

Aeromedical Challenges of Very Large Passenger Aircraft



**Prof Michael Bagshaw
King's College London**



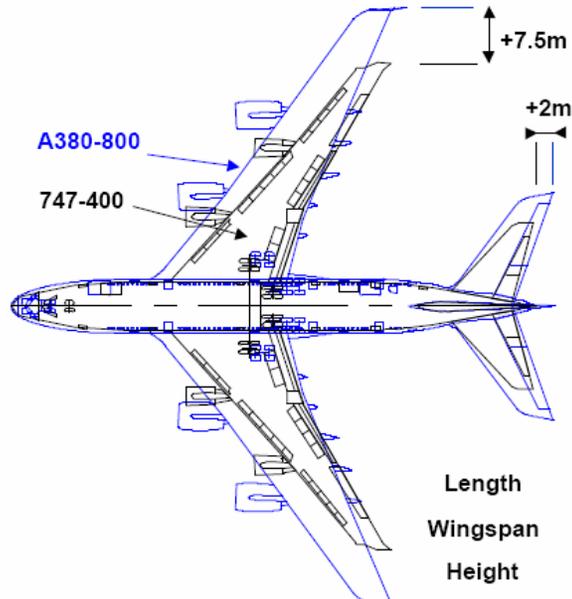
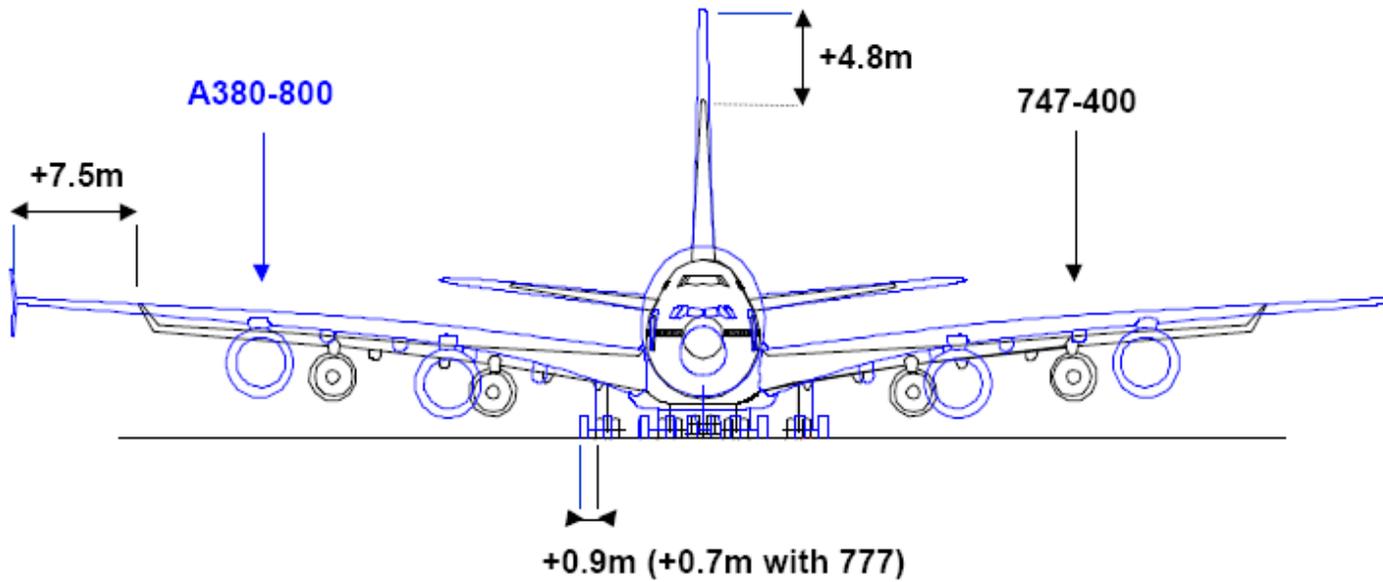
- Does the introduction of very large passenger aircraft pose any unique aeromedical issues to:
 - Passengers?
 - Crew?
 - Others?
- If so, what needs to be done?

Airbus A380-800



- Largest and heaviest passenger aircraft ever built (MTOW: 560t - cf 396t for B747-400)
- 35% more passengers than the B747
- 25% of weight is made up of advanced composites
- 15% reduction in seat mile costs

Comparison with 747-400



	A380-800	747-400
Length	72.7m (239ft)	70.7m (232ft)
Wingspan	79.6m (261ft)	64.5m (212ft)
Height	24.1m (79ft)	19.3m (63ft)

Interiors







A380 Customers / Orders

159 firm orders & commitments from 16 Customers

132 A380
27 A380F



AIR FRANCE



10 A380



中国南方航空集团
CHINA SOUTHERN AIRLINES (GROUP)

5 A380



Emirates



41 A380 **2 A380F**



ETIHAD



4 A380



FedEx
Federal Express



10 A380F



ILFC



5 A380 **5 A380F**

4 a/c



KINGFISHER

5 A380



KOREAN AIR



5 A380



Lufthansa



15 A380



QATAR AIRWAYS القطرية



6 A380



2 A380



GIANT AIR



12 A380



SINGAPORE AIRLINES



10 A380



Thai

6 A380



ups

10 A380F



virgin atlantic



6 A380



Configuration	Total Seats
3-Class (ULR)	489
3-Class (LD)	517
2-Class (HD)	644

Layout



3 CLASS OPERATION

Ultra Long haul=489 pax

-----76 Business Class-----14 First Class-----

-----399 Economy Class-----



3 CLASS OPERATION

517 pax

-----76 Business Class-----14 First Class-----

-----427 Economy Class-----



2 CLASS OPERATION

644 pax

-----155 Economy Class-----52 Business Class---

-----427 Economy Class-----





Passenger Boarding & Deplaning Procedures (Including Upper Deck)

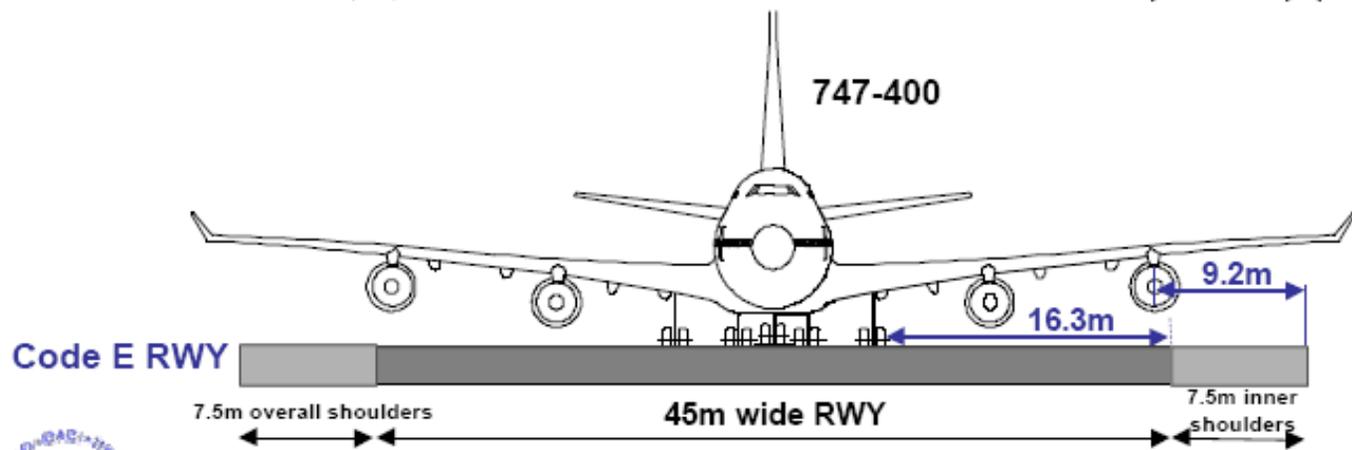
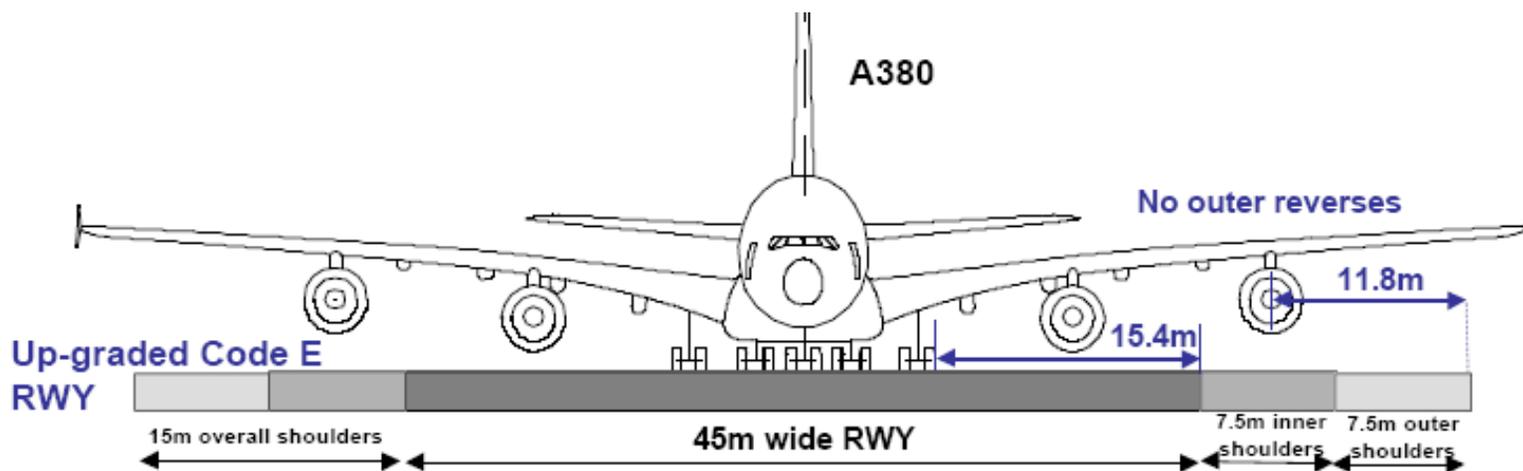


First & Business

Economy

Airport Compatibility





Global A380 airport readiness status - 2006

By 2006, 20 airports will be ready for the A380

These 20 airports handle 52% of all worldwide 747 flights

Source: OAG Airline
Schedule data 2005



● Ready ● Preparing for first A380 service

Airports preparing will be ready for their first A380 service, readiness is driven by airline demand

Aeromedical Considerations



In-Flight Medical Incidents



New Scientist Magazine

Issue 2500 20 May 2005

“ The A380's ability to carry twice the number of passengers as many of today's planes will almost double the chances that on any given flight someone will need urgent medical attention. Yet the air transport industry appears unprepared for this, New Scientist has discovered.”

“ a 2000 UK government report showed that the number (IFMIs) can be as high as 1 in 1400 passengers flown. And a recent US study of one airline showed that 8 per cent of on-board medical incidents resulted in the aircraft being diverted to the nearest airport.”

Farrol Khan of the Aviation Health Institute in Oxford, UK, insists that changes are essential. "It is important that a doctor is on board," he says. "It should be made an essential feature of flying the A380."

In-Flight Medical Incidents (IFMIs)

- Incidence?
- Outcomes?
- Diversions?
 - Incidence and Causation?
- Medical contributions to outcomes?
- Effect of high passenger capacity?



IFMIs – Frequency?

- Literature review by Gendreau MA, DeJohn C.(2002)
 - Varies from 1/39600 pax to 1/11000 pax dep. on reporting
 - Vasovagals = 22% of total
- LAX arrival study (1989)
 - 260 pax (0.003% of the 8,735,000 arrivals) symptoms in-flight
 - 137 required ED assessment , 25 admitted
 - 7 in-flight deaths
- Ground-to-air medical assistance study (DeJohn, 2000)
 - 1,132 IFMIs on 5 US airlines,
 - Rate of 8 per million enplanements
 - 179 passengers required hospital assessment,
 - 173 admitted

IFMIs - Diversions

Delaune et al. (2003) 1.

- 210 medical diversions per million flights (1/4754 flights)
- 7.9% of ‘incidents’ resulted in a diversion
- Chest pain/cardiac, neurological, GIT, syncope & trauma made up 75% of diversions

DeJohn (2000)2.

- Diversion in 13% IFMIs (1/1 million pax)
- Top 4 causes (descending order): Cardiac(45%), neurological, vasovagal & respiratory
- 19% “probably unnecessary in light of subsequent follow-up information.”

BA Reported Incidents Jan - Dec 2000

- Total passengers carried 36,346,000
- Total reported incidents ~3,500
- Deaths on board 10
- Medical Diversions 41

BA 'TOP 6' CONDITIONS

Jan - Dec 2000

1.	Diarrhoea and/or vomiting	25%
2.	Fainting	14%
3.	Asthma	4.8%
4.	Respiratory (other)	4.5%
5.	Head Injuries	3.6%
6.	Burns and Scalds	3.3%

Diversions 2000 - Outcome

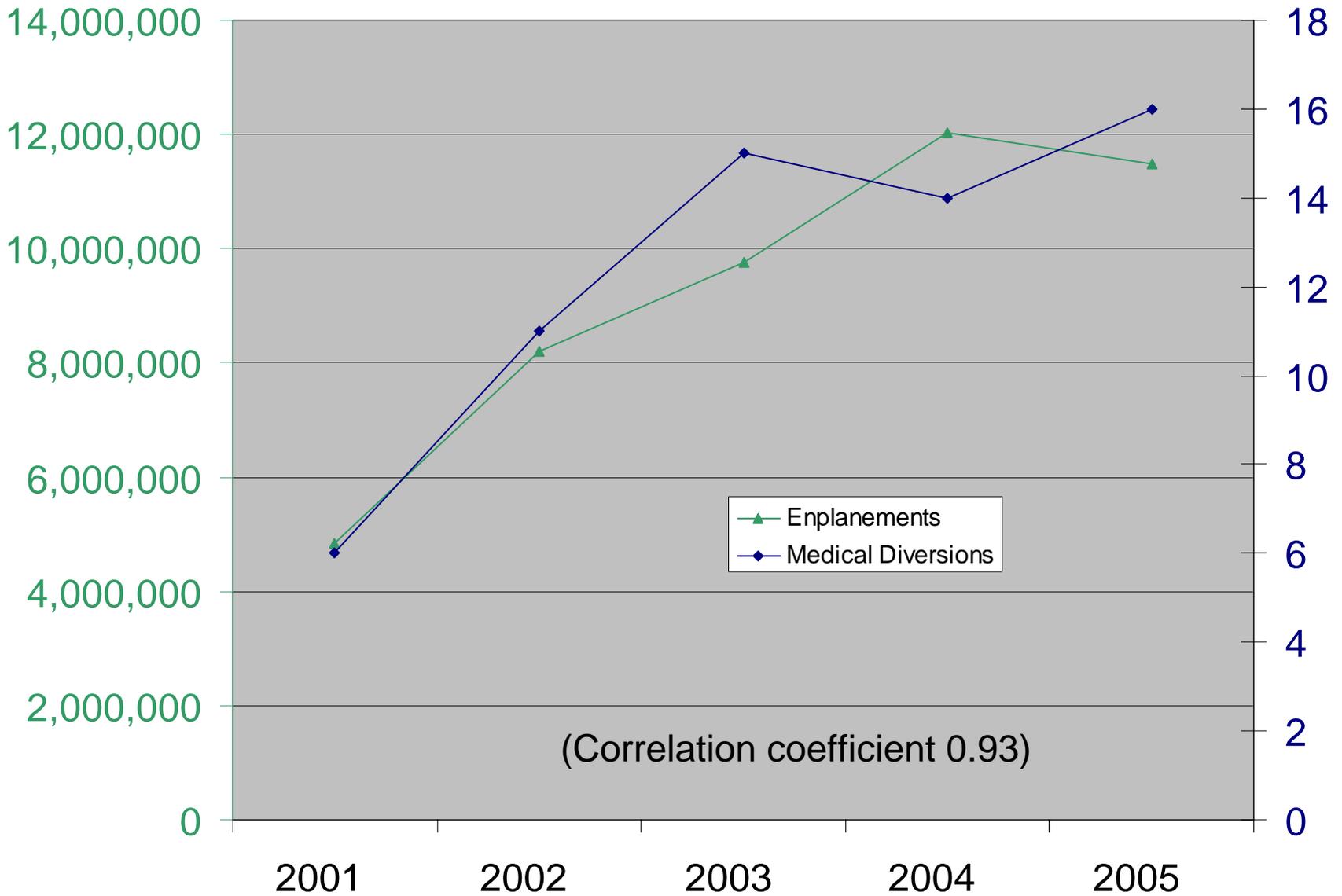
Outcome	%	Pilot initiated	MedLink initiated	Total
Patient admitted to hospital	55%	5	18	23
Patient evaluated at ER & released	38%	6	10	16
Patient evaluated & released at site	2%	1		1
Consultation only - no arrangements made	2%	1		1
Patient refused medical attention	2%	1		1

BA Diversions 2001

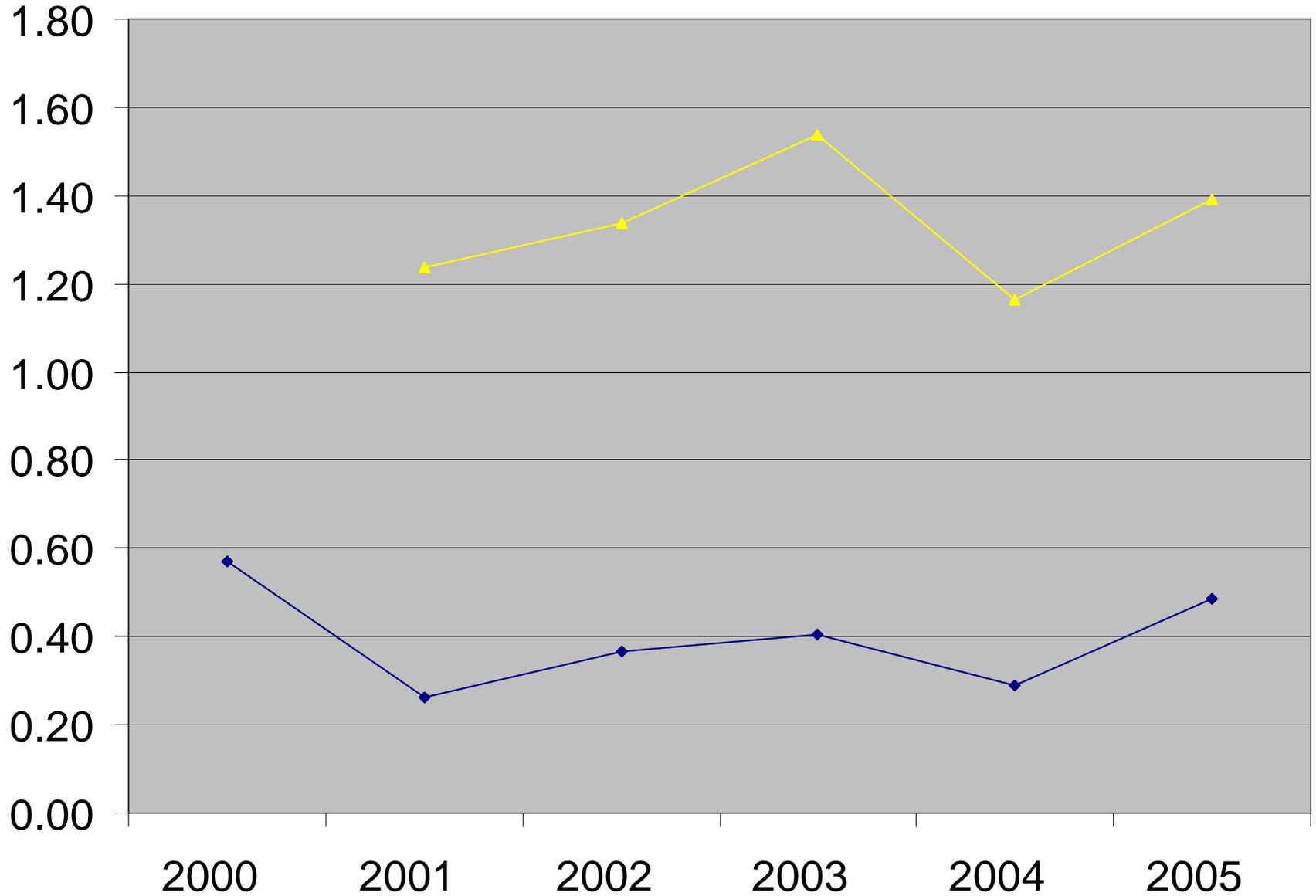
Top 5 reasons for diversion

•Cardiac	26.7%	16
•Neurological	18.3%	11
•Gastrointestinal	11.7%	7
•Obs/Gyn	11.7%	7
•Respiratory	8.3%	5

Enplanements and Medical Diversions per annum



Medical Diversion Rates 2000-2005

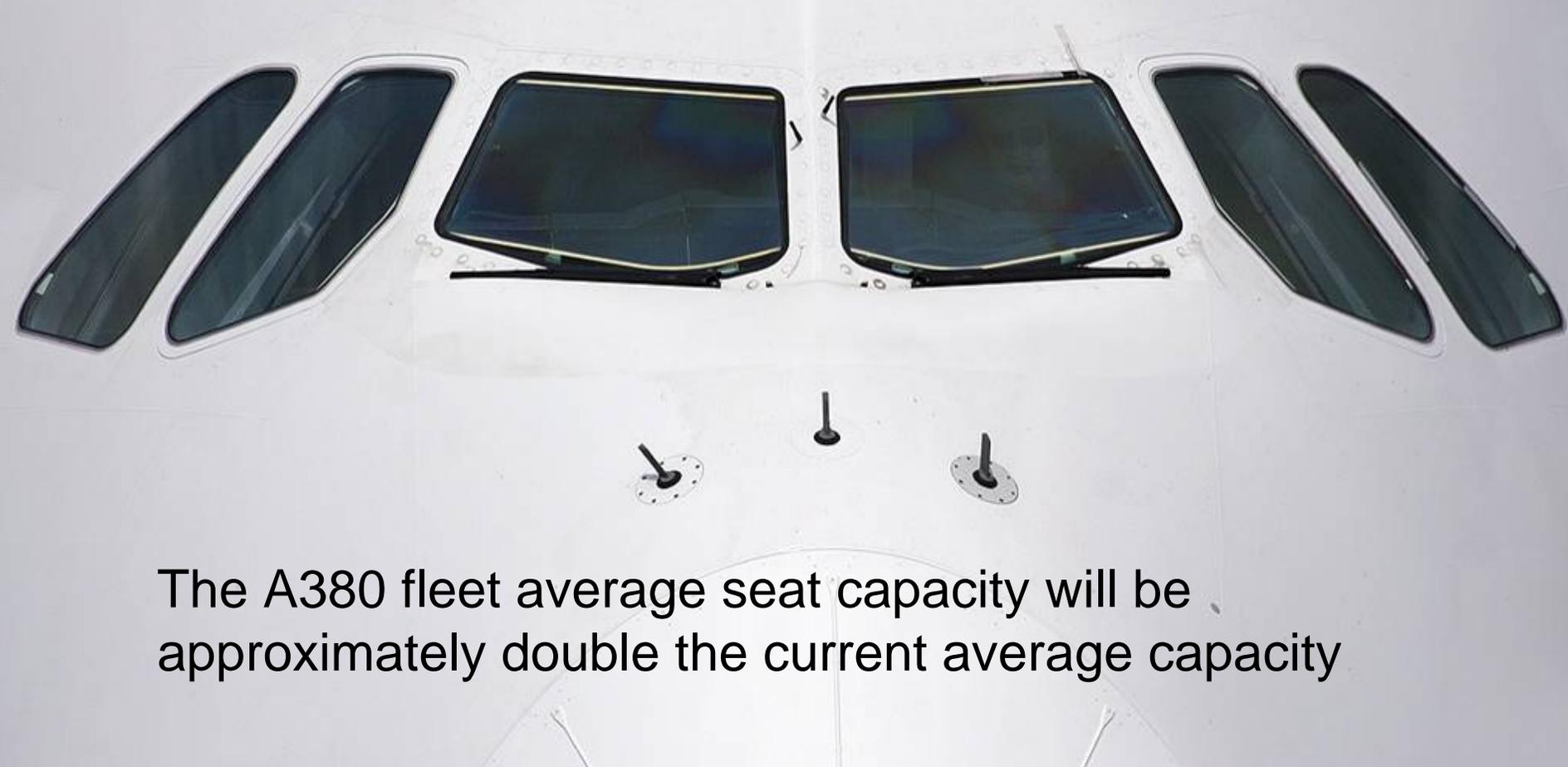


Conclusions from data



- IFMIs are uncommon events
- Serious IFMIs are very uncommon
- Diversions are rare
 - many are unnecessary
 - Cardiac causes constitute 45-50% of cases
- Presence of Medical personnel aboard does not appear to reduce the diversion rate or improve the patient's condition
- Expert advice in diversion decision making and patient care seems to be valuable

A380 and Diversions



The A380 fleet average seat capacity will be approximately double the current average capacity

A380 Diversions - Impact

- Safety
 - Unplanned approach / unfamiliar airfield
 - May be hours from suitable airfield on ULR flights
 - Benefit to patient vs. risk to others
- Logistics
 - Airport compatibility – runway / taxiway / towbar
 - Challenge to receiving airfield - accommodation / medical
 - Inconvenience to pax
- Costs?
 - Fuel
 - Missed connections
 - Accommodation
 - Crew costs



ULR Diversions



EXTRA MEDICAL PRECAUTIONS?

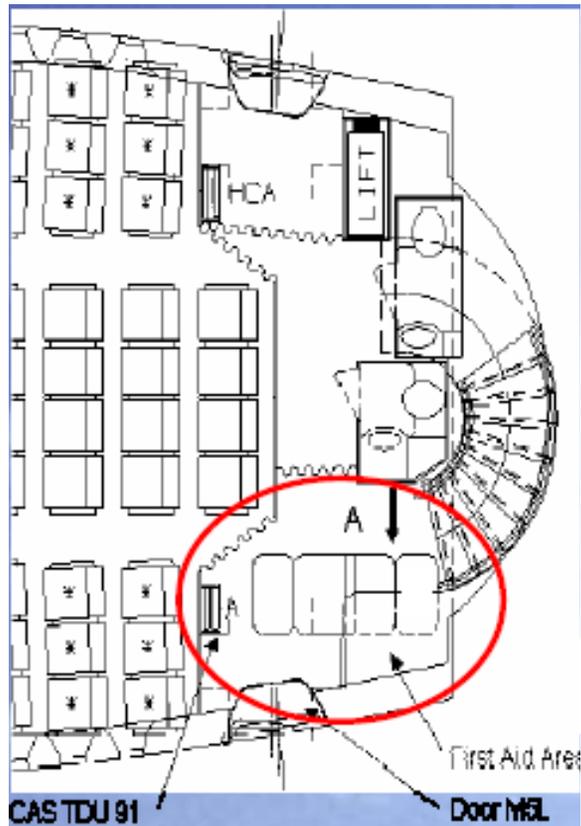


Medical Staff Onboard?

- Doctors, Nurses, Paramedics?
 - Doubling as Cabin Crew?
- Rate of utilisation
 - Any IFMIs 1/39600- 1/11000 pax ¹
= 1 in every 20-72 A380 flights
 - IFMIs warranting Medlink calls 8 per 1M pax ²
= 1/277 A380 flights
 - Diversions currently 1 / 4754 ³
= 1/2377 A 380 flights
- Costs? Logistics?



Medical Modules?



Medical Modules - issues

- Pros
 - Central point for medical care and equipment
 - Well designed space efficient
- Cons
 - Weight / space
 - Takeoff / Landing
 - Expense ~ USD400K
- Alternatives?
- Decision?

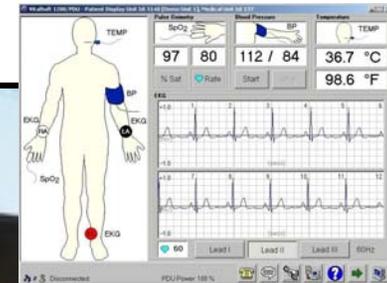
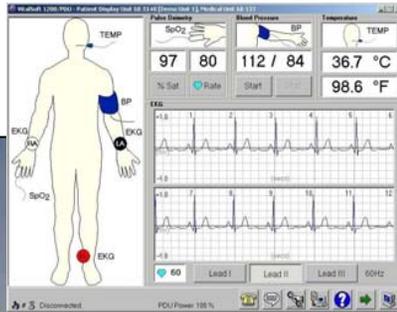
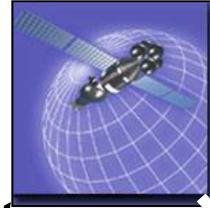


Medical Equipment Enhancement

- More Defibrillators?
- More EMKs?
- Disposables?
- Other equipment?



Medical Telemetry



Conclusions on IFMEs

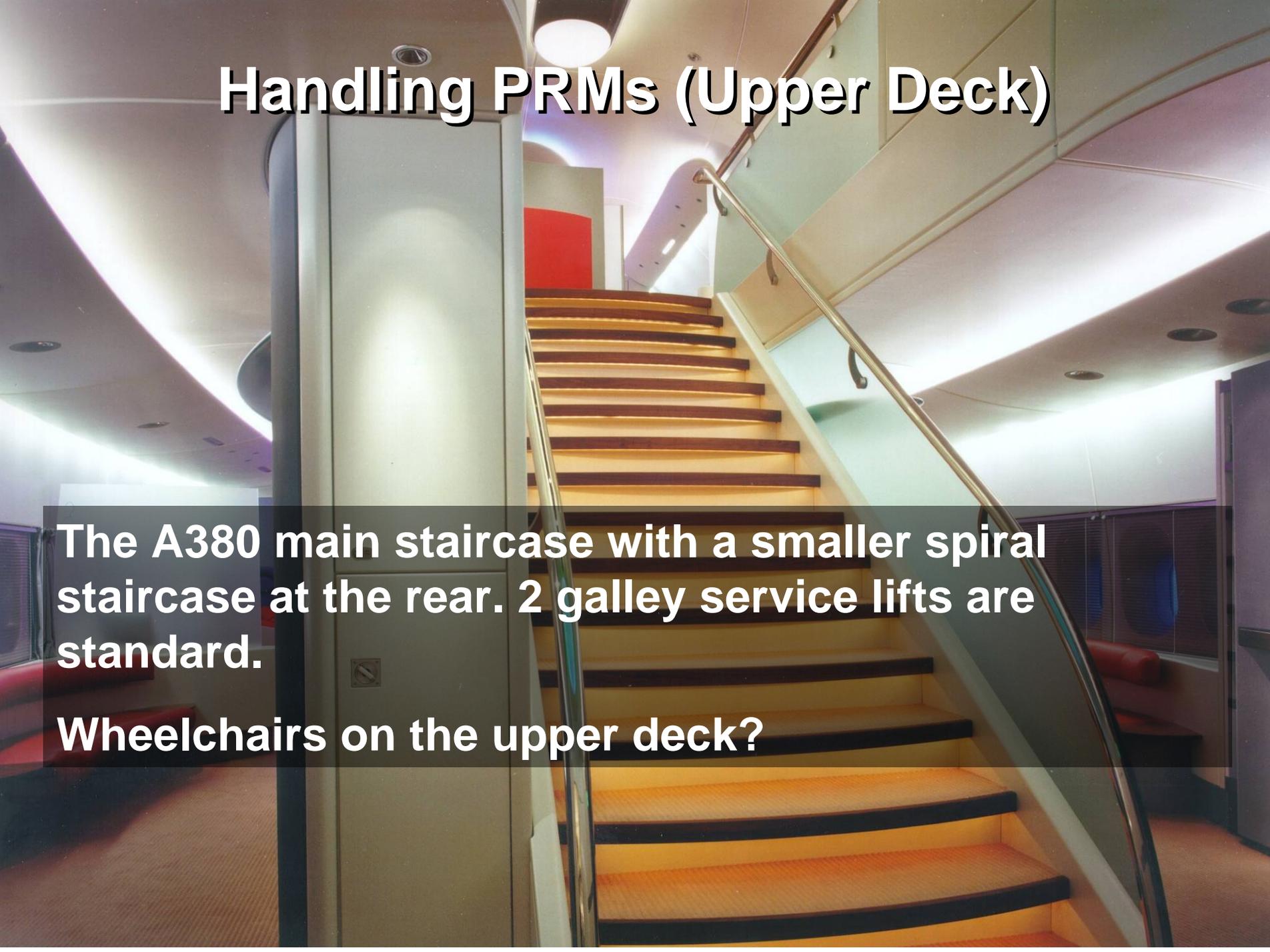
- The high capacity fleet will have an increased medical incident rate per a/c
- Airport compatibility issues and passenger numbers make diversions even less desirable.
- Telemedicine devices may be a cost effective way to improve passenger outcomes and diversion decision making
- Performance needs close audit
- Medical Modules may be advantageous if weight/space permits
- Placing Medical staff onboard high capacity flights is unnecessary as IFMEs are uncommon events



Other Issues

- Passengers
 - PRMs
 - Evacuation
- Crew
 - Crew Rest Facility
 - Noise ?
 - Cosmic Radiation exposure ?
 - Human Factors issues
- Occupational Health Issues

Handling PRMs (Upper Deck)



The A380 main staircase with a smaller spiral staircase at the rear. 2 galley service lifts are standard.

Wheelchairs on the upper deck?

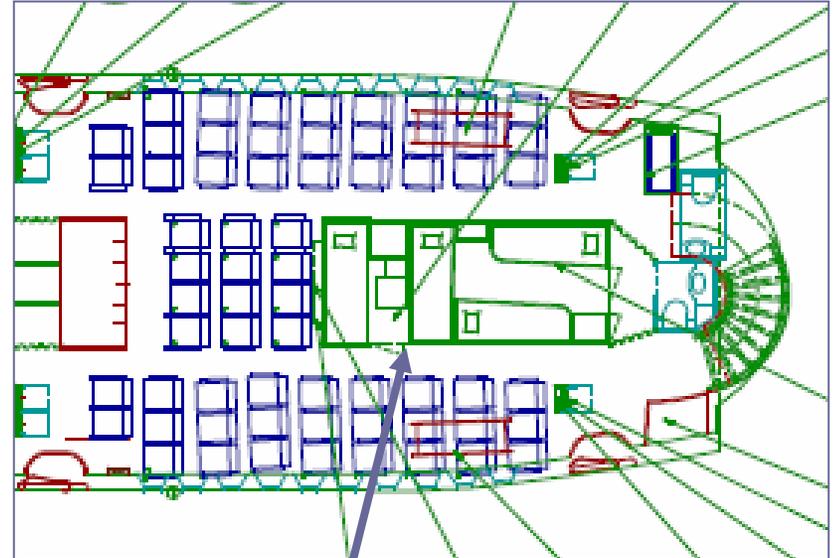
Evacuation

- 853 passengers and 20 crew members had to evacuate the A380 within 90 seconds – in other words, about ten people a second. Only half of the 16 doors were in operation and the drill took place in the dark with just the emergency floor lighting to guide the way – 873 made it off in 78 secs Mar 06



Main Deck Crew Rest Compartment

- Compartment on the main deck rear
- Follows from Crew rest issues on existing ULR a/c
- Increased Crew numbers c.f. A340-500



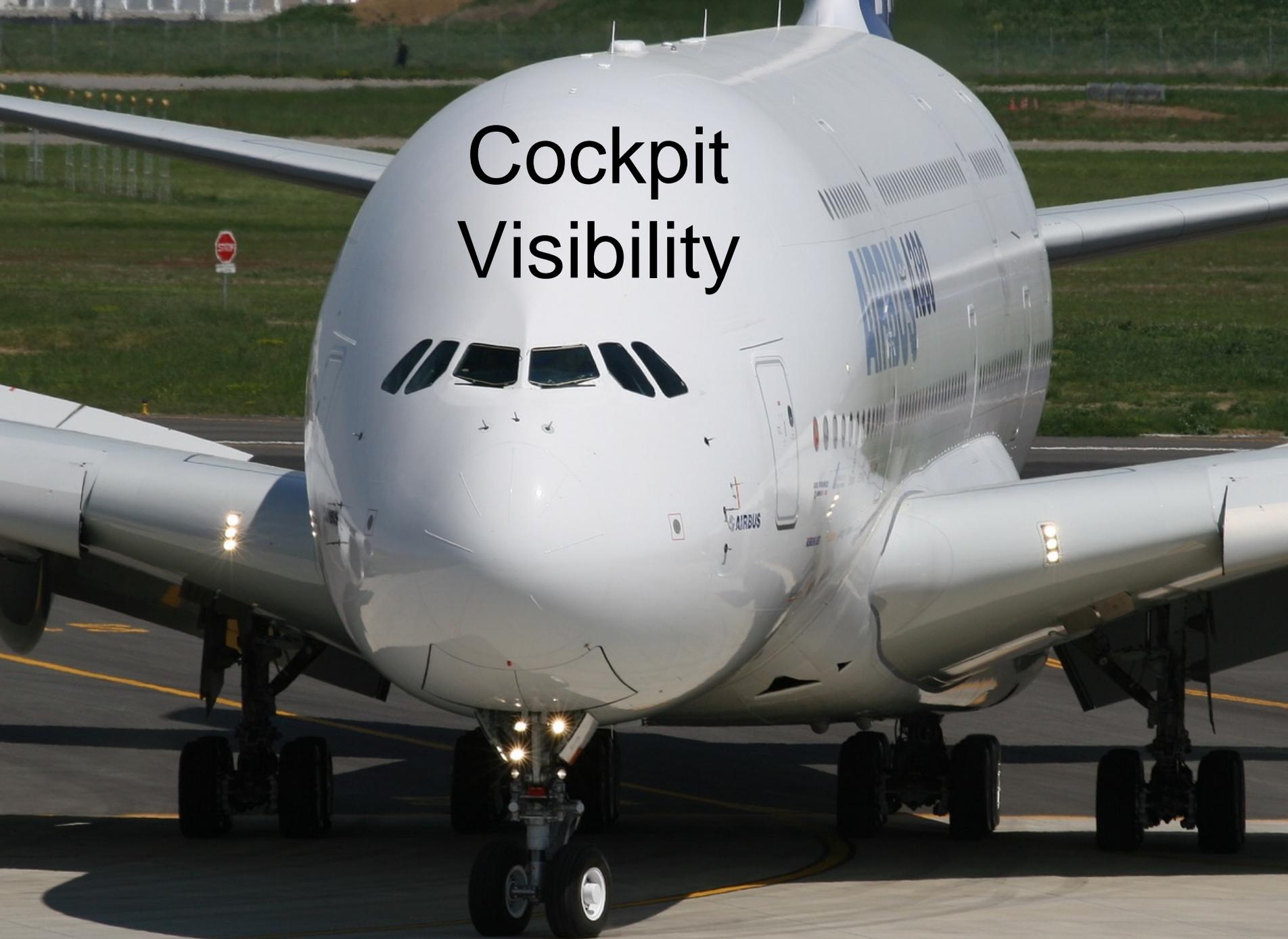
Noise



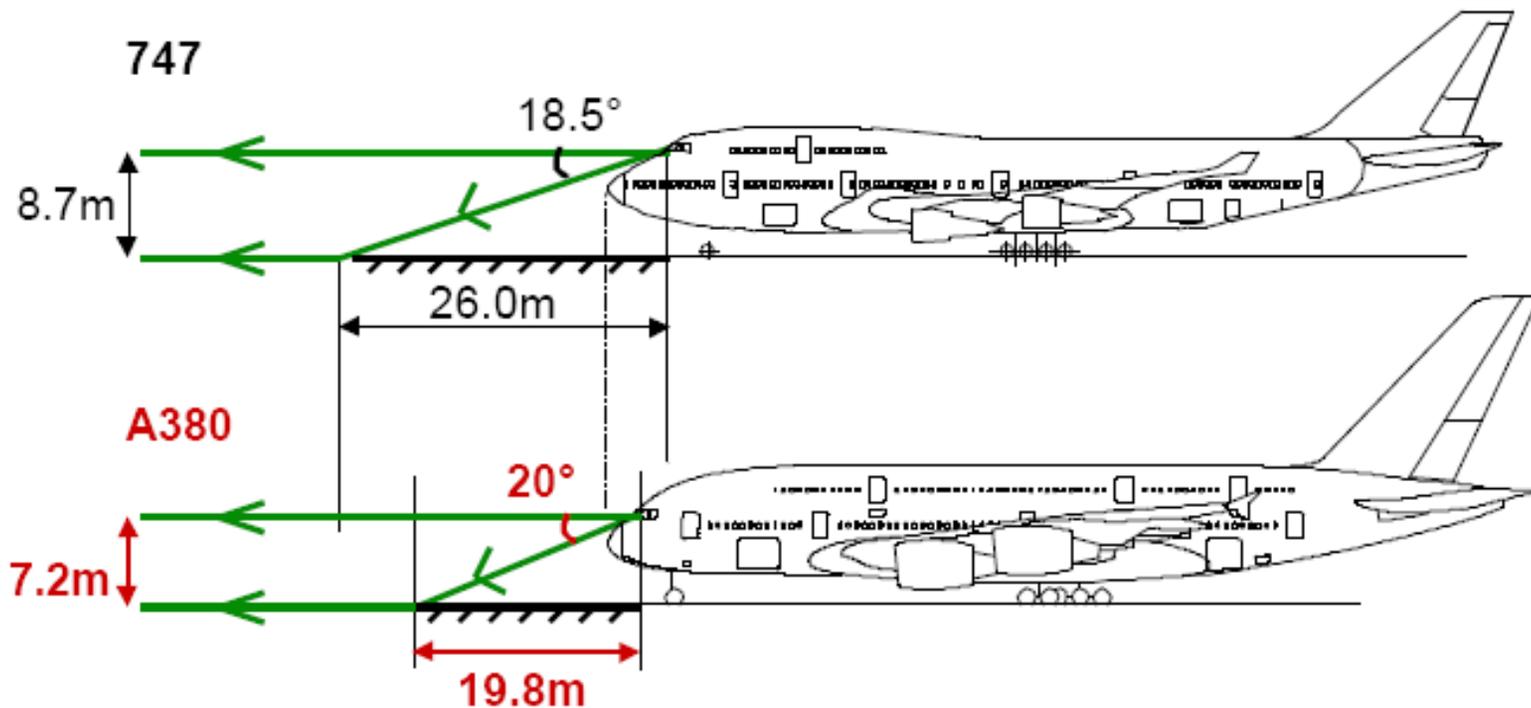
Problems with large passenger volumes??



Cockpit Visibility



Cockpit Visibility A380 - 747



- On ground: cockpit position and pilot view

	A380	747
‣ Pilot eye height less than 747-400:	7.2m	vs 8.7m
‣ Angle of vision better than 747-400:	20°	vs 18.5°
‣ Thus distance from pilot eye to ground better:	19.8m	vs 26.0m
- On approach:

‣ Distance from pilot eye to ground better:	26.5m	vs 44.8m
‣ Lateral visibility better:	40°	vs 27°

Taxi Aid Camera System



- Purpose: to give crewmembers an aircraft **external view** in order to make the manoeuvre easier.
- This visualisation shall be made through the use of two cameras, display being achieved on cockpit displays.
- These cameras are already fitted on A340-500(optional)/600 aircraft.
- This system shall be **basic on A380**.
- It is considered as an aid for ground manoeuvring. It shall be used in same conditions as those defined for Aircraft with his limitations (in day, night, rain, fog, gravel and snow conditions) but has not to bring better vision than that get by human vision. It excludes the use of infrared or ultraviolet pictures.
- It **shall not prevent Aircraft from going in case of failure**.

Cosmic Radiation

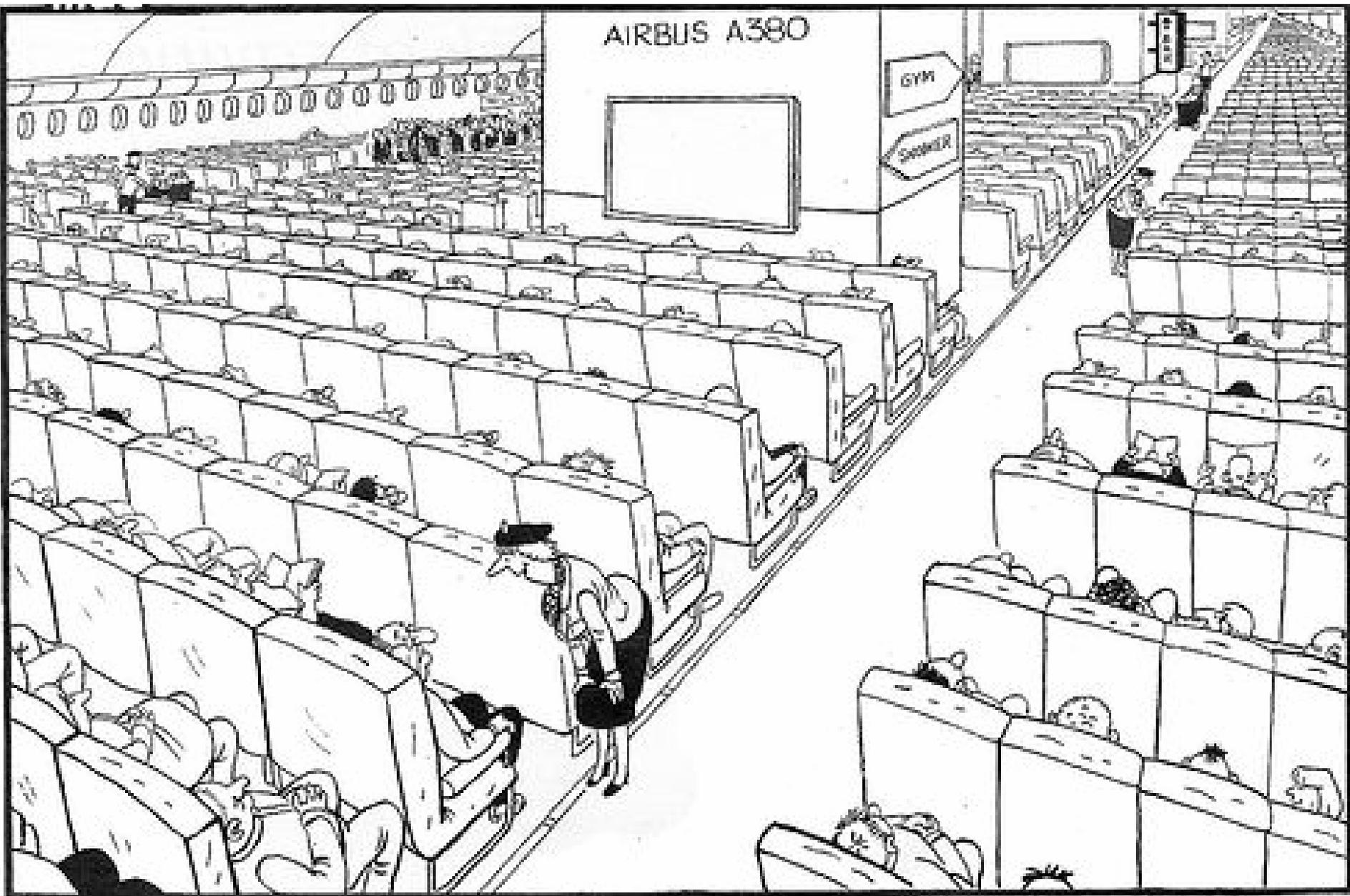
- No difference from current ultra-long haul operations
- Occupational exposures less than 6 mSv per year
- Passenger exposures less than 1 mSv per year

Human Factors Issues

- Commonality with other Airbus flight decks
- Cabin size and service logistics
- Crew rest

Occupational Health Issues





'Time to fasten your seatbelt, sir. The front end has landed.'

Acknowledgement

Dr Ian Hosegood

Emirates

Questions

