Aviation Safety- Relevance to Healthcare

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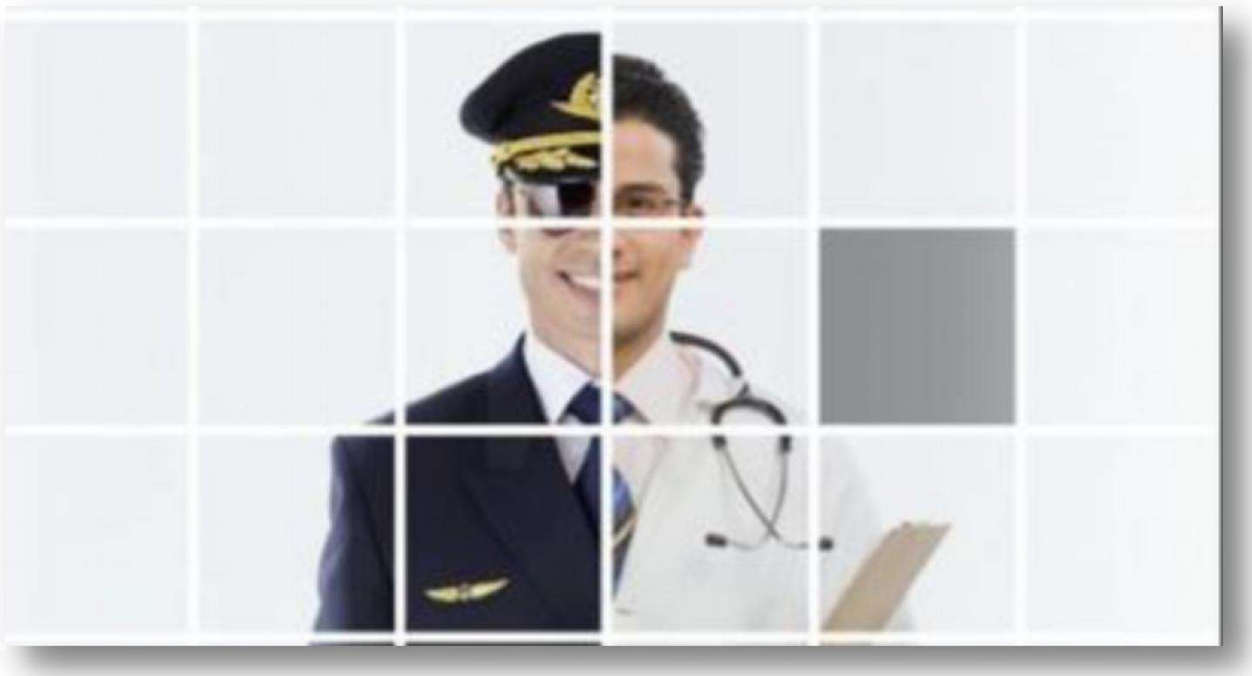
MD

Disclaimer

- These are personal views based on individual experience and open source research and not to be quoted as views of government, regulatory bodies, overall aviation industry.

- There is no known conflict of interest regarding the same

Healthcare Vs Aviation



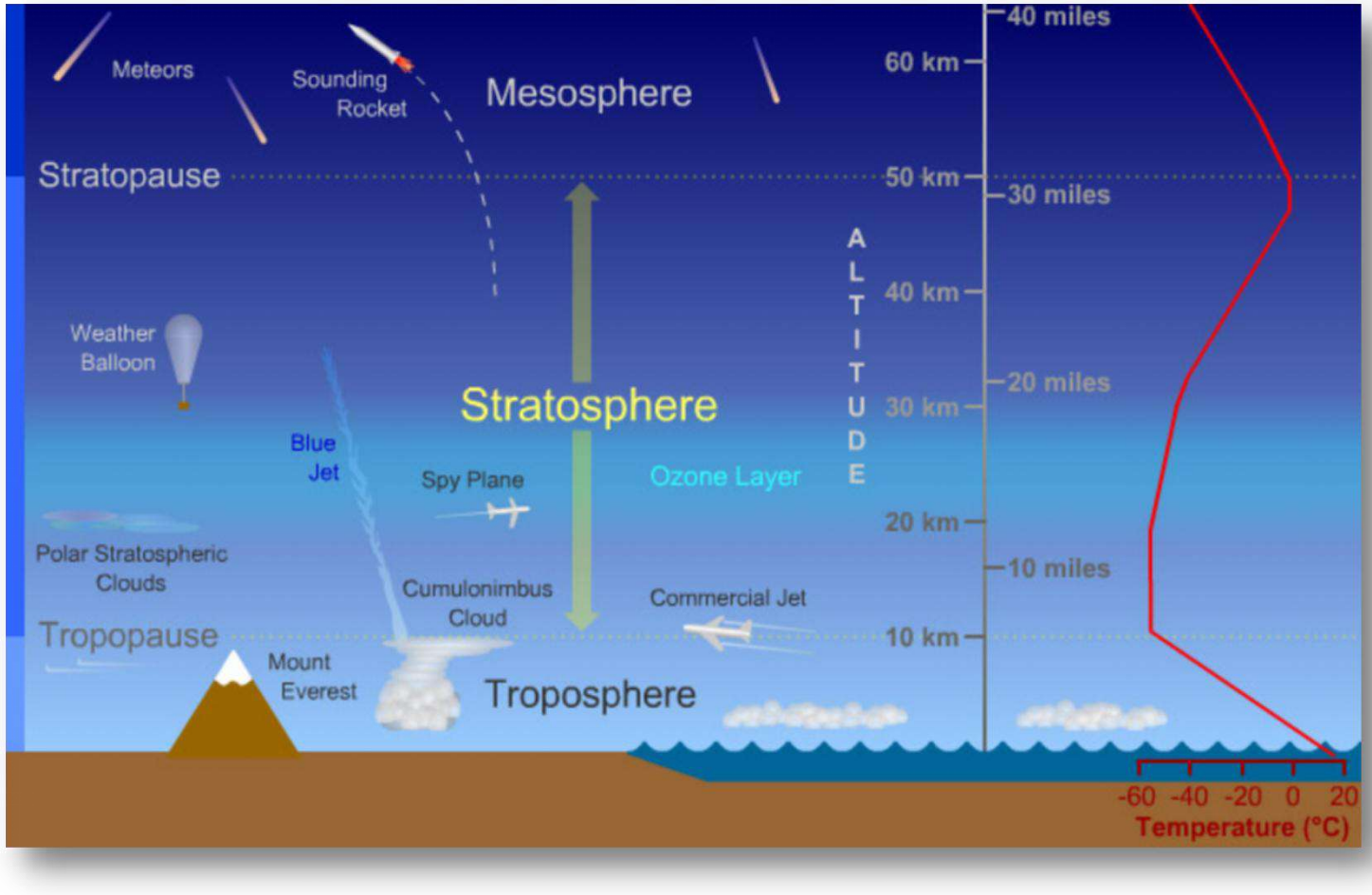
- Staff are highly educated/ trained professionals
- Trying to do the right thing
- Often under extremely stressful circumstances.
- Both handle incredibly complex systems, comprised of several coupled subsystems.
- Responsible for the lives of others
- There is no delegation of responsibility

Plan

- Aviation stresses
  - The Atmosphere
  - Gas Laws
- Mitigating strategies
- Common Challenges
- Aviation safety record
- What can Healthcare learn from Aviation
- What Aviation does better
- Fatigue

The Atmosphere

STANDARD ICAO ATMOSPHERE



Temperature variation

- SEA LEVEL 15.0°C
- 10000 FT - 4.7°C
- 20000 FT - 20.7°C
- 25000 FT - 34.5°C
- 33000 FT - 50.6°C
- 40000 FT - 56.5°C
- 63000 FT - 56.5°C
- 100000 FT - 46.0°C

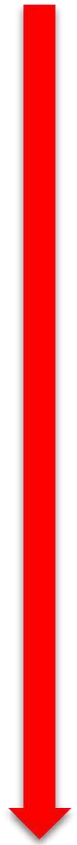
- Temperature lapse rate of 1.98°C for every 1000 ft.
- Ozone layer from above 63000 ft. (formation O_3 exothermic)

◎ Concentration of gases

- Nitrogen 78.09%
- Oxygen 20.95%
- Argon 0.93%
- CO_2 0.03%
- Neon Krypton etc. trace

The Atmosphere

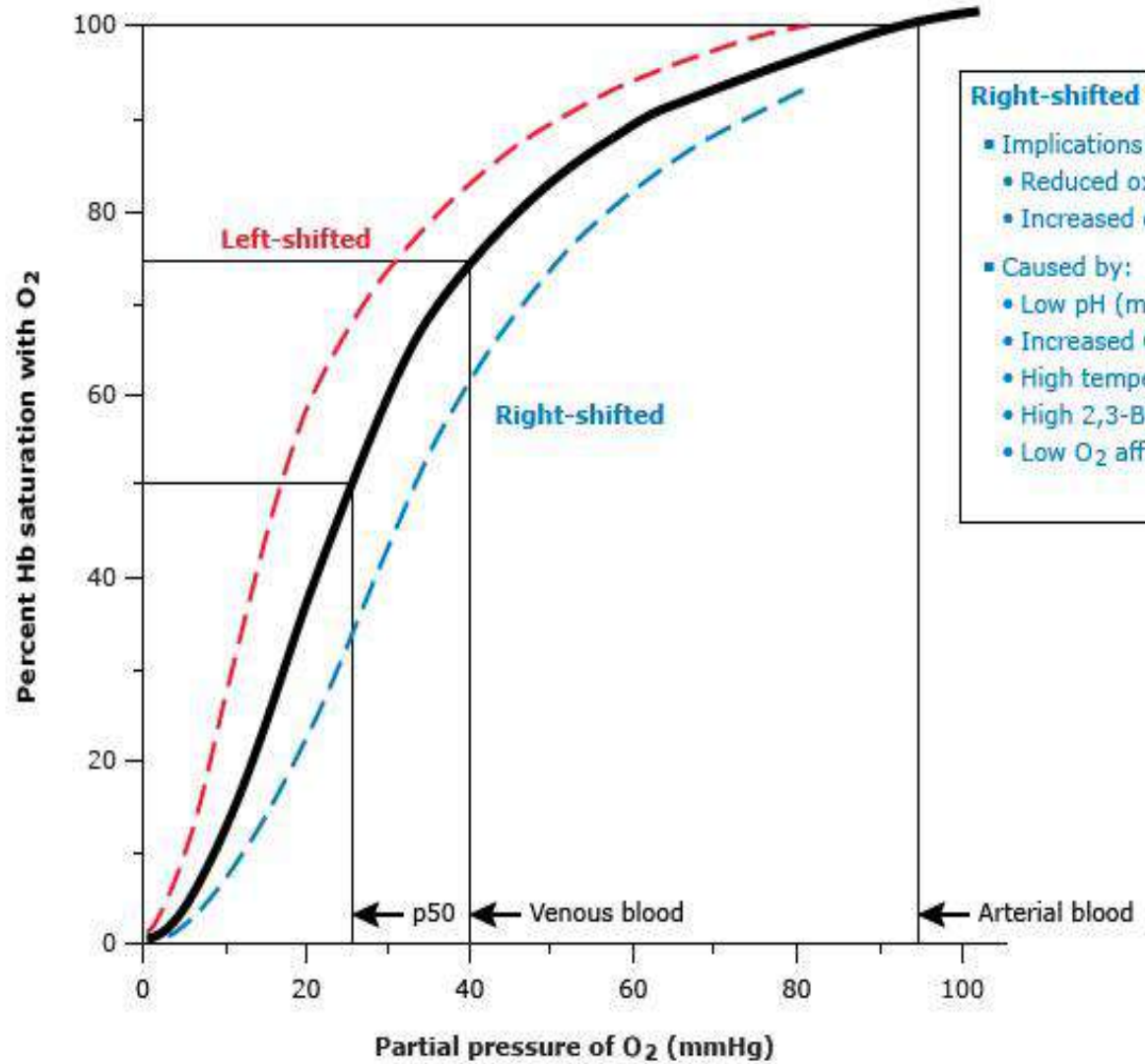
Altitude	Atmospheric pressure	O2 partial pressure mmHg
SEA LEVEL	760 mm Hg	159.6
10,000 ft	523 mm Hg	109.8
18,000 ft	380 mm Hg	79.8
25,000 ft	283 mm Hg	59.4
33,000 ft	196 mm Hg	41.16
40,000 ft	141 mm Hg	29.61
50,000 ft	87 mm Hg	18.21
63,000 ft	47 mm Hg	9.87
100,000 ft	7.6 mmHg	1.5



Oxyhaemoglobin Dissociation Curve

Left-shifted curve

- Implications:
  - Increased oxygen affinity (R state)
  - Reduced oxygen delivery to tissues
- Caused by:
  - High pH (more basic)
  - Low temperature
  - Low 2,3-BPG
  - Fetal Hb (HbF)
  - Methemoglobinemia*
  - High O_2 affinity Hb variants



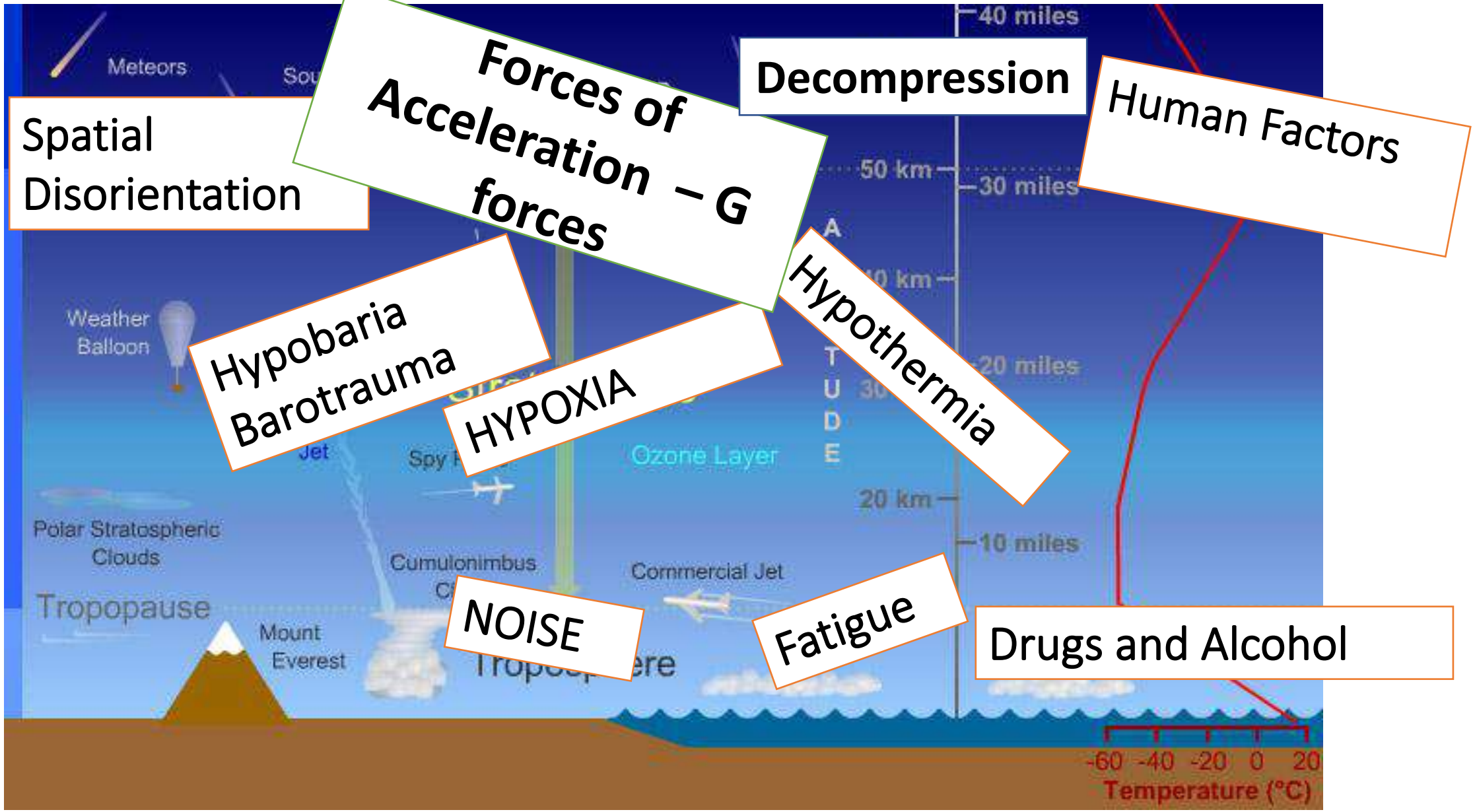
Right-shifted curve

- Implications:
  - Reduced oxygen affinity (T state)
  - Increased oxygen delivery to tissues
- Caused by:
  - Low pH (more acidic)
  - Increased CO_2
  - High temperature
  - High 2,3-BPG
  - Low O_2 affinity Hb variants

And few gas laws

- **Boyle's Law** - P (Pressure) ά ⅟V (Volume) at constant T(Temperature)
- **Charles's Law** - V (Volume) ά T (Absolute Temperature) at Constant P (Pressure)
- **Henry's Law** - Mass of gas dissolved in a liquid is directly proportional to the partial pressure of gas at the surface of the liquid.

Aviation Stresses



Spatial Disorientation

Forces of Acceleration – G forces

Decompression

Human Factors

Hypobaria
Barotrauma

HYPOXIA

Hypothermia

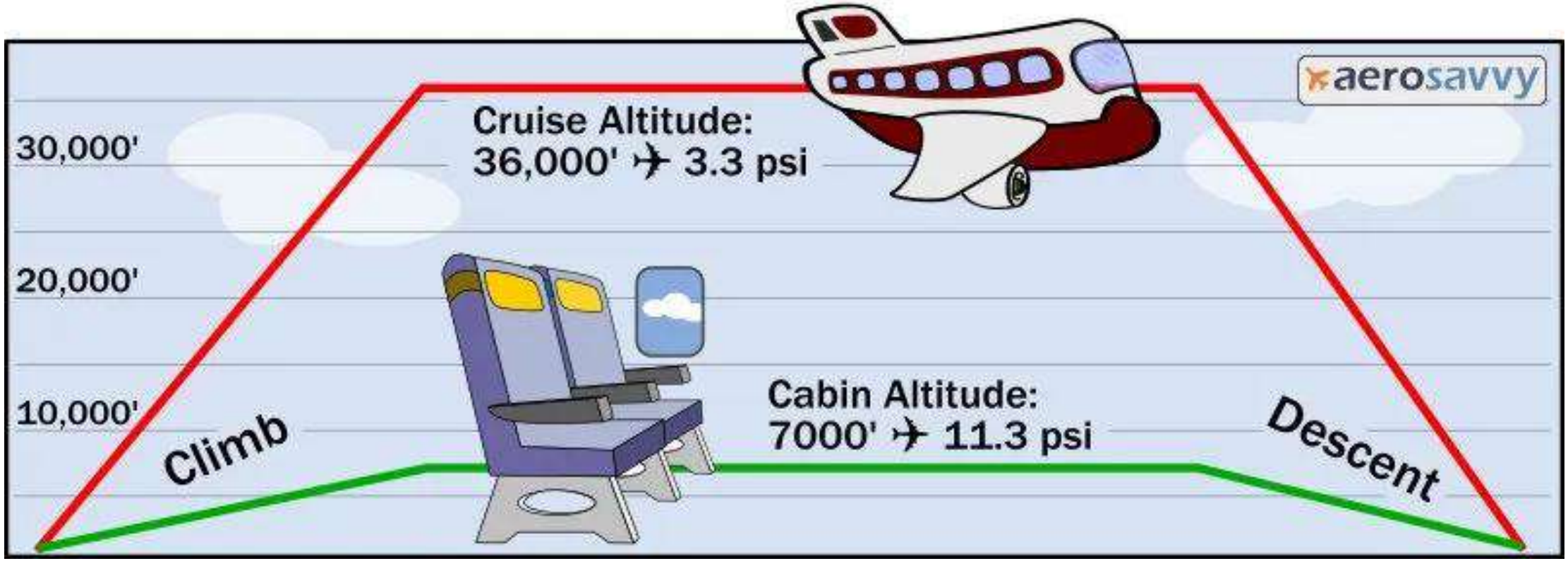
NOISE

Fatigue

Drugs and Alcohol

How these problems are mitigated

- Cabin pressurisation



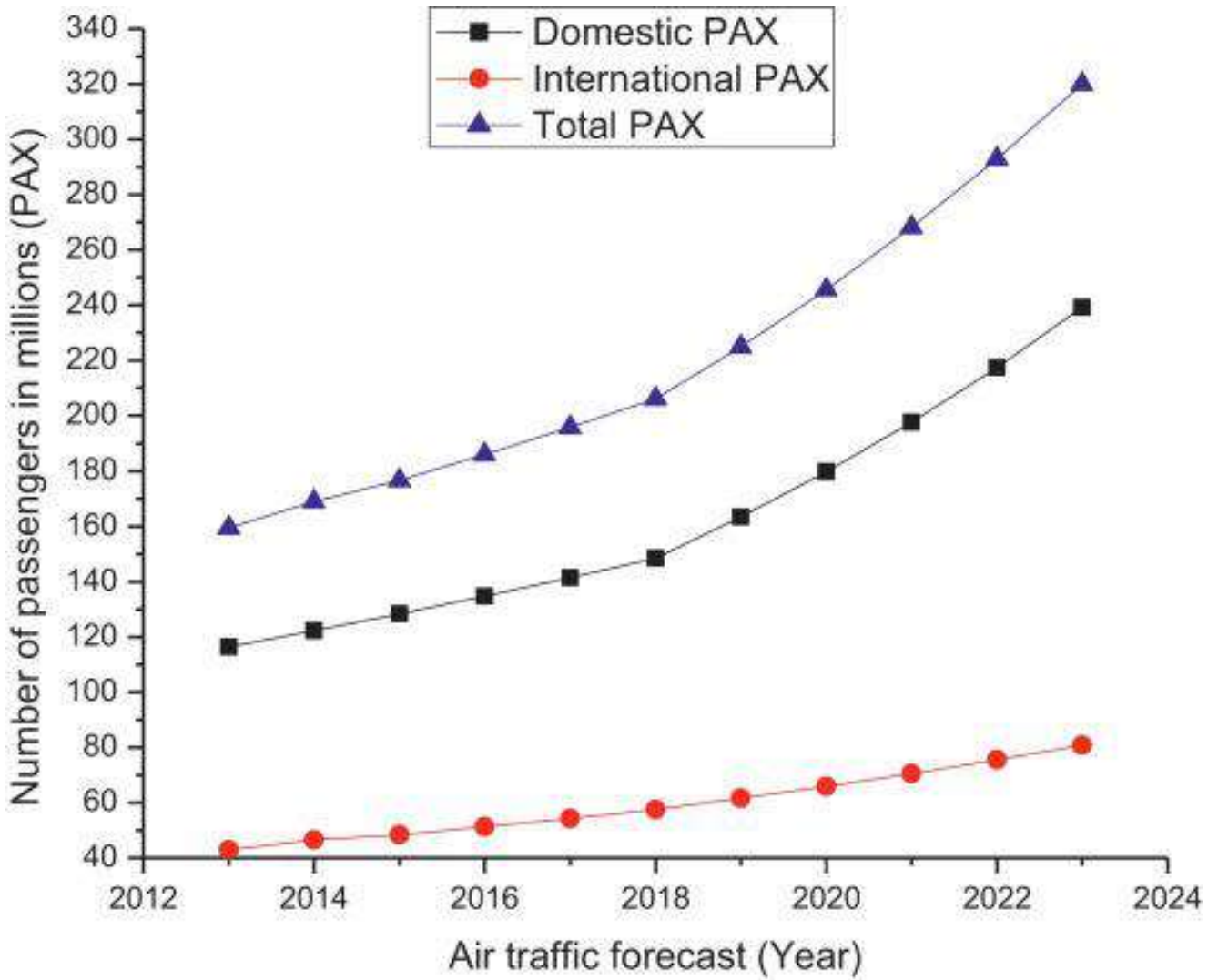
- **More stable and reliable aircraft**
- **Equipped with all kinds of modern gagets to assist**
- **Cabin conditioning**

Aviation and Healthcare have Common Challenges

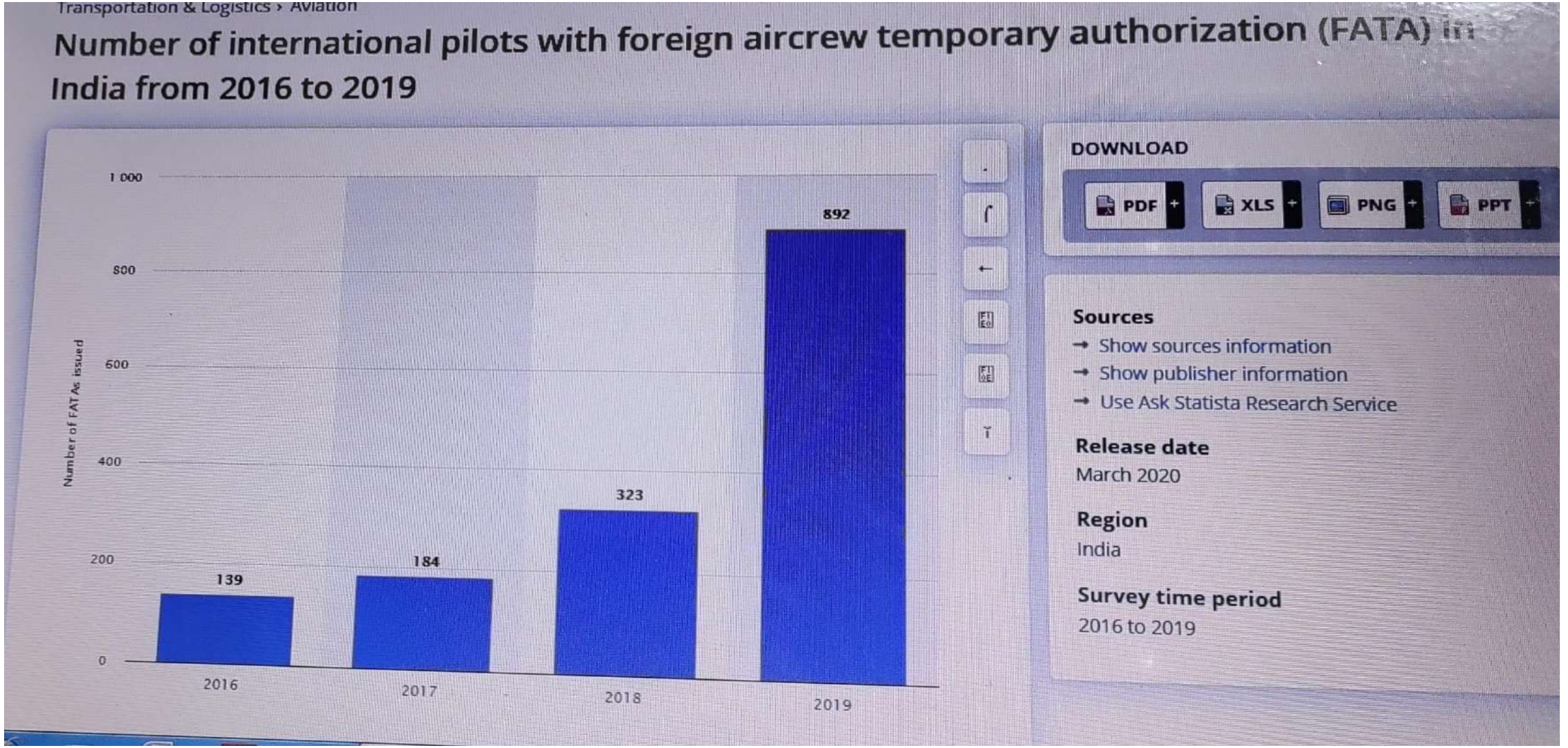
There is a quantum jump in both the Sectors

Projection of Growth in Indian Aviation Sector

– IIM B Management Review

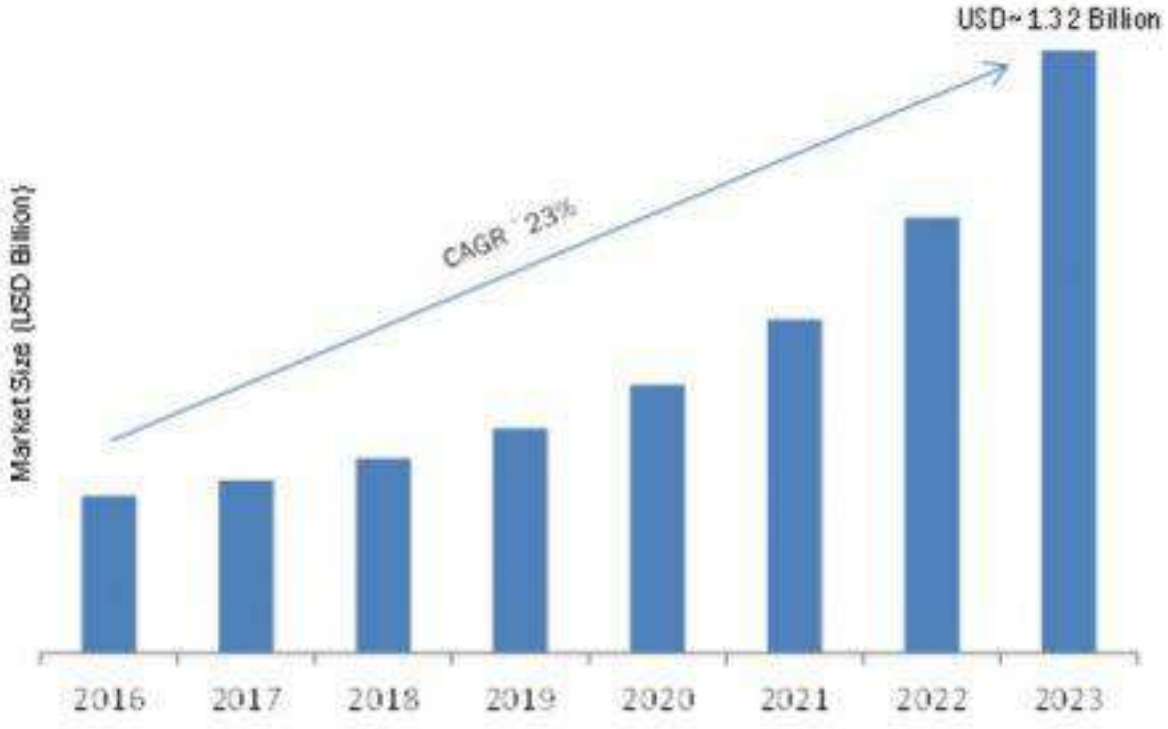


FATA (Foreign Aircrew Temporary Authorization) in India from 2016 to 2019



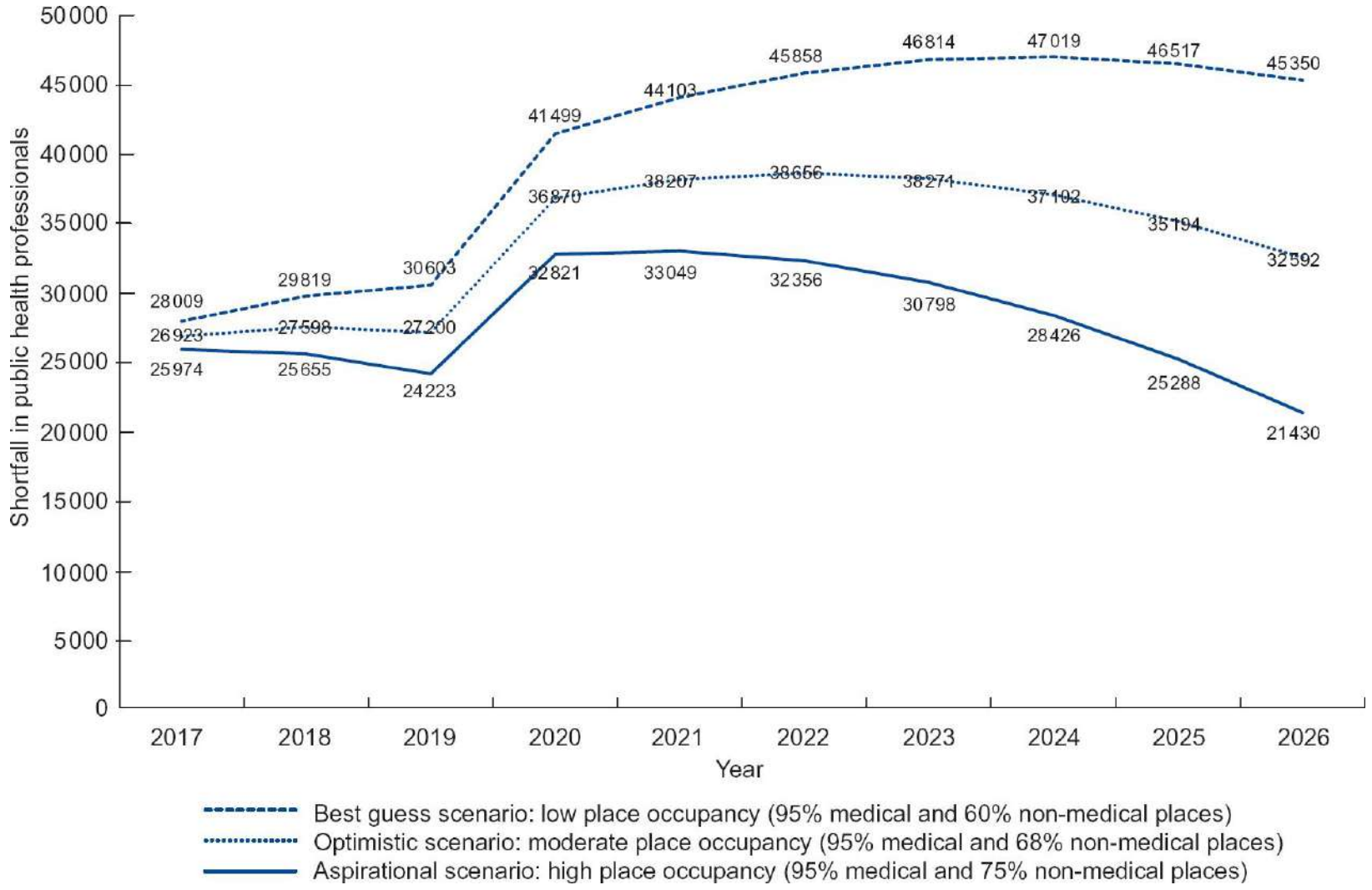
•Growth of Indian Health Sector

Indian healthcare sector 4th largest employer in FY17 - 319,780 employed .
By 2020, it was expected to generate around - 40 million jobs.
By 2022, the healthcare market is expected to increase three fold by US$ 133.44 billion.



Global Augmented Reality in Healthcare **Market Research Report**: Information by Component (Hardware, Software), Device Type (Head-Mounted Display), Application (Fitness Management) – Forecast till 2023

Shortfall in Public Healthcare Professionals



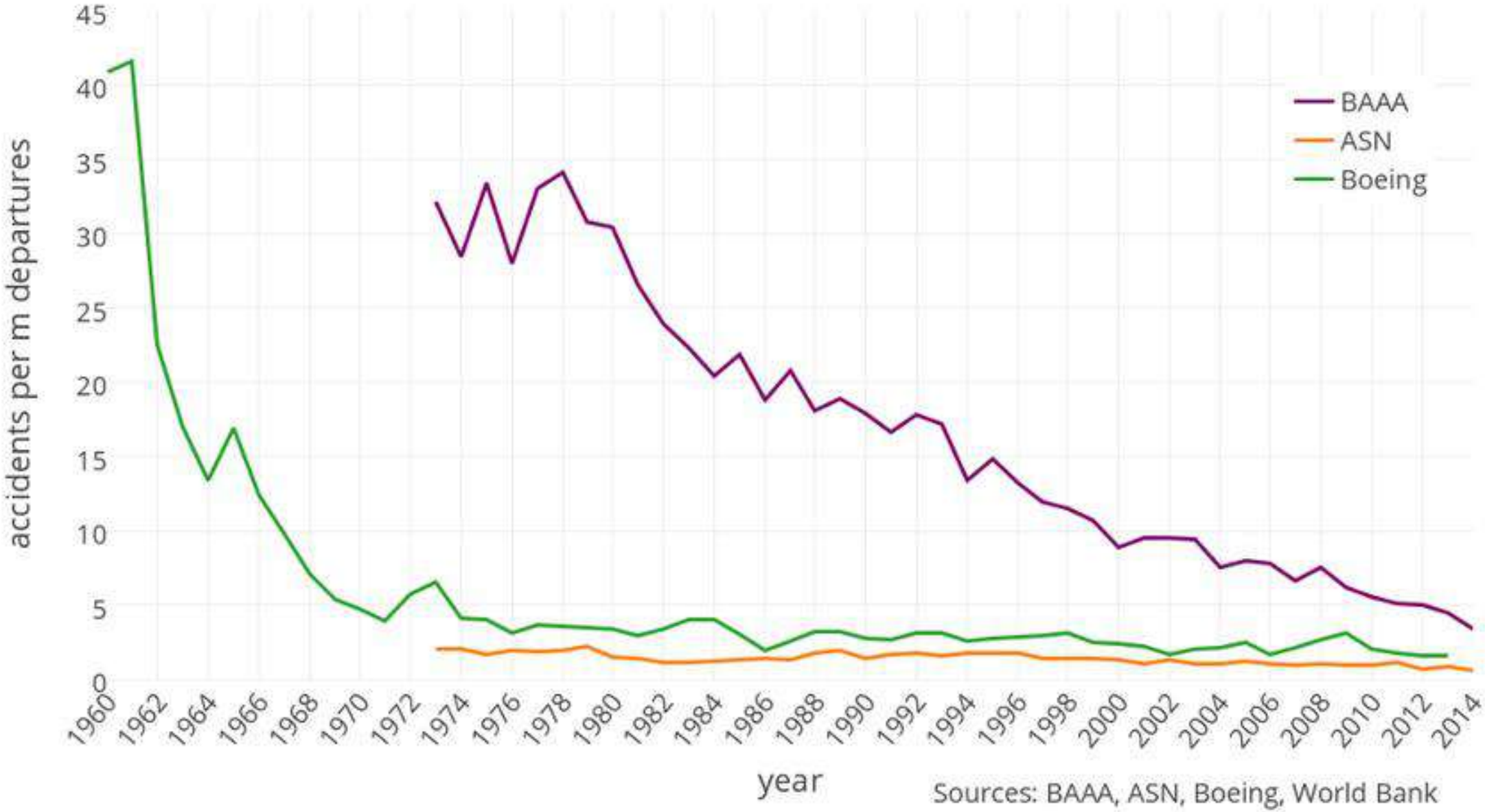
*WHO South-East AsiaJPublicHealth_2019_

Safety records of Aviation

Vs

Healthcare sector

Aircraft accidents per million departures



Sources: BAAA, ASN, Boeing, World Bank

Are medical errors really the third biggest cause of death?

mcdreeamiemusings.com @mcdreeamie

It's often claimed that medical errors are the third biggest cause of death, after heart disease & cancer, with a figure of 250,000 - 400,000 deaths/year being quoted

This is based on Makary and Daniel (2016) who claimed that a third of deaths in the US were due to medical error

BUT Makary and Daniel (2016) used a very broad definition for medical error and did not distinguish whether death was unavoidable or if actually cause by error.

They only looked at hospital deaths. If true 400,000 deaths/year would actually represent 58% of all US hospital deaths

Sunshine et al. (2019) looked at all adverse events (whether medical or not) and their association with mortality in the US between 1990 and 2016

They found that adverse events caused a total of 123,603 deaths in the US in this 26 year period

Makary and Daniel (2016) produced a headline grabbing but implausible figure based on a flawed methodology

A much more rigorous paper (Sunshine et al., 2019) found adverse events caused an average of 0.18% of deaths in US a year

What Can Healthcare Learn From Aviation Safety?

. Medical errors are the third leading cause of death in the United States, just behind heart disease and cancer. - study conducted by Johns Hopkins,

.More than 250,000 people die every year from preventable medical errors. Other studies claim this number could be as high as 440,000. Countless others are unnecessarily injured or maimed.

.**Commercial aviation is safer than you think. The number of accidents is very low. In fact, it is often said that the most dangerous part of commercial flight is the drive to the airport. You are much more likely to die in a car accident than in a commercial airplane.**

.In many years, we see zero deaths in aviation. Even in 2018, which was a particularly bad year for aviation, there were only around 500 fatalities, compared to 3287 deaths per day in road accidents.

What Aviation Does Right

- **1. Aviation has a very strong safety culture**

. Safety comes first and every time.

. Aviation safety is critical to pilots for several reasons.

First, they care about their passengers.

Second, they have a horse in the race; if the plane goes down, they go down with it. Contrarily, if a patient dies accidently on the OT table by the surgeon, he can still go home at the end of the day.

The daily routine of a pilot

- Sortie Preparation
- BA Test
- Preflight papers
- Fuel Calculations
- Preflight briefing
- Preflight checks
- Check Lists
- Standardised Communication
- Post flight Checks

- **2. <u>There is a “just culture” in aviation</u>**

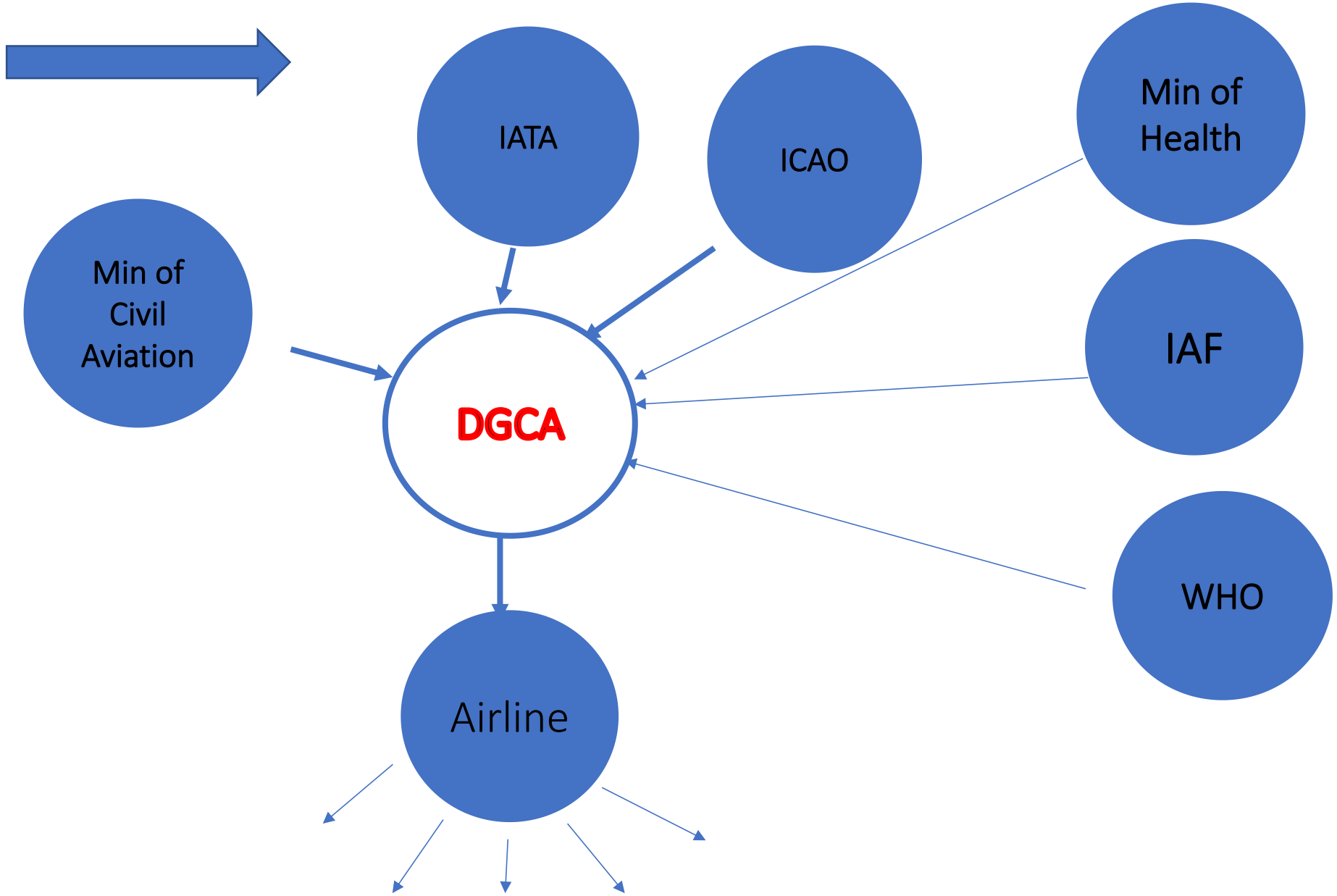
. Initial reaction . blame the pilot or other personnel in charge.

. In Aviation - examine the system for faults.

. In healthcare, it is much more common for the patient (or family) to blame the doctor, get an attorney, and sue for damages. This type of system encourages pointing fingers.

- **3. There are governing national and international bodies.**

In India



- In US. The **Federal Aviation Administration(FAA)** oversees the entire aviation industry in the United States.
- **National Transportation Safety Board (NTSB)** “charged with determining the probable cause of transportation accidents and promoting transportation safety.
- Many other nations have similar agencies. Their goal is to determine the cause of the accident, as suggest strategies to prevent similar events in the future.

- In Health care we have NMC (MCI) at national level and State Medical councils. Their affectivity .....?

AND

- In healthcare, every hospital may have their own rules. Even within a single hospital, different doctors might be subject to different rules from various supervisors.

- Or no rules, personality based rules, Show me the person: I show the rule

- **4.<u>Recurrent Training</u>**
- Airline pilots go through recurrent training at frequent intervals apart from initial training, via **simulator training**, or **a variety of other training techniques.**

. “Recurrent training ensures that skills are retained and standard operating procedures are being followed.

- Most doctors are required to get Continuing Medical Education (CME) credit points, but recurrent simulator training has been slow to catchup.

- **5**. **<u>Checklists.</u>**
- Aviation follows checklist very meticulously. There is a checklist for everything imaginable.

- Checklists are an excellent way to ensure that everything is done in the proper and standardised order.

- Now checklists are becoming more common in healthcare as well.

- **6. Audit**.
- Every Aviation accident or incident is followed by a CoI.

Team consists of Aviator,
Aeronautical Engineers(Eng,
Air Frame, Communication,
Navigation
Met
Medical etc

HFACS (Human Factors Analysis and Classification System)

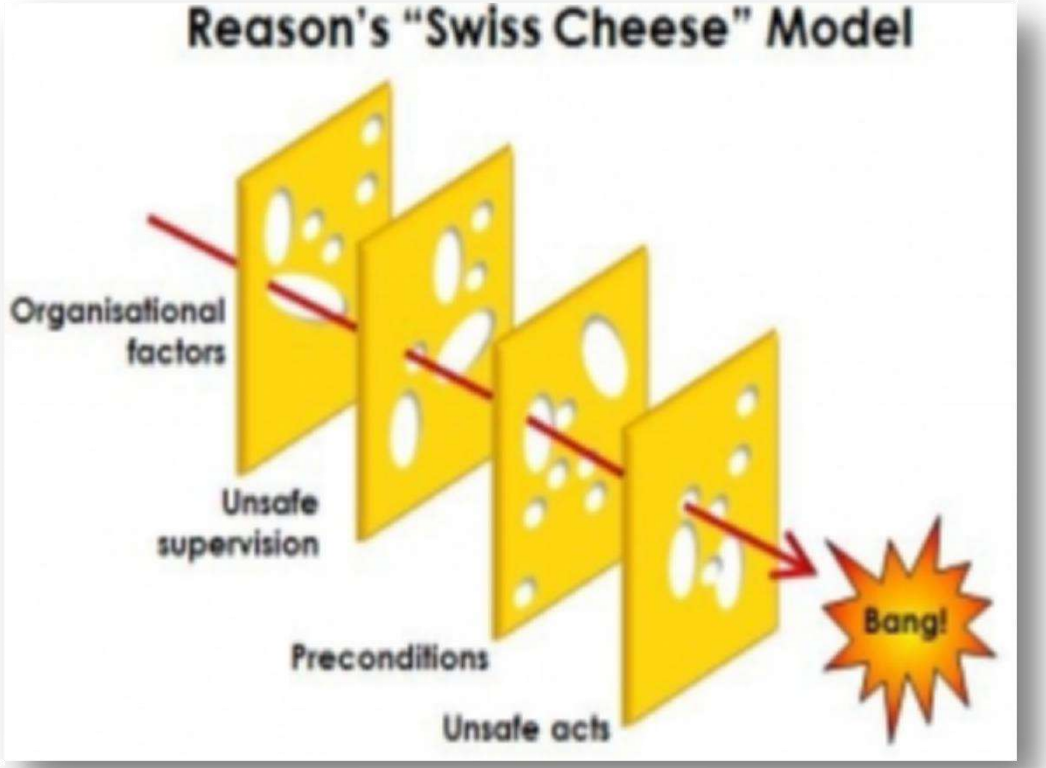
HFACS
(Human Factors Analysis and Classification System)

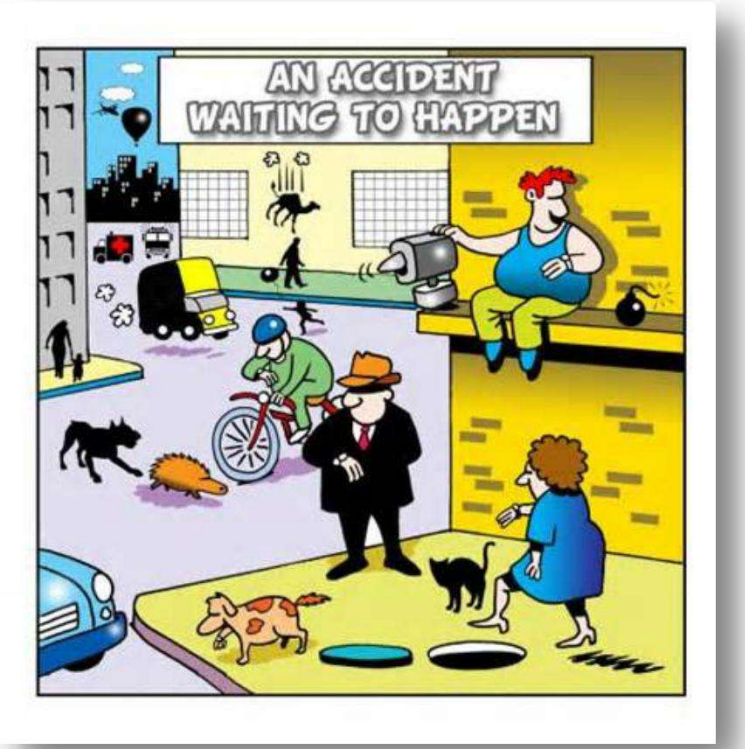
Dr Scott Shappell and Doug Weigmann

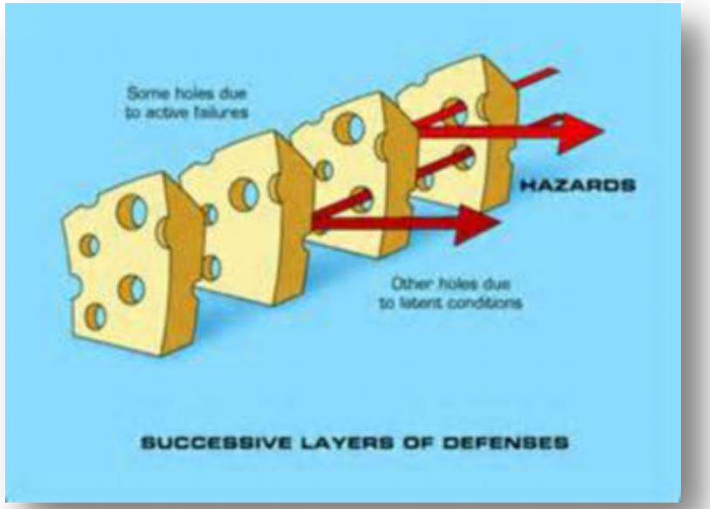
- Based on James Reason's *Swiss Cheese model* (1990)
- Systematically identifies active and latent failures within an organisation.

- **Unsafe acts of operators (eg. Aircrew) Errors or Violations**
- **Preconditions for unsafe acts.**
- **Unsafe Supervision and**
- **Organisational influences**

Accident Causation







No-fault reporting for errors and accidents

- **7. Incident reporting.**

. Every incident how so small – to be reported

. Non reporting is taken very seriously.

In Health care.

What Lessons Can Healthcare Take From This?

- **Heathcare is several decades behind aviation in safety,** -Dr. Keith Ruskin, (Professor of Anesthesia and Critical Care at the University of Chicago , is also a licensed pilot.)
- Need to act quickly in order to catch up.
- Aviation safety has been so successful due to changes made many decades ago.

- **In Healthcare**. Late to start

  Slow to grow

  Time is running out, In coming years with increased demand, will lead to more chaos.

Fatigue

- Pilot fatigue is a significant problem in modern aviation operations, largely because of the **unpredictable work hours**, **long duty periods**, **circadian disruptions**, and **insufficient sleep** that are commonplace in both civilian, military flight operations and also among medical professionals.

- Full extent is not known.

- People who are sleep deprived think and move more slowly, make more mistakes, and have memory difficulties.

FATIGUE COUNTERMEASURES IN AVIATION

I. Description of the Problem

II. Crew Rest Guidelines.

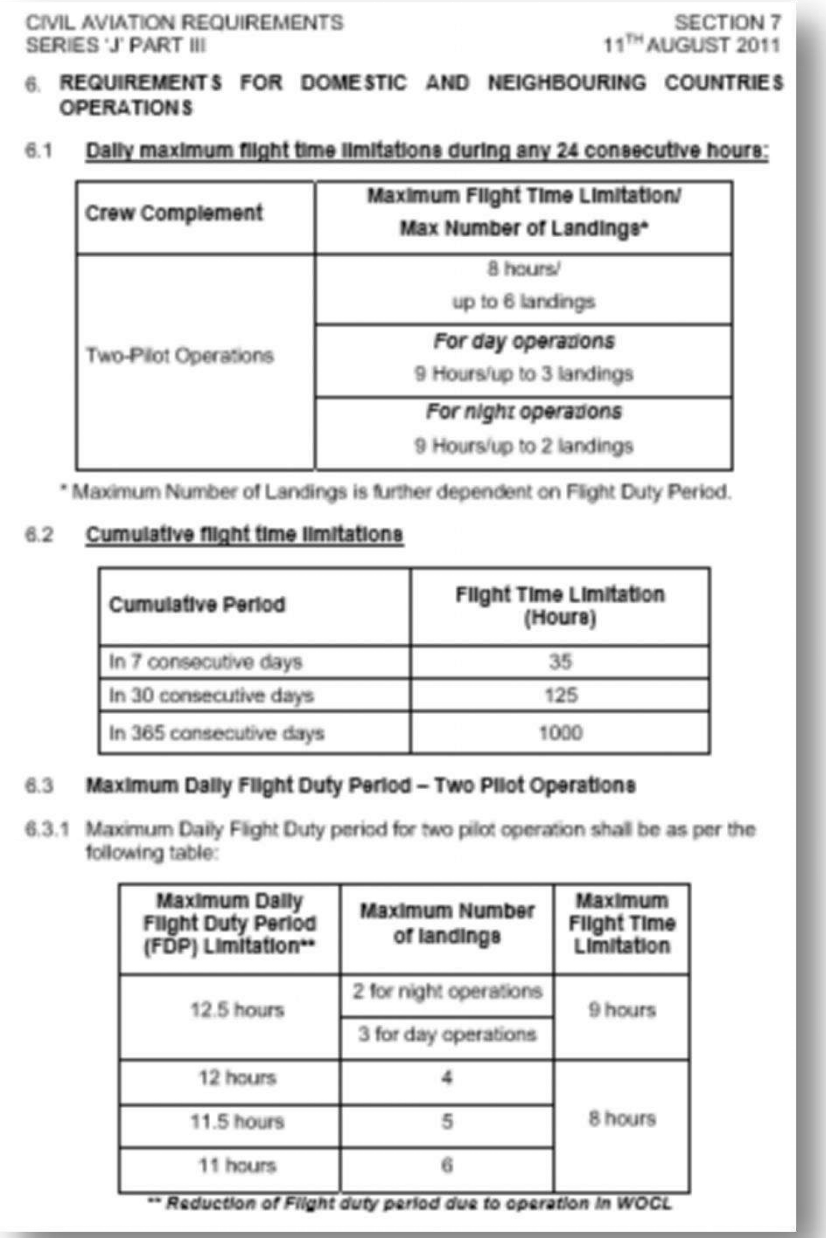
Flight and Duty Time Guidelines

Fatigue Risk Management System (FRMS): An Alternative Regulatory Approach

Flight Duty Time Limitation

CFRS FOR MINIMUM REST PERIODS AND MAXIMUM FLIGHT AND DUTY PERIODS FOR BOTH NONAUGMENTED AND AUGMENTED CREWS.

Crew	**Non-Augmented Crew (Single- or Two-Pilot Crew)**	**Augmented**
Minimum pre duty rest period	10 h	10 h
Minimum post duty rest period	10 h	12 h
Maximum flight time	10 h	12 h
Maximum duty time	14 h	16 h
Maximum duty time; 1 wk	30 h	30 h
Maximum duty time; 1 mo	100 h	100 h
Maximum duty time;1 yr	1400 h	1400h



CIVIL AVIATION REQUIREMENTS
SERIES 'J' PART III

SECTION 7
11TH AUGUST 2011

6. **REQUIREMENTS FOR DOMESTIC AND NEIGHBOURING COUNTRIES OPERATIONS**

6.1 **Daily maximum flight time limitations during any 24 consecutive hours:**

Crew Complement	Maximum Flight Time Limitation/ Max Number of Landings*
Two-Pilot Operations	8 hours/ up to 6 landings
	For day operations 9 Hours/up to 3 landings
	For night operations 9 Hours/up to 2 landings

* Maximum Number of Landings is further dependent on Flight Duty Period.

6.2 **Cumulative flight time limitations**

Cumulative Period	Flight Time Limitation (Hours)
In 7 consecutive days	35
In 30 consecutive days	125
In 365 consecutive days	1000

6.3 **Maximum Daily Flight Duty Period – Two Pilot Operations**

6.3.1 Maximum Daily Flight Duty period for two pilot operation shall be as per the following table:

Maximum Daily Flight Duty Period (FDP) Limitation**	Maximum Number of landings	Maximum Flight Time Limitation
12.5 hours	2 for night operations	9 hours
	3 for day operations	
12 hours	4	8 hours
11.5 hours	5	
11 hours	6	

** *Reduction of Flight duty period due to operation in WOCL*

III. In-Flight Countermeasures and Strategies

- Cockpit Napping
- Activity Breaks
- Bunk Sleep
- In-Flight Rostering

IV. Pre-/Post flight Countermeasures and Strategies

- Pharmacological intervention
- Exercise

- In healthcare . In our times we used to work ……
  Now a days you are paid well and have so many facilities, etc.

- There is a need to recognise the problem and change the mindset.

Air Mshl (Dr) M S Butola AVSM (Retd) MD