

# Investigating Health and Exposure Circumstances of Persons after Aircraft Fume Events: A Narrative Review with Medical Protocol

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# Background and Overview

- Term 'Aerotoxic Syndrome' - Not accepted by some
- Aerospace industry does not like term
- Not all present with same symptoms
- 'Aircraft related illness' suggested (CASA EPAAQ 2012)
- For now term 'Aerotoxic Syndrome' reasonable & justifiable

# Background - Guidelines

- Some past Guidelines – none comprehensive
- Acknowledged that Guidelines will vary
- Our Comprehensive Guidelines
  - Consensus view of international experts
  - About 32,000 words
  - Very near completion
  - Updated synopsis presented today
  - Pocket Guidelines will also be published separately



# Scope of Presentation

- We are addressing
  - Bleed/supply air contaminants
    - Oils, hydraulic, de-icing fluids
- Not other pollutants
  - Pesticides
  - Infections



# Technical Matters (1)

- Medical need for understanding background of FE
- Outside air used to flush cabin & assist with pressurisation
- Pyrolysed oil in bleed air - not Boeing 787 Dreamliner
- Good data assists in medical investigation/management
- Air exchange rates > than other indoor sites (sealed buildings)
- High occupancy in aircraft cabin

# Technical Matters (2)

- Industry set standards

PROTECT MOST - NOT EVERYONE !

and are

- No fine lines separating healthy from unhealthy
- Not available for all substances
- Set for ground level
- Not applicable to cabin environment
- Take no account of altitude / pyrolysed mixtures

# Time of Presentation / Injury

- Time of presentation with illness after FE important
  - In-Flight
  - Immediate Post Flight
  - Late / Subsequent
- Most report symptoms in-flight or immediately after
- Long-term cumulative low dose exposure (months / years) important

# Presenting Symptoms

- Presenting symptoms - described elsewhere
- May involve all organ systems
- Duration
  - Hours, days, weeks, months
  - Sometimes, full recovery never occurs

Symptoms  
Experienced after  
FE - Summary

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Neurotoxic

Neuropsychological

Respiratory

Gastrointestinal

Cardiovascular

Mucosal irritation

Others



# Environmental Investigation of Fume Event: In-Flight

## Record

- Type of aircraft
- When did event occur (stage of flight)?
- Where in the aircraft?
- What happened (smell, fumes, smoke)?
- How long did the event continue?
- Describe type of smell
- Who and how many (x out of y) affected?
- Record air quality monitor recordings (if available)

# Medical Investigation of Fume Event: In-Flight

- Detailed careful history of FE including severity
- Record
  - Previous FE exposure and frequency, length of service
  - Symptoms and progression of symptoms
  - Observations of others
  - Unusual behaviour
  - Pre-existing medical conditions
  - Oxygen use (when/duration) including flow rate
  - Any treatment given/used
  - Trained medical personnel may record more

# Medical Investigation of FE: Post Flight

- Medical, occupational and FE event history as before
- Will be more detailed – healthcare workers involved !
- History of career flying time (important)
- Detailed clinical examination
  - All organ systems
  - Emphasis on presenting complaints, neurological and respiratory systems
  - Mental and cognitive state important
- Special investigations - appropriate for presenting complaints

# Medical Investigation of FE: Post Flight

- Special Investigations - appropriate for presenting complaints
  - Collect blood as soon as possible (record time from exposure)
  - Cholinesterases\* (ideal 4-24 hrs) – \*low exposure may not cause inhibition
  - Routine biochemistry, haematology, muscle enzymes
  - Others, as clinically indicated
  - Carboxyhaemoglobin - HbCO (within 2 hrs post flight, maximum 4 hrs)
  - Methaemoglobin
  - Collection time should be recorded **and** time from exposure.

# Medical Investigation of FE: Ongoing Biomonitoring

- After immediate post flight assessment
  - Investigations based on clinical indication
  - Repeat again at week 1, 4, 12 weeks (especially cholinesterase) or symptom stability
  - Note need for repeat cholinesterase measurements (2-3 months)
  - May allow for normal assessment - Pre-exposure levels measurements unlikely.
  - Ongoing biomonitoring allows toxicological assessment relative to symptoms

# Medical Investigation of FE: Ongoing Investigations

- Investigations based on clinical indication
- In particular
  - Neuronal and glial autoantibodies – indicate neuronal injury and gliosis
  - Detailed lung function testing may be needed to detect respiratory injury
  - Neurological defects – MRI scans, MRI/PET scans more sensitive
  - Neurobehavioural – Tests include Coding test (Processing speed), Problem solving, Learning, Memory, Sleep studies and others
  - Malignancy – Emerging reports of some cancers

# Medical Investigation of FE: Emerging Areas

- Recognised that **fine particulates** affect health
- **Ultrafine (nanoparticles)** now accepted as more toxic
- **Low level recurrent exposures** probably cumulative in effect
- Underscores issue of air quality standards

# Medical Protocol – Additional Material

- Sections expanded and further examined
  - Neurology and neurotoxicity
  - Best collection times for anticholinesterases
  - Effect of anticholinesterases on different nervous systems
  - Effect of recurrent and cumulative low dose exposure
  - Effect of ultrafine (nanoparticles) particles
  - Association with fatigue, sleep disorders, infection, malignancy, visual disturbance, arthritic symptoms
  - Other possible associated conditions eg malignancy, chemical sensitivity



# Conclusions

- Preparation of medical protocol publication
- Long journey by many
- Some previous Guidelines and Protocols
- None as comprehensive as present
- Consensus document - Internationally expert authors
- Booklet also prepared for Guidance (What to do) for aircrew
- Be patient – we are almost there !