# BRE's Aircraft Cabin Environment (ACE) facility

Farshad Alamdari, Chief Scientist

4th Aircraft Fire and Cabin Safety Research Conference, Lisbon, 2004

BRE

- Located in the UK near London Heathrow
- Over half of the 600 staff are consultants, many of whom are international experts
- Extensive experimental facilities

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# About BRE

- World leading Centre of expertise on the built and internal environment
- Established for over 80 years
- Consultant to UK and other national Governments, European Union and major commercial clients
- Structured to ensure confidentiality

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# Specialists in the indoor environment

- Buildings
- Aircraft
- Trains
- Motor vehicles
- Ships

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- Buildings
- **Aircraft**
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# ACE facility

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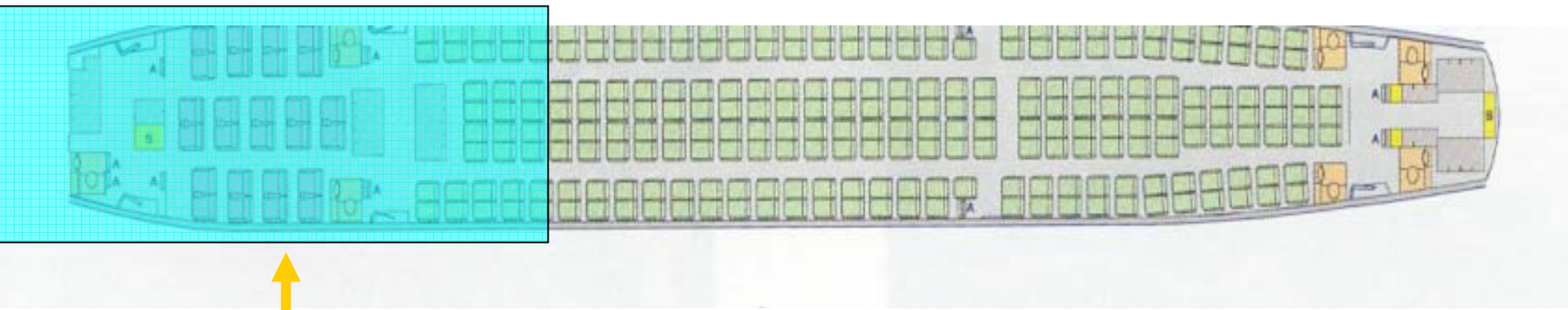
# ACE facility

- 17 m long forward section of a wide-bodied fuselage
- Capacity for 50 passengers, flight and cabin crew



**We have this section plus cockpit**

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# ACE facility

- Designed as an adaptable facility
- Study specific aspects of the cabin environment during simulated flights
- Currently controls noise, vibration, temperature, humidity, ventilation

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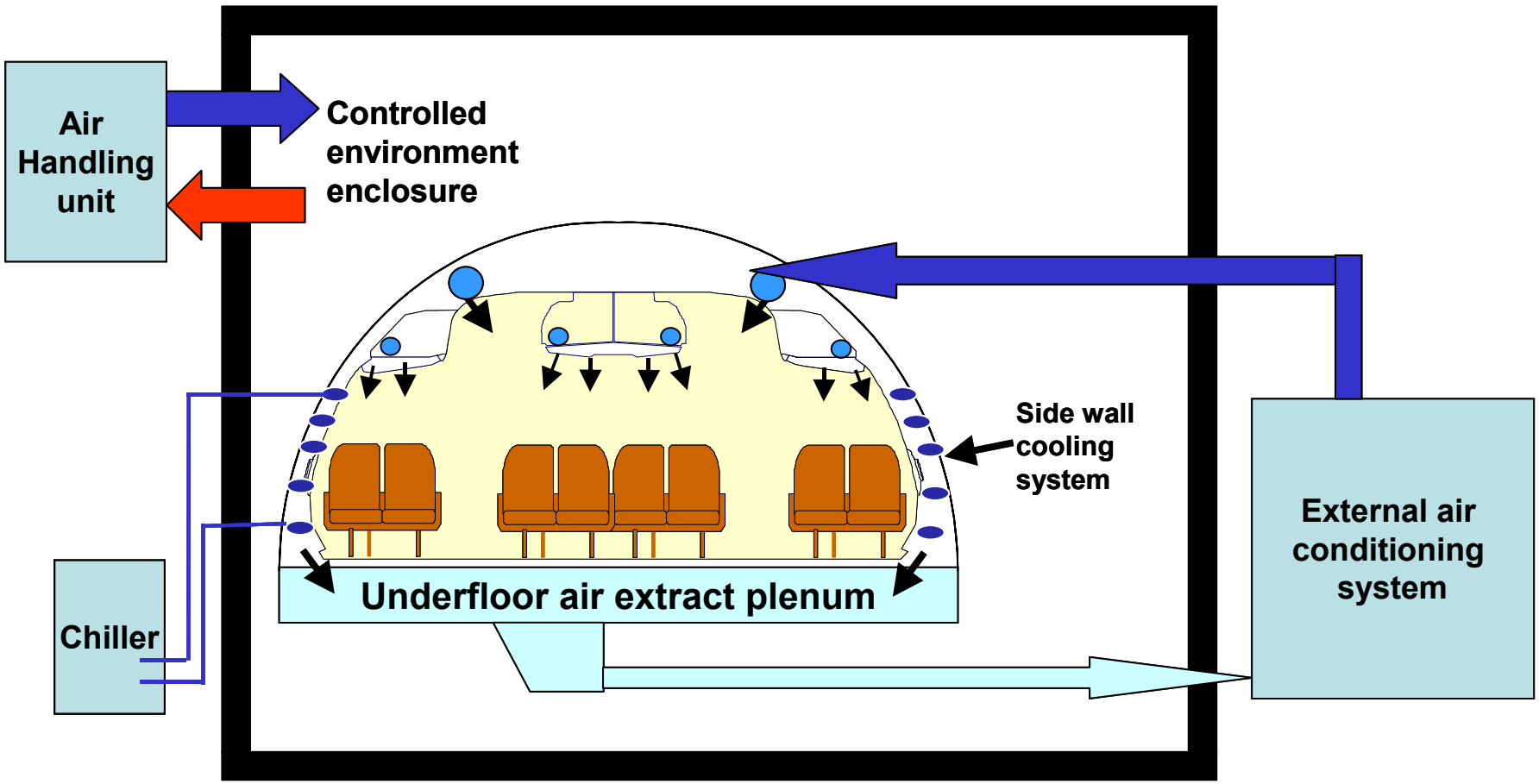
# Air conditioning system



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European Commission

# BRE Aviation projects using ACE

- Work Package leader in EC HEACE project
  - € 6 million, 3 year programme
  - 8 partners
  - Scientific knowledge, assessment tools for more ‘friendly’ aircraft design

- Work Package leader in EC FACE project
  - € 48 million, 4 year programme
  - Industry led partnership
  - Selection and integration of improved technology concepts

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# HEACE

HEACE (Health Effects of Aircraft Cabin Environment)

- This project investigates the aircraft cabin and flight deck as a working environment
- The principle aim is to develop a Human Response Model for cabin and flight crew
- This model will predict health, comfort and performance of crew for given environmental parameters

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# FACE

FACE (Friendly Aircraft Cabin Environment)

- This project aims to improve cabin comfort for passengers
- It investigates technological advances in airframe and multimedia design
- The aims of these innovations include the reduction of noise and vibration in the cabin, and the improvement of air quality and hygrothermal conditions.
- BRE's main focus is the development of an Environmental Comfort Index for passengers, which will be used for the assessment of the cabin environmental impact of new technologies

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# Experimental Design and Methodology

- All experimental settings were based on in-flight measurements and recordings
- Each test included flight crew, cabin crew and passengers
- ACE bridges a gap between chamber work and fieldwork – providing a realistic flight experience with environmental control. This makes results and modelling more transferable to the real environment.

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# Test parameters

- Noise
- Vibration
- Air quality
- Temperature
- Humidity
- (Workload)  Crew only
- (Glare)  Flight crew only
- (Heat gain)  Flight crew only

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# CBRN

- BRE has computational modelling tools to simulate the movement of a contaminant release about the aircraft
- ACE complements this and can be used to:
  - validate any computer model
  - experimentally simulate a release
- The computational and experimental modelling is useful to:
  - identify ways of minimising the risk from any attack
  - Develop and locate CBRN sensors

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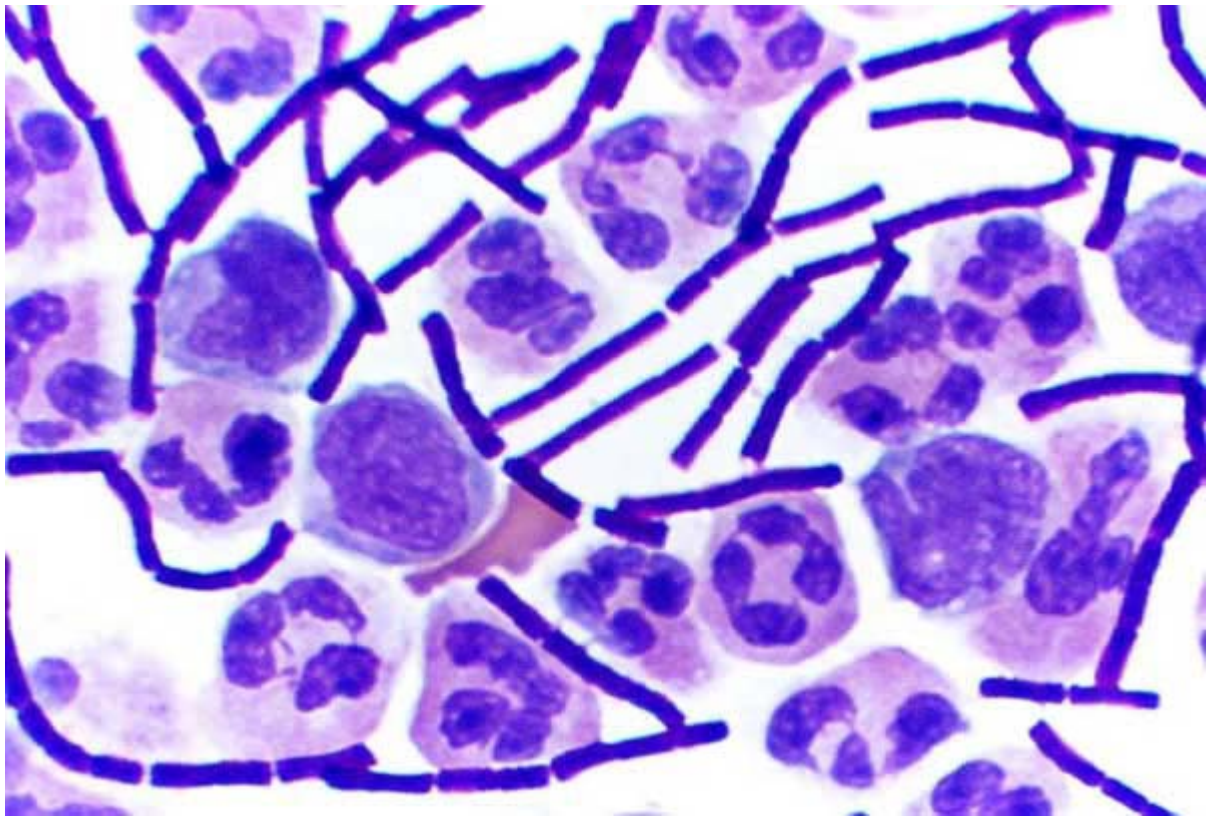
# Anthrax



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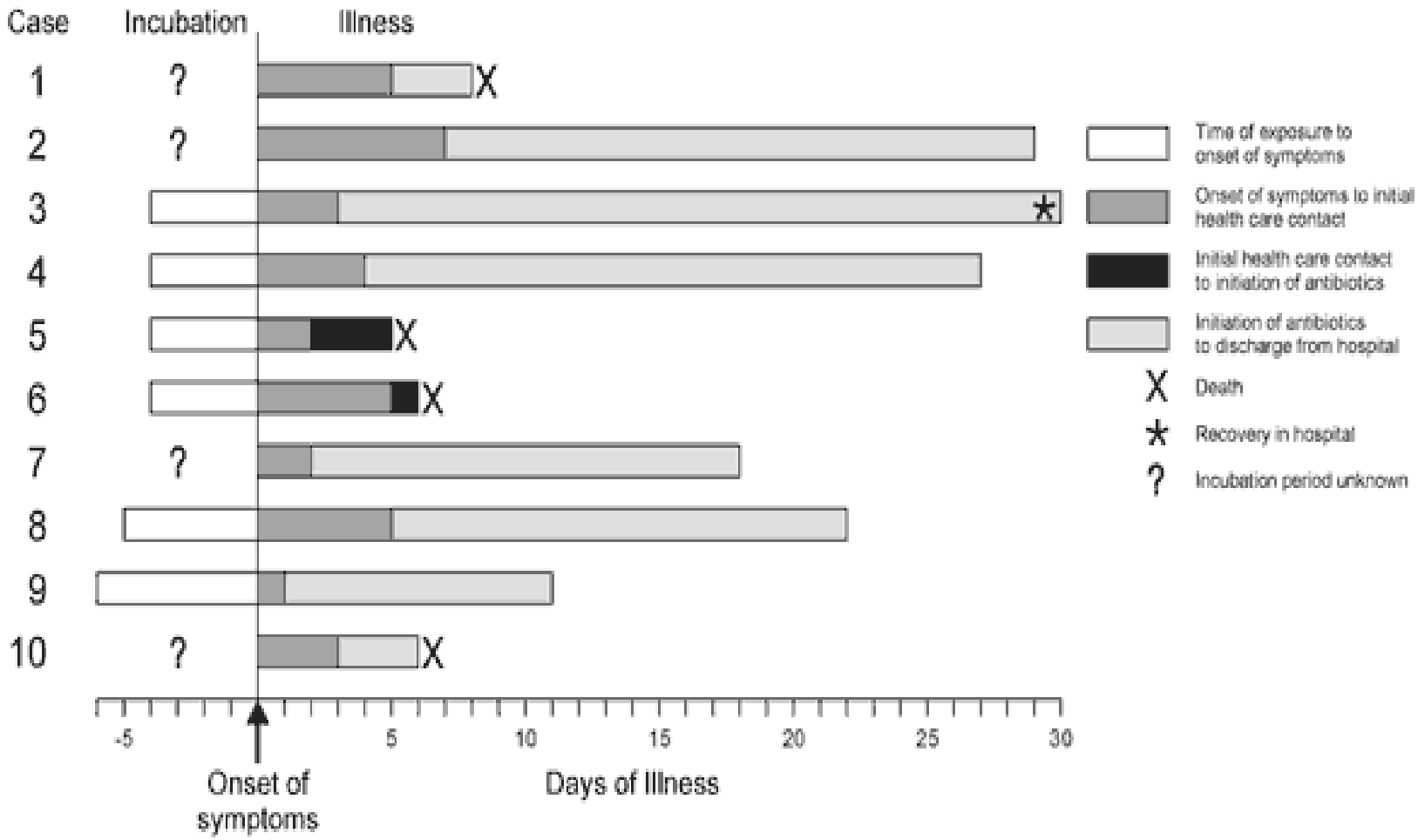
# Anthrax – recent cases



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# Smallpox

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# Modelling contaminant movement

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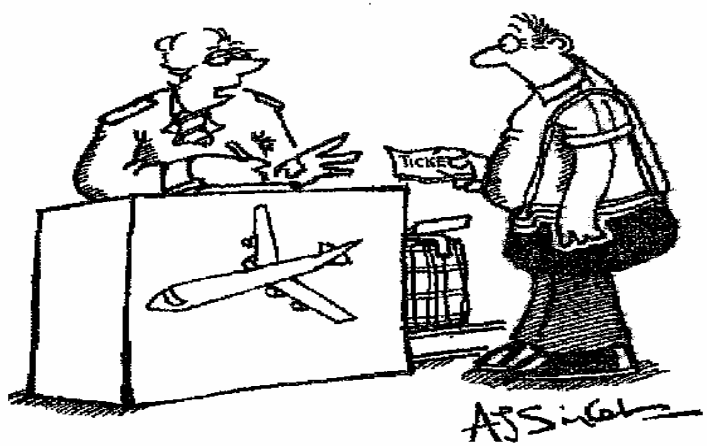
# Deep Vein Thrombosis (DVT)

- ACE facility provides an excellent opportunity to investigate DVT
- Both the cabin interior and environment are realistic
- A large series of controlled experiments can be undertaken
- The sensitivity to pressure can be assessed by other ground-based facilities or in-flight measurements

*'I had a stiff leg but I've been upgraded to deep-vein thrombosis.'*




*'Clotting or non-clotting?'*

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# Fire protection

- Experimental assessment of water spray protection in aircraft fuselages
- Fire safety review and experimental assessment of aircraft baggage fires
- Experimental assessment of fires in micro-gravity and a review of the fire safety provisions on the European Space Station module

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# Fire protection

- Fire suppression development, testing & Certification
  - Water - sprinklers, sprays, mists
  - Chemical agents - halon replacement gases
  - Inert gases

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# Fire protection

- Reaction to Fire & Fire Resistance testing & Certification

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# Fire protection

- Design of fire scenarios and fire tests
  - Free burning
  - Vitiated
  - Fire Effluent measurement and analysis
    - Temperature
    - Rate of heat release
    - Smoke optical density, back-scatter and visibility
    - C0, $CO_2$, $O_2$ Irritants etc

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# Fire protection

- Human Factors
- Human Behaviour/People Movement & wayfinding
- Tenability criteria
- Environmental factors

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