CABIN AIR QUALITY
THE COT INVOLVEMENT AND FINDINGS

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SCOPE

- COT and how it operates
- 2007 review and statement
- 2013 position paper
- Others' interpretation of COT position

COMMITTEE ON TOXICITY OF CHEMICALS IN FOOD, CONSUMER PRODUCTS AND THE ENVIRONMENT

- Independent committee providing advice to Food Standards Agency, Department of Health and other UK Government Departments and Agencies regarding the toxicity of chemicals
- Chair and 16 members, mostly from academia, with expertise in toxicology, epidemiology, exposure sciences, pathology, and representing public interest
- Addresses questions posed by Government or (more rarely) identified by Committee
- Outputs in published statements, position papers and minutes.
- Strong commitment to openness

BACKGROUND TO 2007 REVIEW

- Requested by Department for Transport
- Based on data submitted by BALPA and sourced by COT secretariat, assess risks from exposure of aircrew to cabin air contaminated by engine oil and its pyrolysis products in commercial aircraft
- Advise on further research that might be useful

SOURCES OF EVIDENCE

- Extensive data provided by BALPA in two submissions that included 266 references (details of incidents, airline bulletins, information leaflets, data sheets, scientific papers etc)
- A further 169 references identified by COT secretariat, some of which were included in systematic review of epidemiological studies by DH Toxicology Unit

ASPECTS OF PROBLEM COVERED

- Laboratory analyses of the pyrolysis of jet oils and hydraulic fluids
- Exposure monitoring
- Reporting of contamination incidents
- Pilot health (epidemiological data, case reports, neuropsychological investigations, biomarker studies)

CONCLUSIONS - GENERAL

- Not possible to conclude a causal relationship between cabin air exposures and ill-health, but temporal relationship indicated that an association was plausible
- “It would be prudent to take appropriate action to prevent oil or hydraulic smoke/fume contamination incidents”

CONCLUSIONS - EXPOSURE

- Much uncertainty regarding VOCs, SVOCs and other pyrolysis products released into cabin air during fume incidents, but they include ketones, acids, aldehydes, esters, oxygen-containing heterocyclic compounds, tricresyl phosphate isomers, carbon monoxide, carbon dioxide and ozone.
- Possible options for passive air sampling
- A large number of sectors would need to be monitored to have a high degree of confidence of including and engineering-confirmed fume incident.

CONCLUSIONS - HEALTH

- Insufficient evidence to recommend additional epidemiological research on acute health effects
- Available evidence, although limited, supported further investigation of neuropsychological impairment in commercial pilots
- This could take form of a cross-sectional comparison of symptoms and testing in pilots flying different airframe/engine combinations, and in those who do or do not report air quality incidents.

BACKGROUND TO 2013 REVIEW

- Asked to comment on reports of four projects commissioned by UK Department for Transport in response to COT recommendations in 2007
- Also considered peer-reviewed papers on exposures published since 2007

PROJECT 1 (CRANFIELD UNIVERSITY)

- Preliminary study to test air-sampling devices
- Identified need for better standardisation and further validation of analytical methods, and adaptation to a wider range of pollutants
- Diffusive SPME fibres unsuitable for sampling
- Transient increase in ultra-fine particle concentration during perceived fume event, but only for a few seconds
- Peak concentrations during such events would be difficult to detect for many pollutants

PROJECT 2 (CRANFIELD UNIVERSITY)

- Air sampling during 100 flights (5 types of aircraft)
- No major fume events
- Limited range of analytes and quality assurance less than desirable
- For the types of aircraft studied, and in the absence of a major fume event, airborne concentrations of the pollutants studied are likely to be very low
- Does not rule out higher concentrations on some flights or of other pollutants
- Large scale monitoring using similar methods would be difficult and expensive

PROJECT 3 (IOM)

- Measured surface residues of four organophosphate compounds in 17 aircraft (not subject to any major fume events)
- Levels were all low
- Uncertainties about deposition velocity for particles, and possibility of occurrence as vapour as well as in particles

PROJECT 4 (CRANFIELD UNIVERSITY)

- Statistical analysis of operational parameters in relation to fume events
- Limited by lack of information about timing of events during flights (could not distinguish effects of pilot's response)
- Demonstrated feasibility of such analyses, which could usefully be refined

OTHER PUBLISHED PAPERS ON EXPOSURES

- Liyasova et al (2011) detected adducts of a TCP metabolite with butyryl cholinesterase in blood of 6 out of 12 jet plane passengers, but only at very low levels
- Biomonitoring study by Schindler et al (2013) found no *o*-TCP above limit of detection (0.5 µg/l) in urine samples from crew who reported fume/odour during last flight

COT CONCLUSIONS

- Based on new data reviewed and information considered in earlier review
- Published as position paper

COT CONCLUSIONS 1

Contamination of cabin air by components and/or combustion products of engine oils, including triaryl phosphates does occur, and peaks of higher exposure have been recorded during episodes that lasted for seconds

COT CONCLUSIONS 2

- Episodes of acute illness, sometimes severely incapacitating, have occurred in temporal relation to perceived episodes of such contamination
- There are a number of air crew with long-term disabling illness which they attribute to contamination of cabin air by engine oils or their combustion products

COT CONCLUSIONS 3

- The acute illness which has occurred in relation to perceived episodes of contamination might reflect a toxic effect of one or more chemicals, but it could also have occurred through nocebo effects
- There is strong scientific evidence that nocebo effects can lead to (sometimes severely disabling) illness from environmental exposures that are perceived as hazardous

NOCEBO EFFECTS

- An illness or exacerbation of illness that arises from perceived exposure to a noxious agent through psychogenic mechanisms which depend on an expectation of harm
- Parallel with placebo effects
- Not a reflection of mental illness
- May be mediated through demonstrable physiological processes

COT CONCLUSIONS 4

- There is no simple and reliable way of demonstrating that nocebo responses are responsible for individual cases of illness
- Distinguishing likelihood of toxic v nocebo effects depends on:
  - pattern of symptoms and clinical abnormalities
  - known toxicity of relevant chemicals and exposure-response relationships

COT CONCLUSIONS 5

- Patterns of illness that have been reported following fume events do not conform with what would be expected from exposure to triaryl phosphates
- Over-exposure to tricresyl phosphates would be expected to cause delayed peripheral neuropathy

COT CONCLUSIONS 6

- More generally, a toxic mechanism for the illness that has been reported in temporal relation to fume events seems unlikely
- To cause serious acute toxicity, chemicals would have to occur at very much higher concentrations than have been found to date
- The symptoms that have been reported have been wide-ranging and non-specific

POSSIBLE LINES OF FURTHER RESEARCH

- Collect better information about incidence and nature of fume events (limited data for all flights and more detail for flights in which events occurred)
- Case-control study to investigate associations of fume events with operational parameters
- Further biomonitoring studies
- Exploit new technology for automated triggering of air sampling, or induce fume events experimentally, to better characterise pollution during fume incidents

CAUTION

"Finally, it should be emphasised that illness can be disabling whether it occurs through toxicity or through nocebo effects, and therefore there is a continuing imperative to minimise the risk of fume incidents that give rise to symptoms."