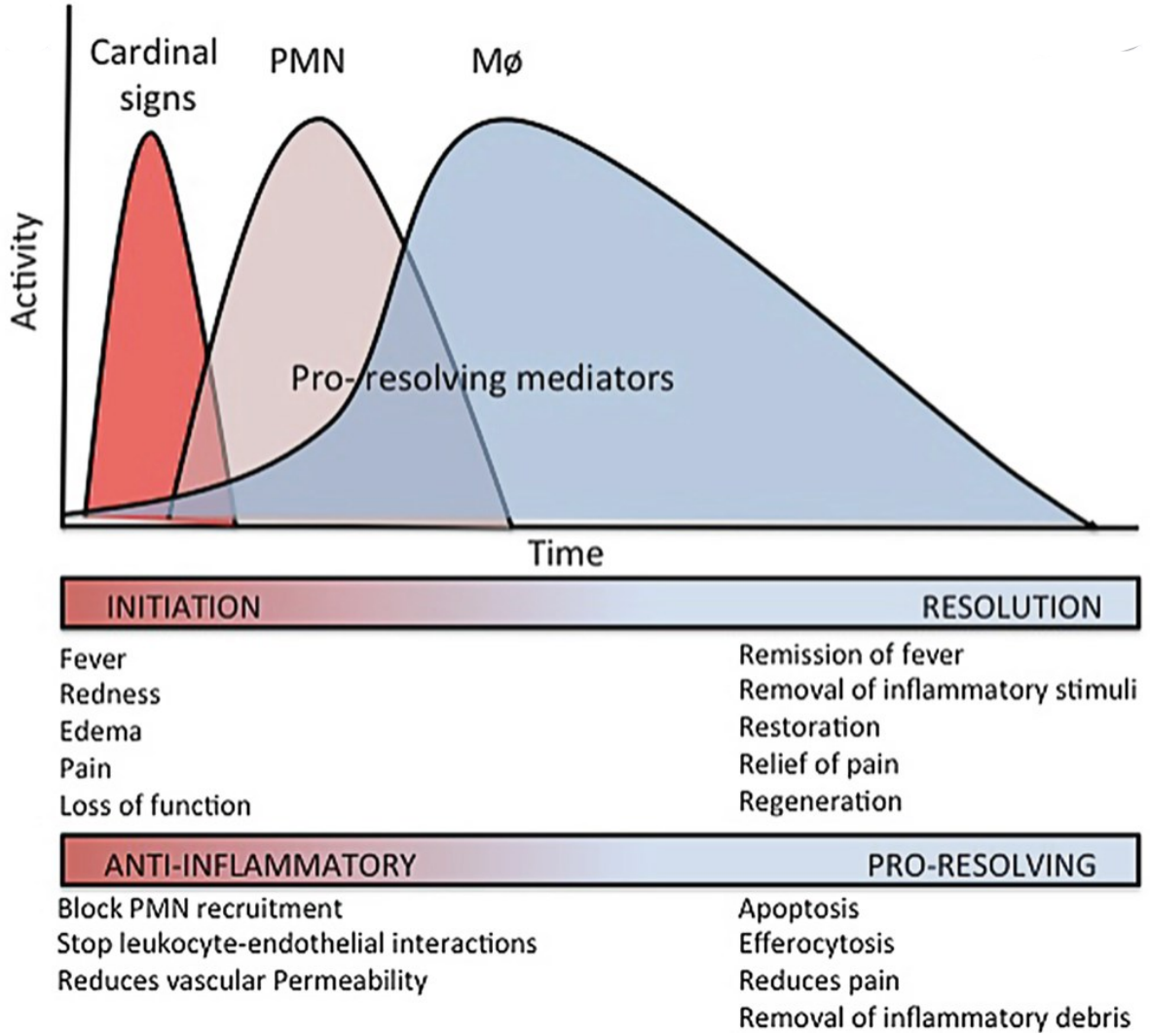
Class	Medications	Adverse effects
Calcium supplements	Tums, Citracal, Neo-calglucon	Confusion, Hyperkalemia, Constipation Headaches, Nausea
Vitamin D	Vitamin D supplements	Fatigue, Headache, Thirst, Anorexia, Metallic taste, GI disturbances
Bio-phosphates	Fosphomax Aredia	GI disturbances Reflux, Fever
Calcitronin	Cibacalcin Calcimar	Stomach pain, Redness, swelling at injection site, GI disturbance, Redness hands & feet
Estrogen	Raloxifen Evistra	Cardiovascular disease Certain cancers

Acute inflammation

- The body's response to injury
- Signals the immune system to heal and repair tissue

Triggers for acute inflammation

- Infections
- Trauma
- Physical & chemical agents
- Tissue necrosis
- Foreign bodies
- Immune reactions



A positive and protective physiological response

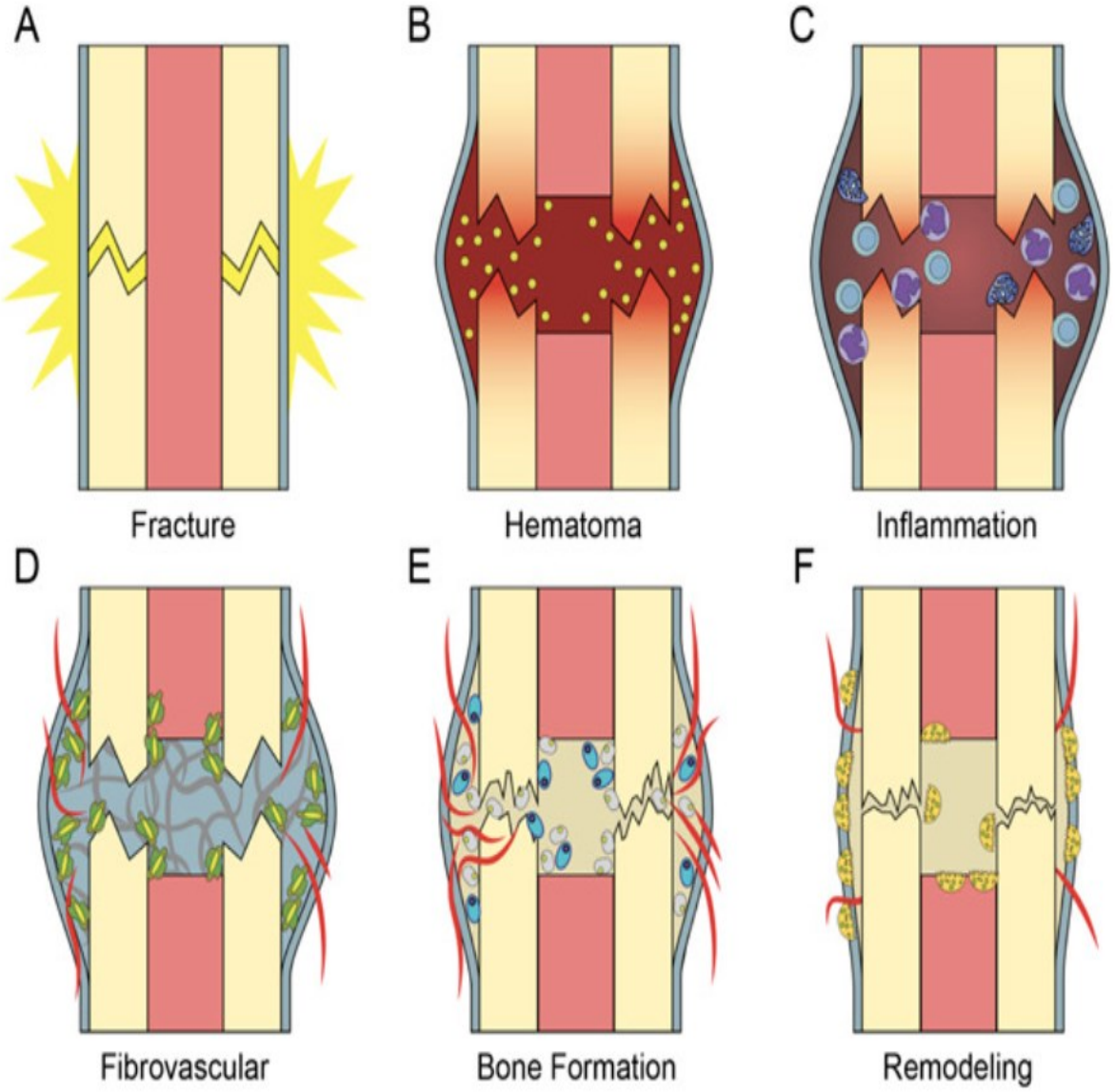
NSAIDs & bone healing

Meta analysis of 16 studies

Post fracture NSAIDs

- Delayed union
- Non-union
- pseudarthrosis

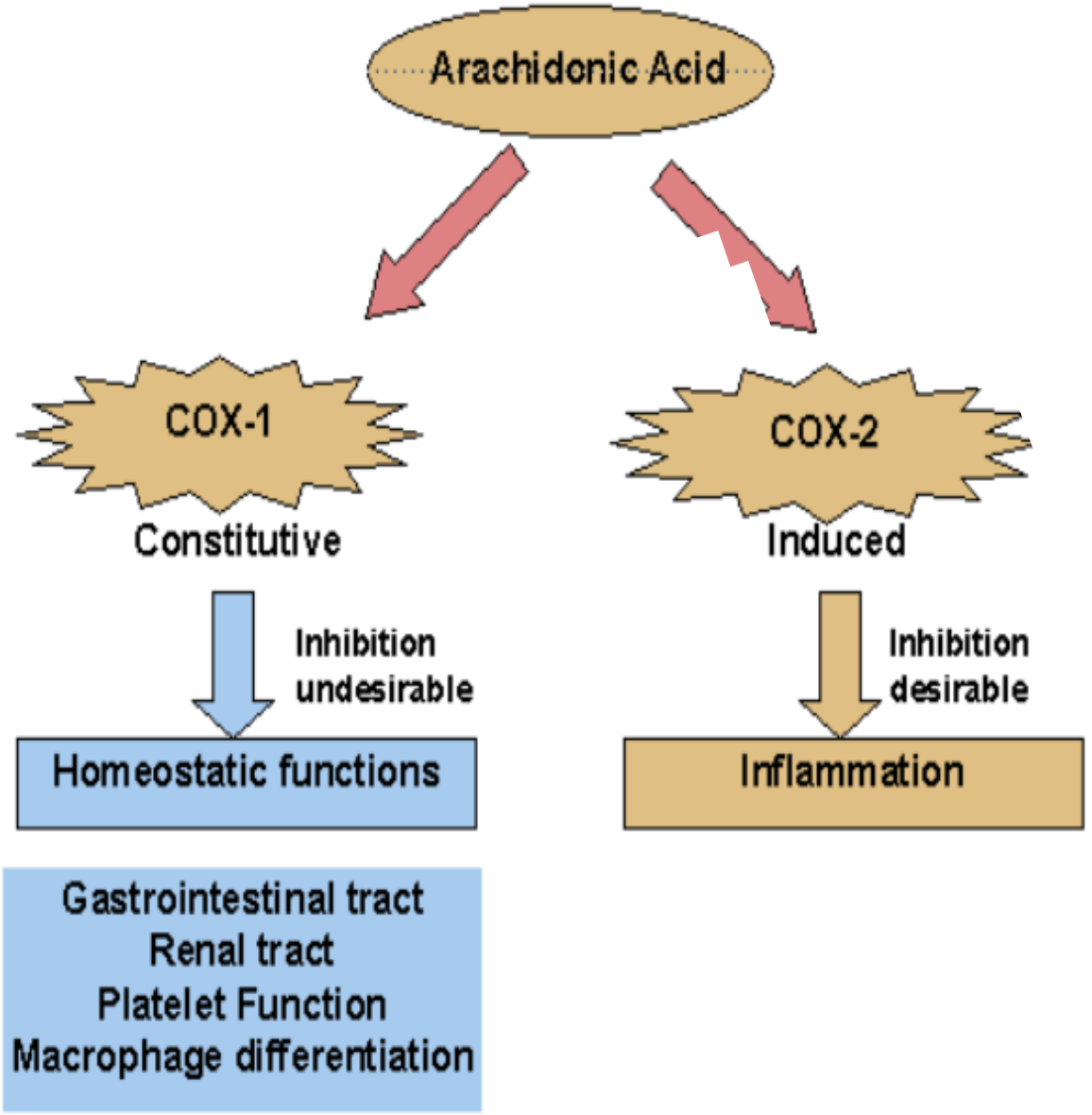
“NSAID exposure increased delayed union or non-union odds ratio 2.07”



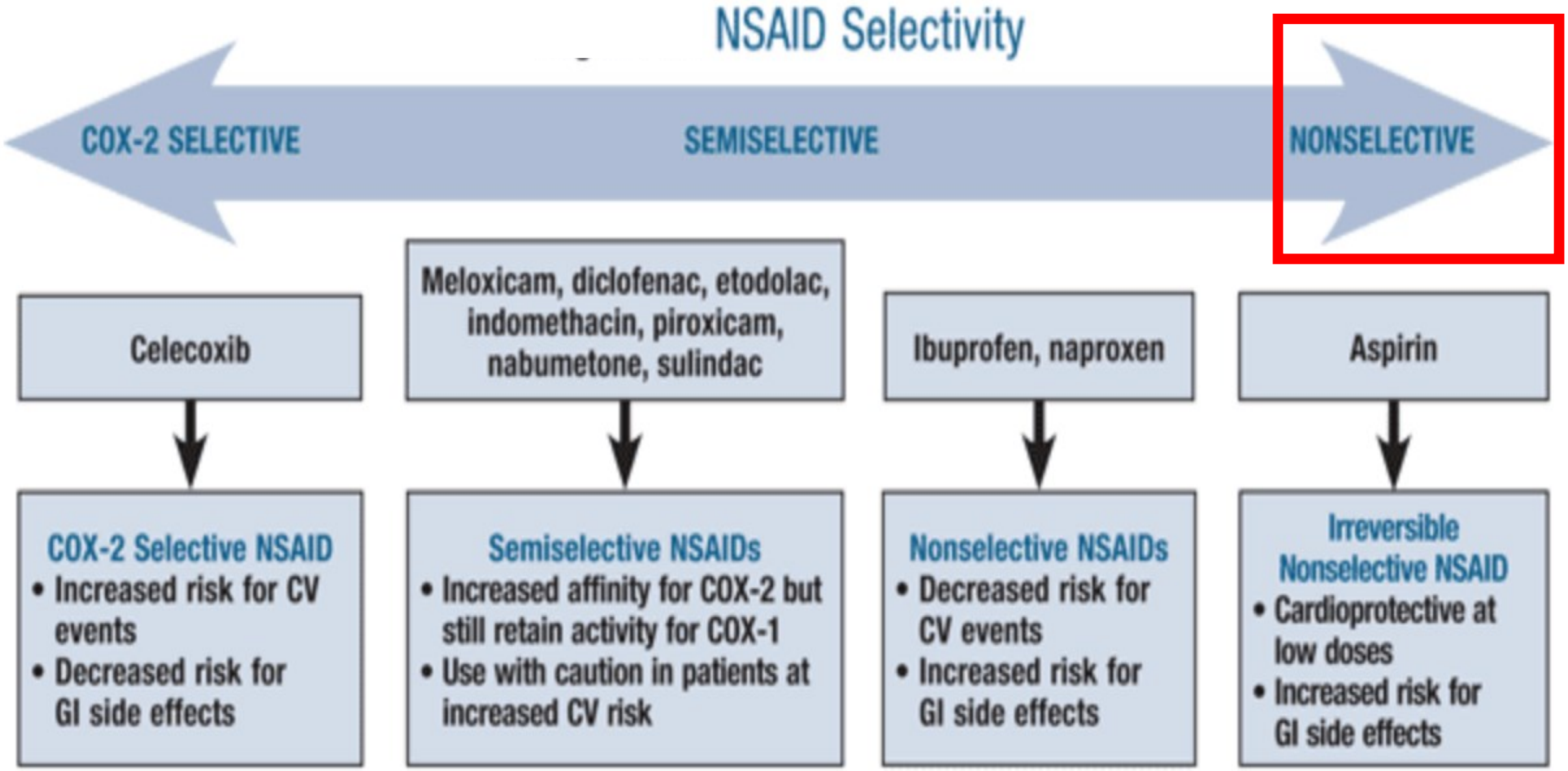
Wheatley 2019

Role of prostaglandins

- COX 1 responsible for mediating normal cell activity (i.e. help protect stomach lining from gastric acid secretions)
- COX 2 produced by injured cells mediate pain and inflammatory response



Non-Steroidal Anti-Inflammatory Drugs



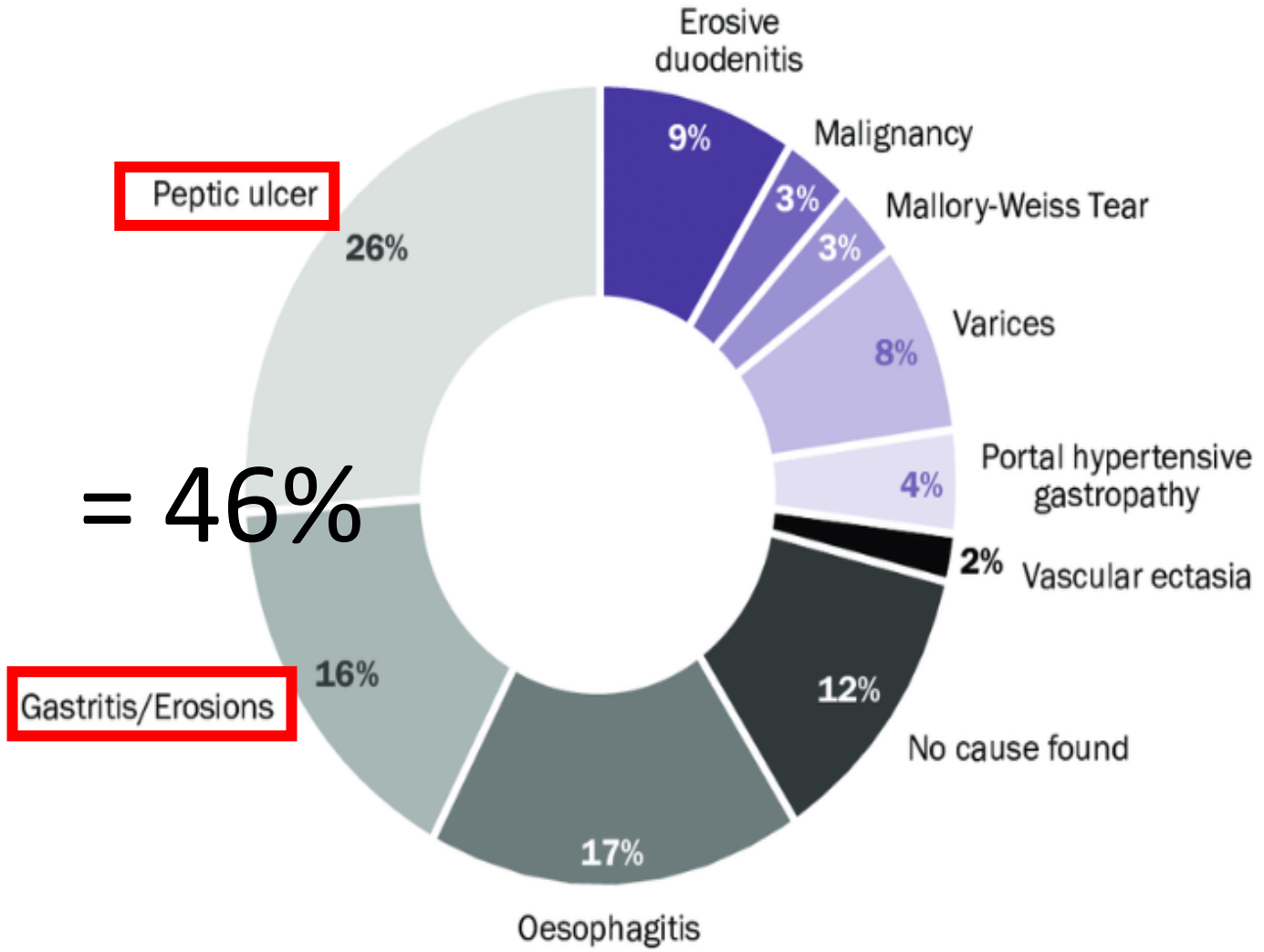
Most common adverse response

KEY CLINICAL SKILLS

Signs & Symptoms of Acute GI bleed

- Coffee ground vomit
- Bloody diarrhea
- Stool colour may vary between:
  - Bright red blood
  - Black tarry

Causes of death from Acute GI bleed in UK

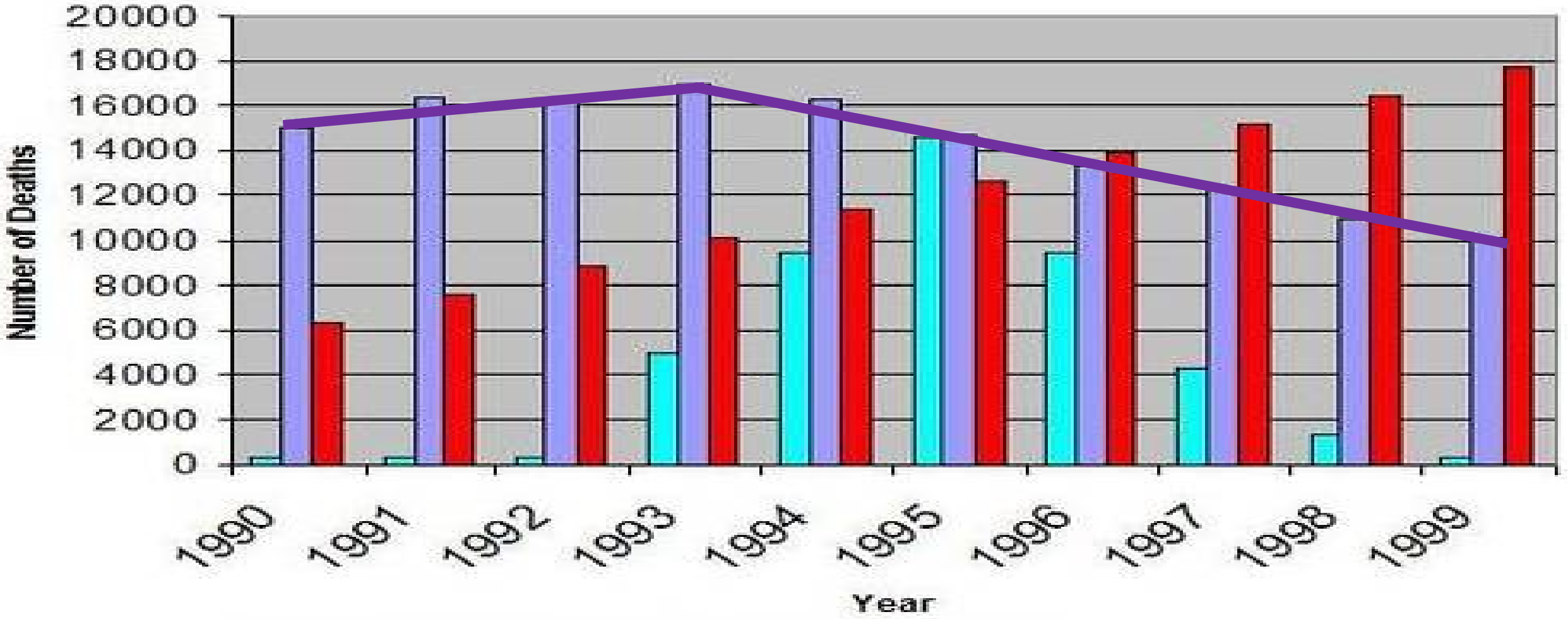


Goodman 2007, Siau 2017

Deaths from war

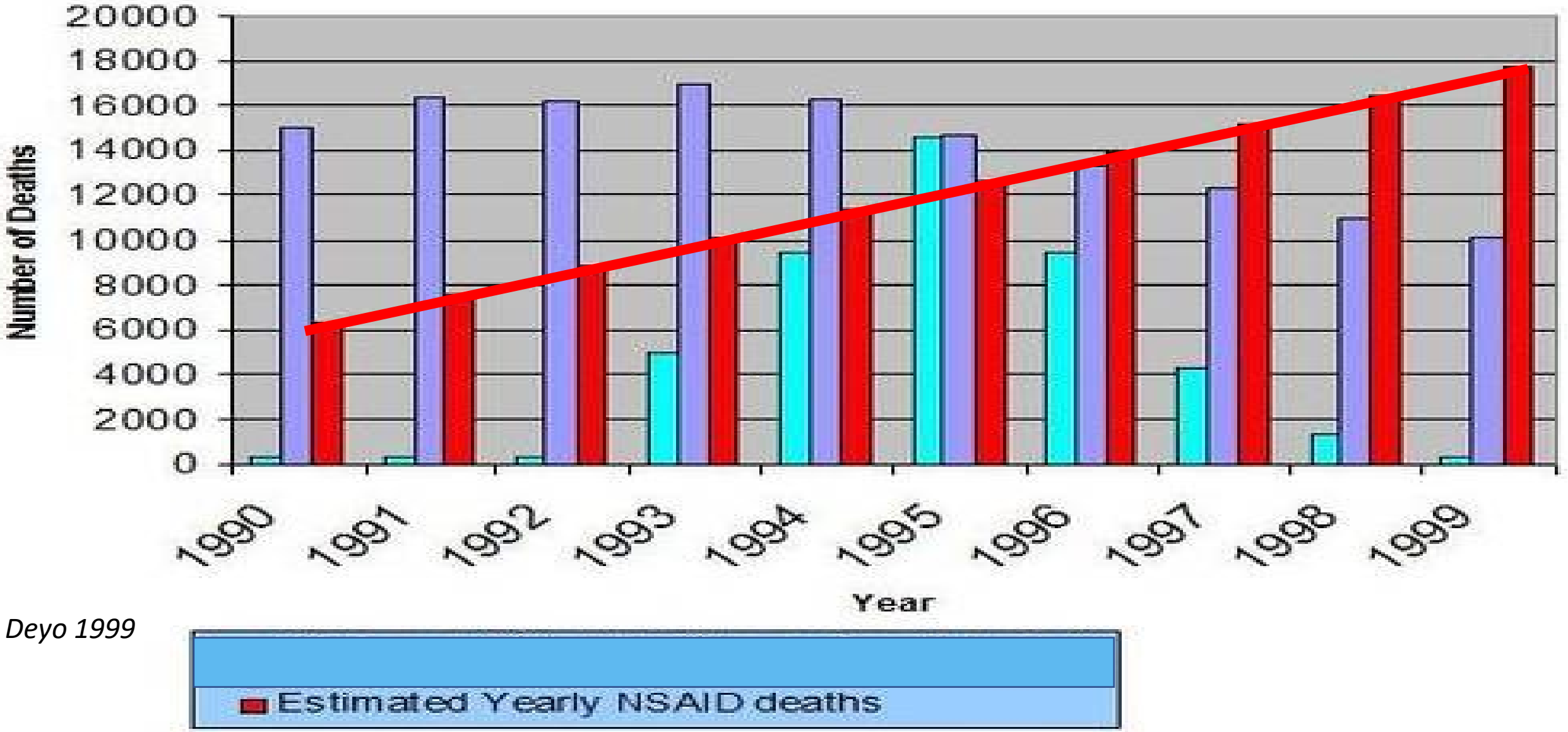
Deyo 1999

Deaths from guns



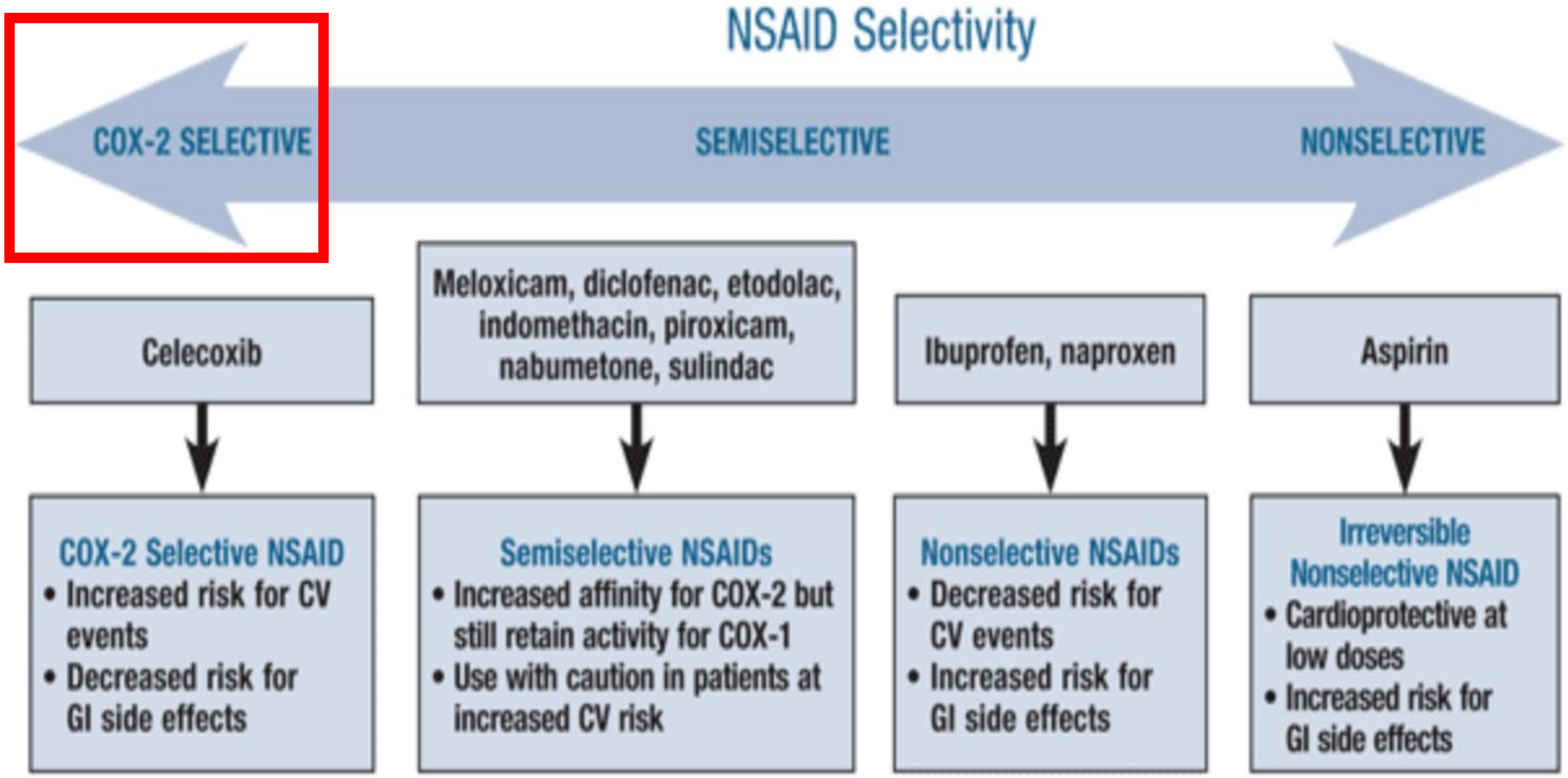
Deyo 1999

Deaths from NSAIDs



Deyo 1999

Non-Steroidal Anti-Inflammatory Drugs

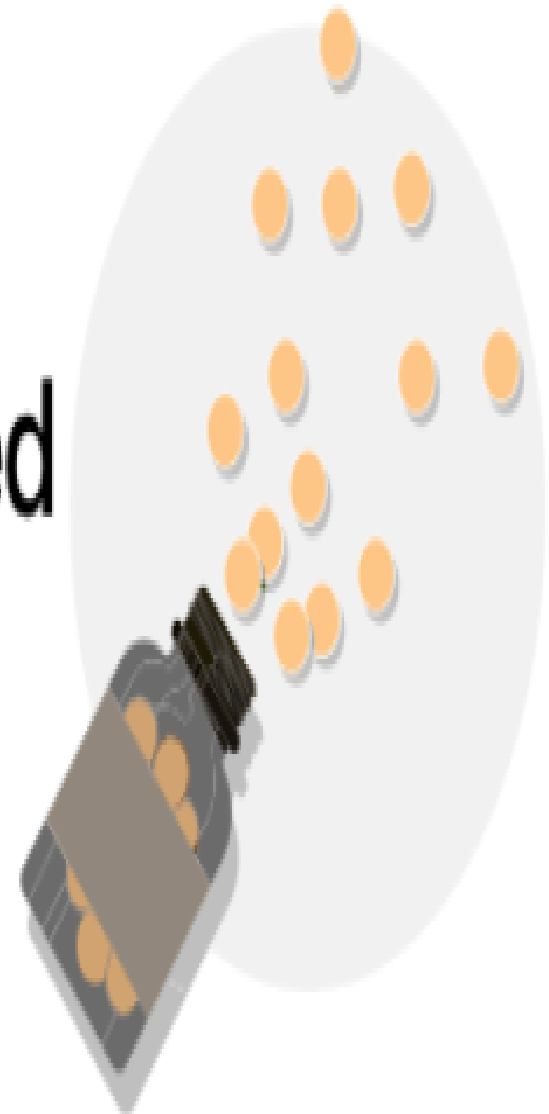


Deaths from NSAIDs

- Most popular selective COX2 inhibitor Vioxx
- Estimated 88,00 heart attacked linked to Vioxx

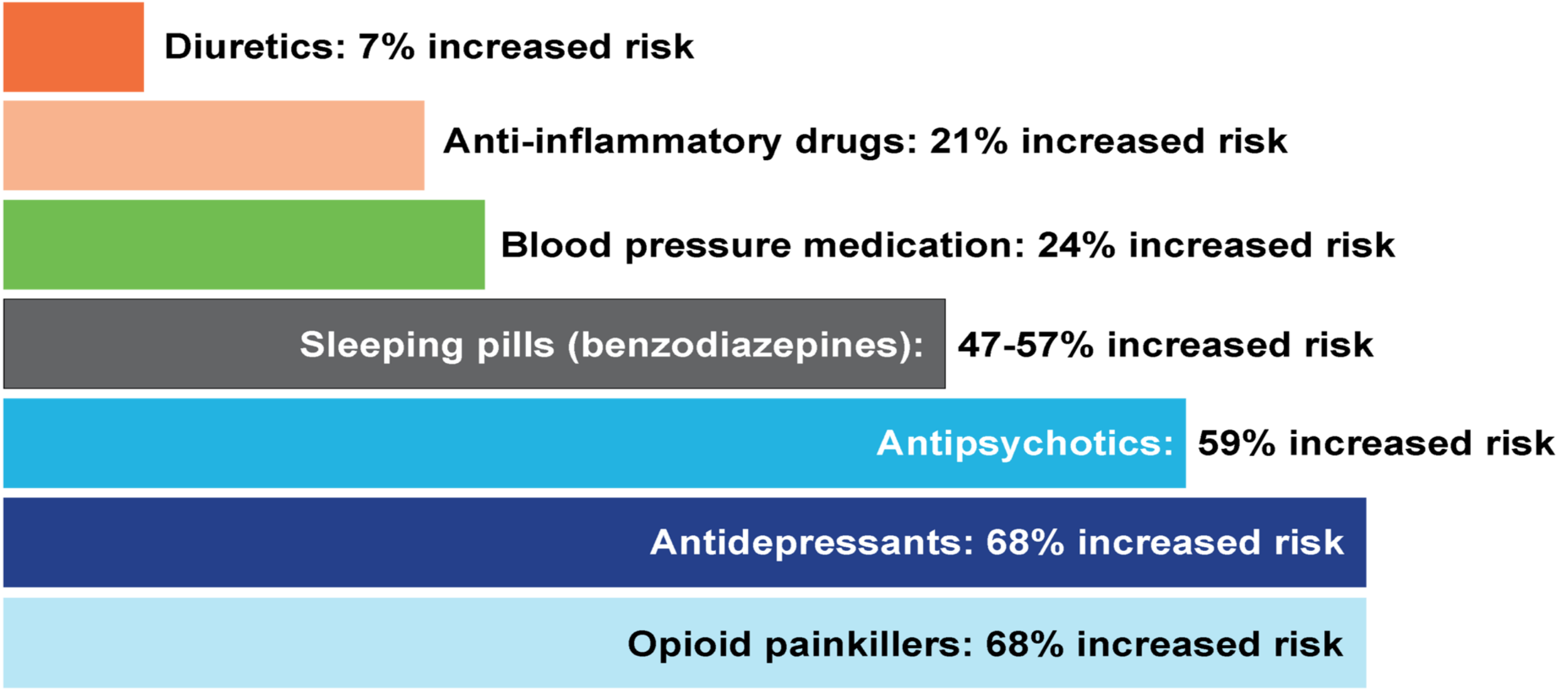
79 of 4,000

Vioxx users suffered heart problems or died



Prakash 2007

The bottom line



Huang 2013

Psychotropic drugs & falls

Medication group	Overall risk	Common medications	Risk effect
Sedating anti-depressants	**Very high risk**	Amitriptiline Nortriptyline	Drowsiness Slow reaction Orthostatic hypotention
Sedatives	**High risk**	Lorazepam Nitrazepam	Drowsiness Impaired balance
MOA inhibitors	**High risk**	Phenelzine Morclobemide	Severe orthostatic hypotention
Anti-psychotics	**High risk**	Haloperidol Olanzapine	Reflex and balance impairment
SSRI uptake inhibitors	**Moderate risk**	Fluoextine Duloetine	Bradycardia Impaired sleep

Darowski 2015

Cardio-vascular drugs & falls

Medication group	Overall risk	Common medications	Effect
Alpha receptor inhibitors	**High risk**	Doxasozin Tamsulosin	Severe orthostatic hypotention
Centrally acting Alpha-2 receptor blockers	**High risk**	Clonidine Moxoline	Severe orthostatic hypotention Sedation
Thiazide diuretics	**High risk**	Bendroflumethiazide Metolazone	Weakness Hyponatremia Hypotention
ACE inhibitors	**High risk**	Ramipril Lisinopril	
Loop diuretics	Moderate risk	Furosemide bumetanide	Dehydration Hypotention
Calcium channel blockers	Moderate risk	Digoxin Flecainide	Bradycardia Arrythmia

Darowski 2015

Pharmacology for Physiotherapists

KEY CLINICAL SKILLS

10% discount code:

Phalls2022

Advanced Physiotherapy Practitioner Certification

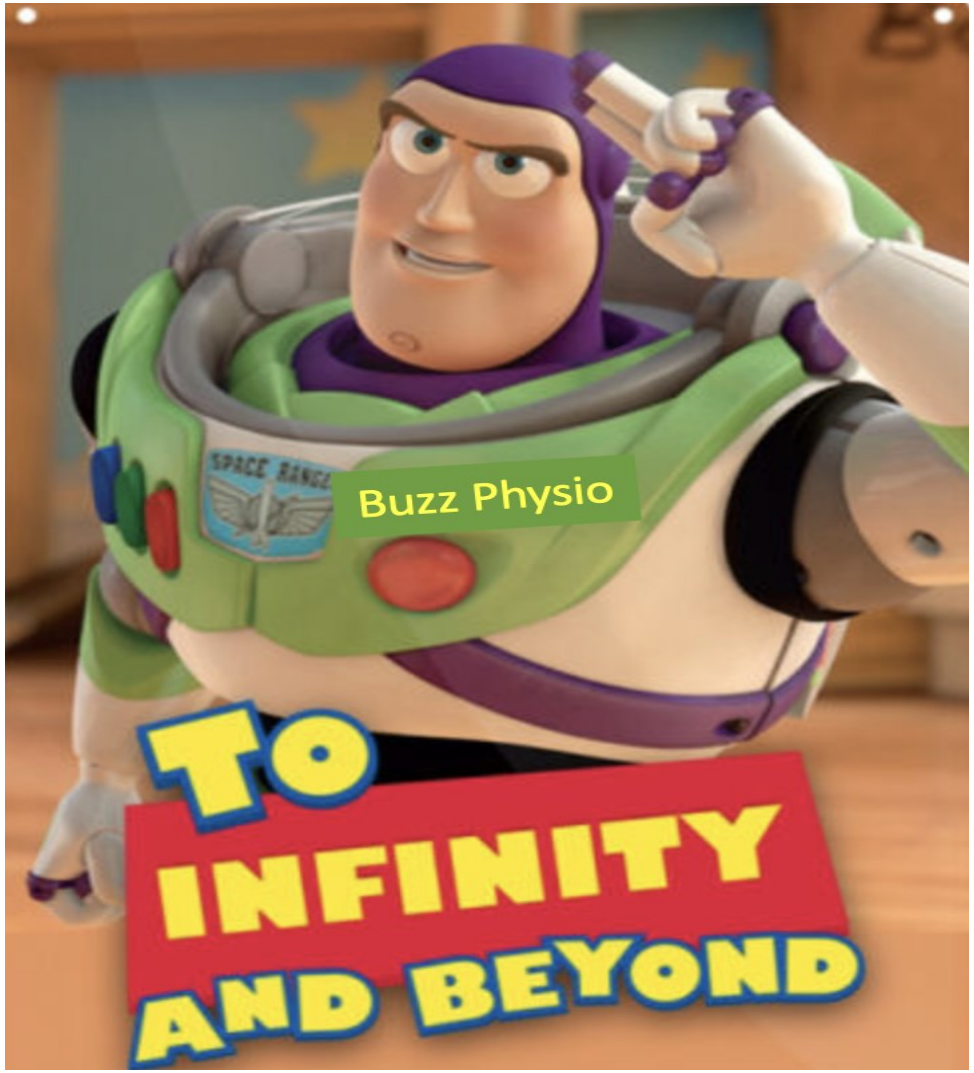
KEY CLINICAL SKILLS

Hybrid programs

- Medical/Surgical Triage

Online programs

- Imaging foundations
- Imaging spine
- Imaging extremities
- Essentials of lab testing
- Regional medical screening
- Systems medical screening
- **Pharmacology for Physiotherapists**



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