

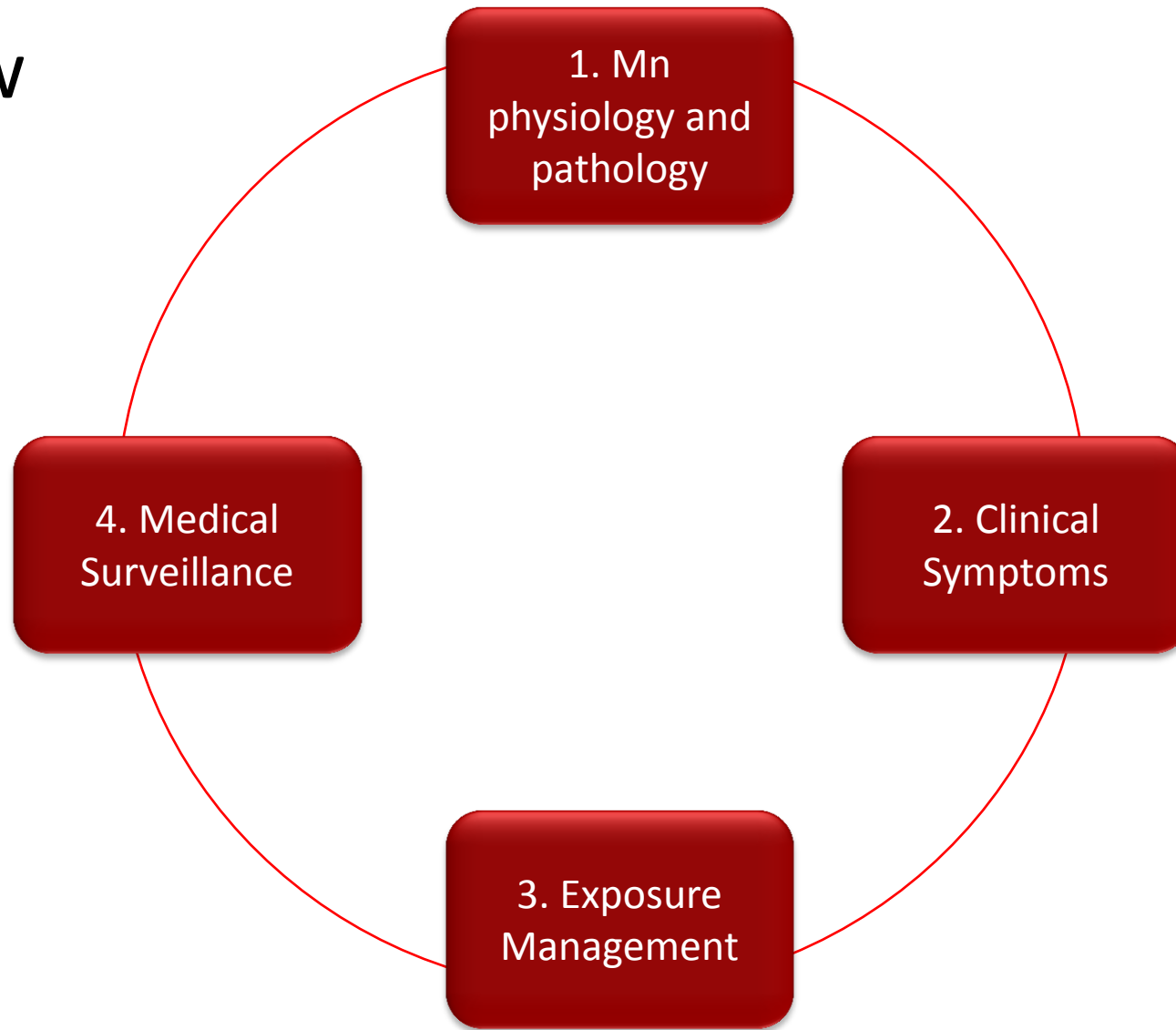
Medical Surveillance of Manganese exposed workers

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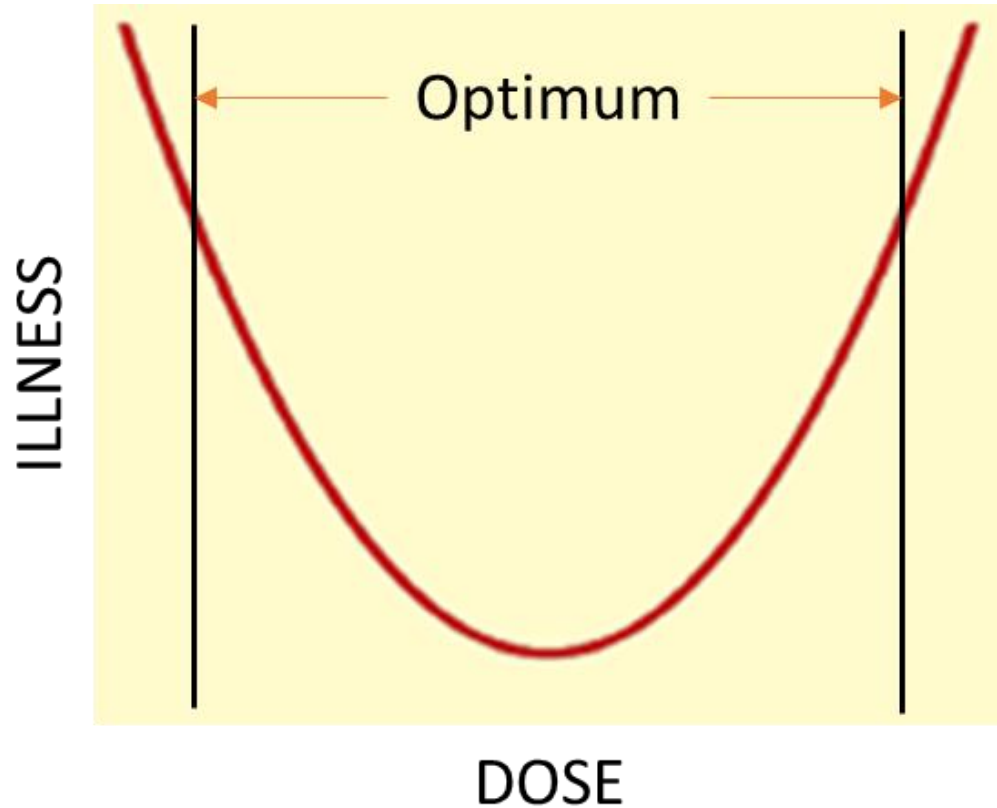
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Reduced risk IS the
reward

Overview



Manganese is an essential element



- Mn is essential to maintain healthy bodily function
- Mn plays a role in skeletal function, enzyme activity, nerve conduction, carbohydrate and fat metabolism
- Excess Mn associated with enzyme malfunction, impaired iron metabolism, neurotoxicity
- Mn deficiency causes dermatitis, abnormal hair and nail growth, blood clotting abnormalities

Absorbed primarily through the lungs



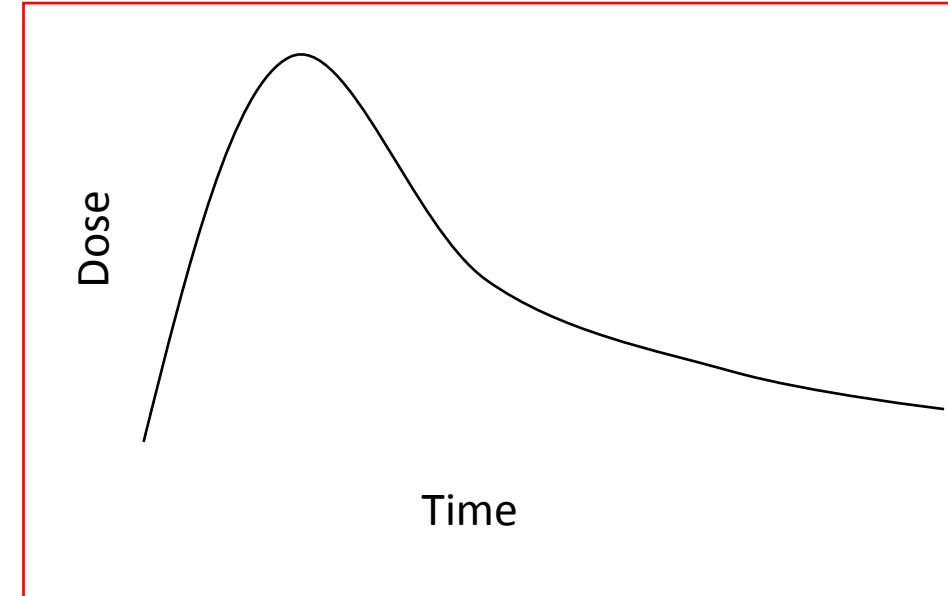
- Ingestion
- Skin Contact
- Olfactory nerve

INHALATION

- Critical in occupational setting
- Absorbed at level of respiratory bronchioles
- Important factors = size, solubility, concentration
- Bypasses regulatory mechanisms

Distributed to all organs

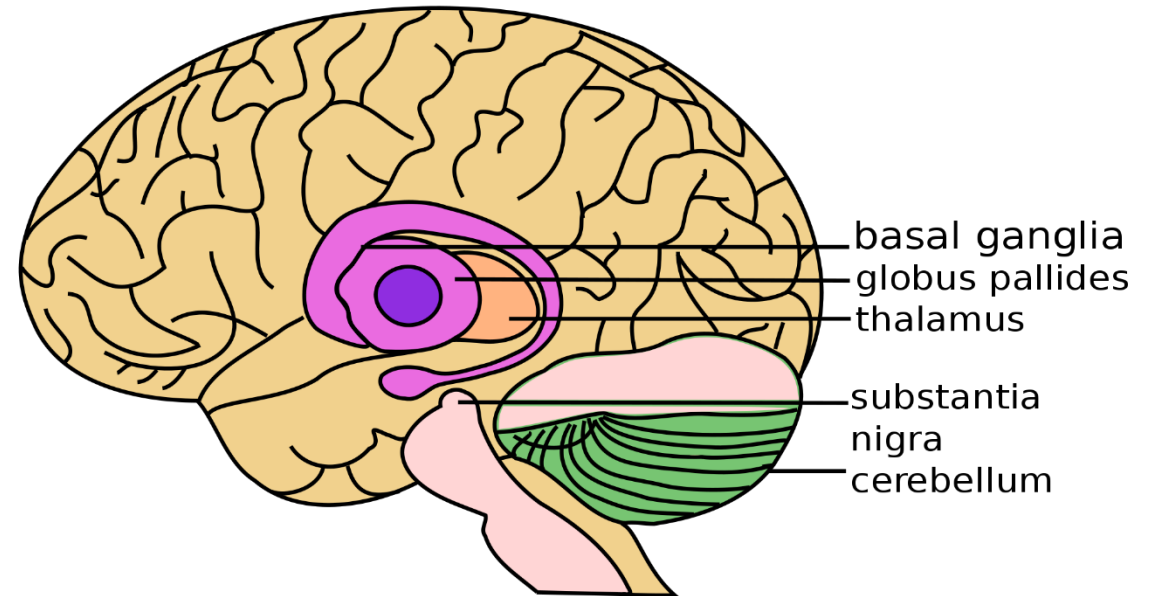
- Ingested Mn is first processed in the liver and excess Mn is excreted in bile
- Inhaled Mn bypasses the liver and enters the bloodstream directly via the lungs
- Carried in blood either in free form or bound to proteins (carriers)
- From the bloodstream Mn is distributed RAPIDLY to body organs
- The rapid distribution out of the bloodstream makes blood Mn an unreliable biomarker



Deposition in the Brain

- Distributed to basal ganglia – particularly globus pallidus and substantia nigra
- These areas are primarily associated with the co-ordination of movement
- Exposure to significant quantities Mn over a long period of time is required to cause sufficient neural damage
- Damage to these areas give rise to the clinical symptoms of Manganism

Basal Ganglia and Related Structures of the Brain



Neurotoxic Effects

- When sufficient neurones have been damaged – clinical effects occur
- Occurs over an extended time (years)
- No capacity for regeneration – once critical mass damaged, effects are permanent
- Subtle effects can be seen early on
- Other stressors can impact the same area of the brain
 - ✓ Drugs, Infections, Endocrine/metabolic abnormalities, Trauma, Cancers
 - ✓ Idiopathic Parkinsons Disease affects very similar part of brain

Clinical Presentation

- Key areas damaged are globus pallidus and substantia nigra – part of the basal ganglia
- These structures are responsible the co-ordination and smoothing out of movement
- As result, cardinal symptoms are:
 - Bradykinesia
 - Dystonia
 - Rigidity
 - Tremor
- Preceded by more subtle signs – which may be useful pointers during medical surveillance:
 - Mood and behaviour changes
 - Fatigue or sleep disturbance
 - Irritability
 - Speech disturbances

“cock walk”



Diagnosis of Neurotoxicity

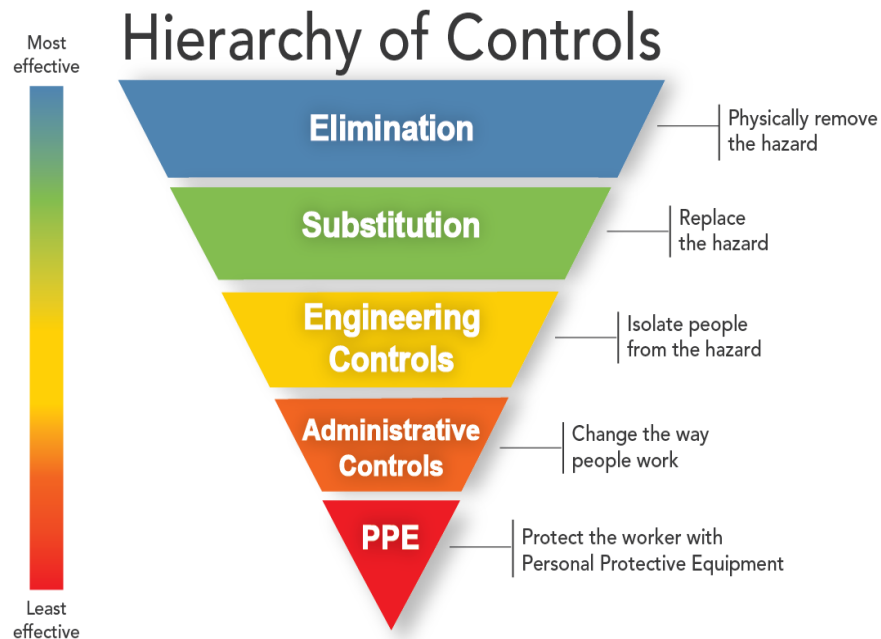
There is no international standard for the diagnosis of Mn neurotoxicity

Essential features include:

- Confirmation of exposure to Mn
- Exclude other conditions that may give rise to similar symptoms
- Examine for cardinal symptoms
- Visualise the areas of damage in the basal ganglia - imaging
- Movement abnormalities

Management of Exposure

The primary method of preventing health effects is to decrease exposure



Engineering options:

- Extraction – furnace extraction, taphole extraction, launder extraction
- Suppression – transfer points, stockpiles
- Enclosure – furnace and baghouse, launder

Administrative options:

- Access control
- Limiting time in high exposure areas

Personal Protective Equipment:

- Last line of defence
- Respiratory protection programme
- Appropriate filtration fraction
- Training and compliance monitoring

Medical Surveillance

Medical Surveillance is a planned programme of medical examinations and tests on workers to detect health impacts of work exposures

Important factors taken into account are:

- Exposure profile
- Toxicology
- Health risk assessment

Medical surveillance aims to:

- Establish workers' health status before commencing work
- Determine fitness to perform work
- Detect health impacts early
- Demonstrate that exposure controls are effective



Medical Surveillance

A medical surveillance programme should include:

1. Pre-employment examination
 - To establish baseline health status
 - Detect conditions that may increase susceptibility to neurotoxicity
 - Confirm fitness to work
2. Routine medical examination
 - At a frequency based on exposure risk – consistency important
 - Early detection of abnormalities
3. Exit medical examination
 - Establish health status on leaving employment – compare with baseline
 - Create record for future employer

Medical Surveillance

Occupational History

- Previous exposure to Mn – work related
- Previous neurological conditions, trauma, childhood
- Medications
- Family history of neurological illness
- Hobbies!

Examination

- Full neurological examination
- Tests for hand/eye co-ordination, balance, muscle tone and strength
- Hand writing, pattern tracing

Investigations

- Blood count - Iron levels
- Liver function

Medical Surveillance

Biomarkers

- A biomarker is a measurable indicator of a specific biological state i.e. tests that are done on tissue to determine if an impact is present.
- An example is prostate cancer
- In manganese neurotoxicity, there is no reliable biomarker available
- Although Mn can be measured in skin, hair, nails – poor correlation to neural effects
- Blood Mn also is a poor indicator of neural effects in an individual
- Blood Mn can be used to statistically analyse average levels in groups of workers – gives an indication of efficacy of controls rather than individual risk