

Reducing fatigue risk: building a consistent Fatigue Management approach across borders

eurostar

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Introduction

- In safety critical organisations, management of fatigue risk is essential
- Fatigue affects decision-making, reaction time and awareness
- Potential impact on personal safety, colleagues, passengers, and the wider public
- There is a legal responsibility to manage fatigue risk in every railway organisation

🤝 **Balance between company responsibilities and personal responsibility**

Just and Fair culture of openness and trust is essential to support fatigue management

What is fatigue?

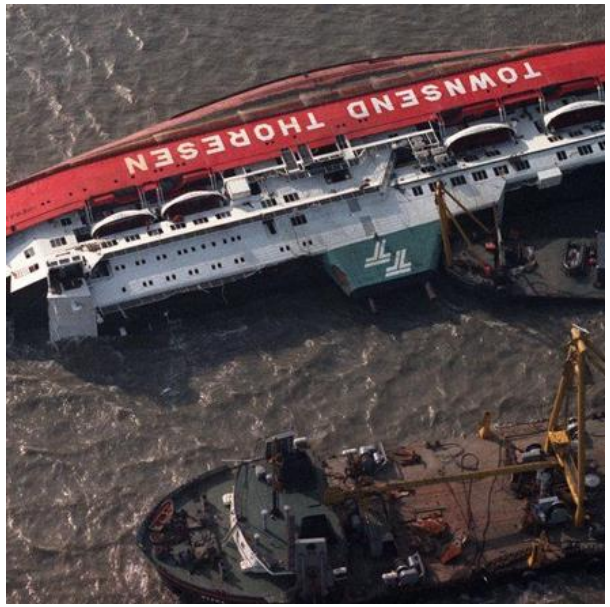
Fatigue is:

"A feeling of **mental and/or physical exhaustion**, caused by events and activities that take place **within or outside the work environment**, affecting an individual's ability to **perform their work safely and effectively.**"

Fatigue can have fatal consequences



Clapham Junction Train Crash, UK 1988



Herald of Free Enterprise, Belgium, 1987



Sandilands Tram derailment, UK 2018

Fatigue as an underreported issue?



Figure 3 : *état des wagons après l'accident : wagons sur voies 1R et 2R (sens percussion de droite à gauche) – wagons sur la voie 51-61 percutés par les wagons déraillés (photos SNCF)*



Figure 4 : *état des wagons après l'accident : support caténaire impacté s'appuyant sur les wagons de la voie 51-61 – wagons déraillés traversant la voie 2R (photos SNCF)*

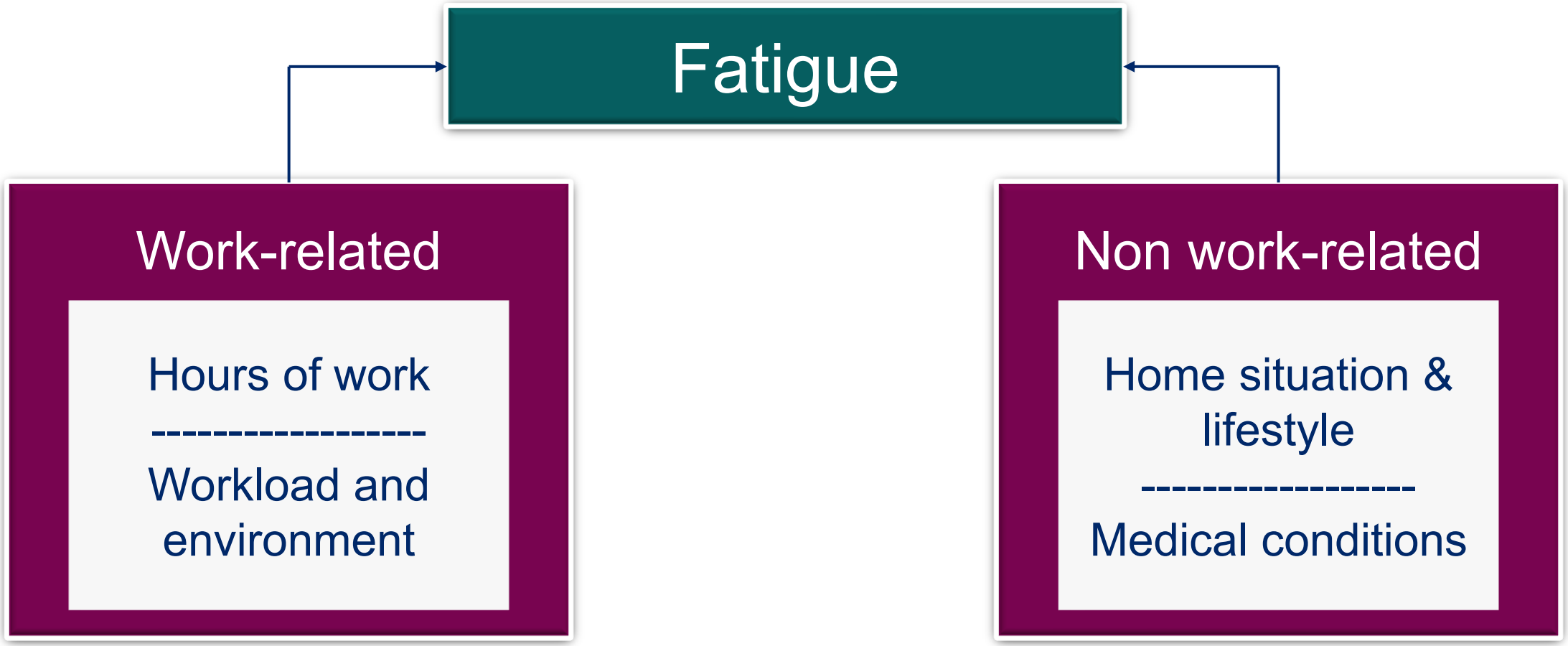
- **Few major European rail accidents** identify fatigue as a contributing factor
- Metz-Sablon Feb 2024 Freight train collision and derailment
  - Late notice change to shift time and location for a night shift
  - Insufficient rest period before work
  - No 'check in' for work process
  - Delays to scheduled train movements, the derailment happened at 05:58.



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Fatigue Risk Management

Sources of fatigue



Elements of a Fatigue Management System



ORR (2024), Managing rail staff fatigue, section 5

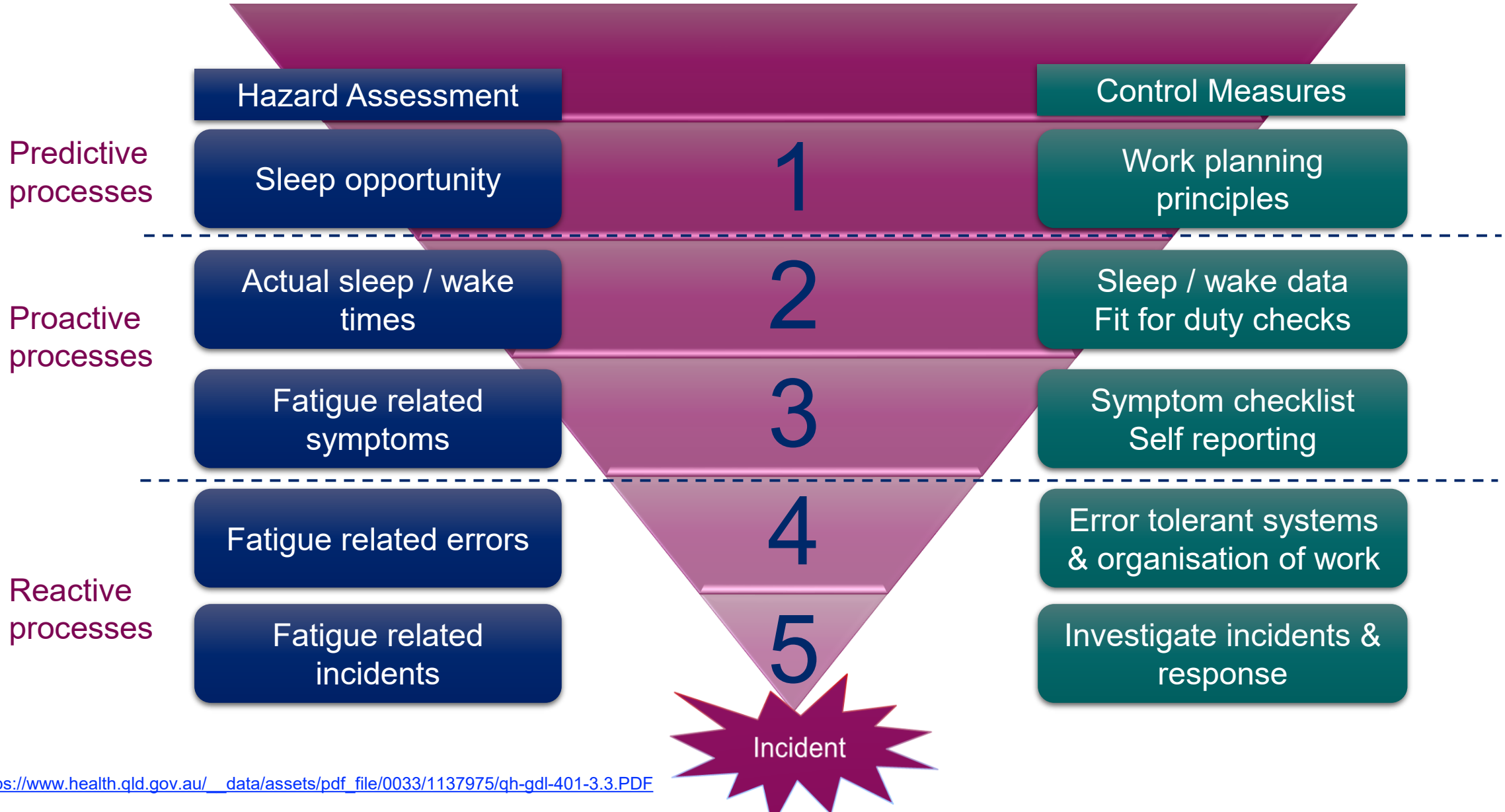
The Railways and Other Guided Transport Systems (Safety) Regulations 2006 defines core duty to manage fatigue (UK)

ORR Guidance identifies the elements to manage fatigue risk

Follows the **Plan, Do, Check, Act** cycle

Additional resources and support provided by RSSB

Fatigue Hazard Control Model – 5 levels of defence to reduce fatigue risk



https://www.health.qld.gov.au/__data/assets/pdf_file/0033/1137975/qh-gdl-401-3.3.PDF

Understanding fatigue risk in Eurostar



Operating across borders and application of legislation







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Understanding fatigue risk

CONTEXT

Fatigue is recognised as a critical factor in railway safety due to the exposure of rail staff to irregular work hours.

In the light of the ‘One Safety Management System’ for Eurostar Group, its safety management system arrangements must comply with UK and EU directives, national fatigue legislations, and local working conditions documentation.

All fatigue risk management arrangements across the group were reviewed.



Review practices and legislation, compare with best practice



Review safety critical rosters

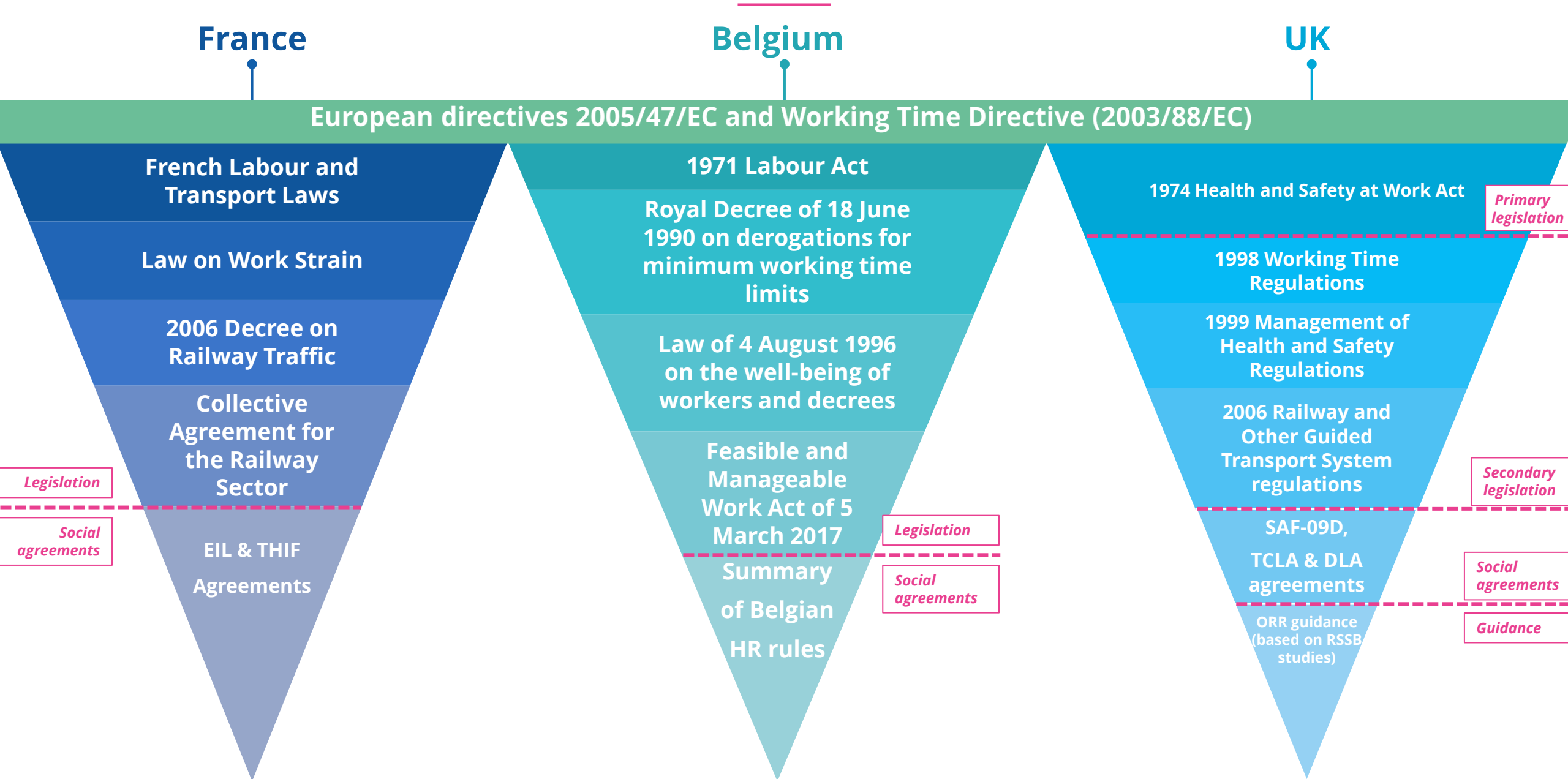


Draw recommendations for improvement and KPIs for regular fatigue monitoring



Define a KPI reporting plan, train roster teams and support KPI implementation

ANALYSED TEXTS (2025 UPDATED)



PHASE 1: REVIEW OF PRACTICES AND LEGISLATION

Welbees

ONLY HARD RULES (LEGISLATION, AGREEMENTS) ONLY GUIDANCE LEGISLATION + GUIDANCE NONE

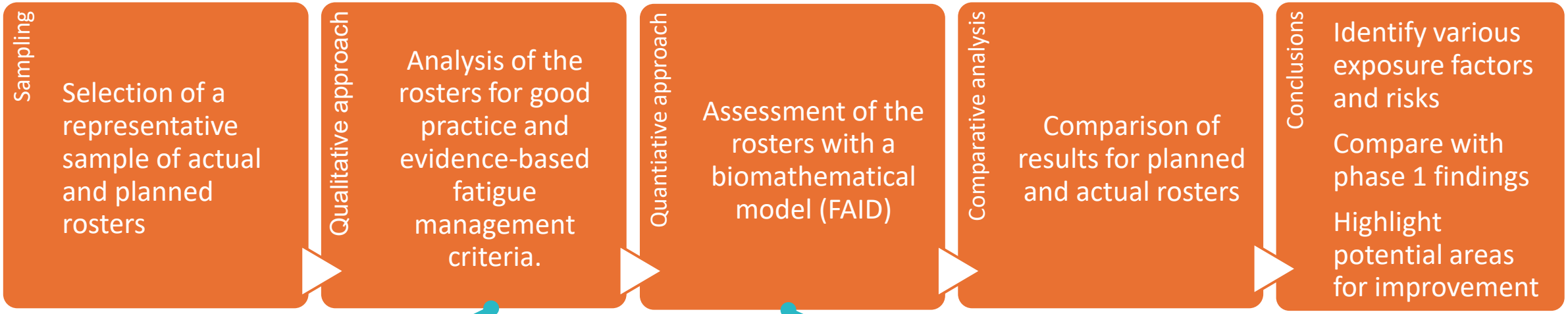
Investigated elements	France	Belgium	UK
Maximum working time per duty			
Night work			
Maximum actual working time per week			
Duty length and cumulative fatigue controls			
Breaks			
Workload by duty			
Shortest time between two duties			
Rest days			
Maximum consecutive shifts (block length)			
Overtime & conditions to obtain compensatory rest			
Morning duties			
Direction and speed of rotation			
Frequency of medical assessment			
Daily fitness-for-duty assessments			
Fatigue risk assessment requirements			
Reporting fatigue-related incidents			
Fatigue training and awareness			

CONCLUSIONS

- **All three countries regulate working time**, with particularly strict provisions in France.
- **The UK goes further with science-based fatigue guidance**, while France and Belgium mainly address fatigue through occupational health and night work rules.
- **Specific fatigue management requirements remain limited**, particularly for roster design, training and reporting.

Key finding: working time compliance provides a foundation, but effective fatigue management requires a broader approach.

ROSTER ANALYSIS METHODOLOGY



Qualitative Analysis – Roster Review

- Assesses schedule features against fatigue-related risk factors: duty length; time between duties; night work; rest days; etc.
- Expected outcomes:
  - Transparency of fatigue factors
  - Highlights design weaknesses
  - Supports compliance

Quantitative Analysis – Biomathematical Models (BMMs)

- Uses sleep/wake data & circadian science
- Expected outcomes:
  - Predicts fatigue over time at a granular level
  - Enables simulation of “what-if” scenarios
  - Quantifies how much fatigue is likely at a given moment

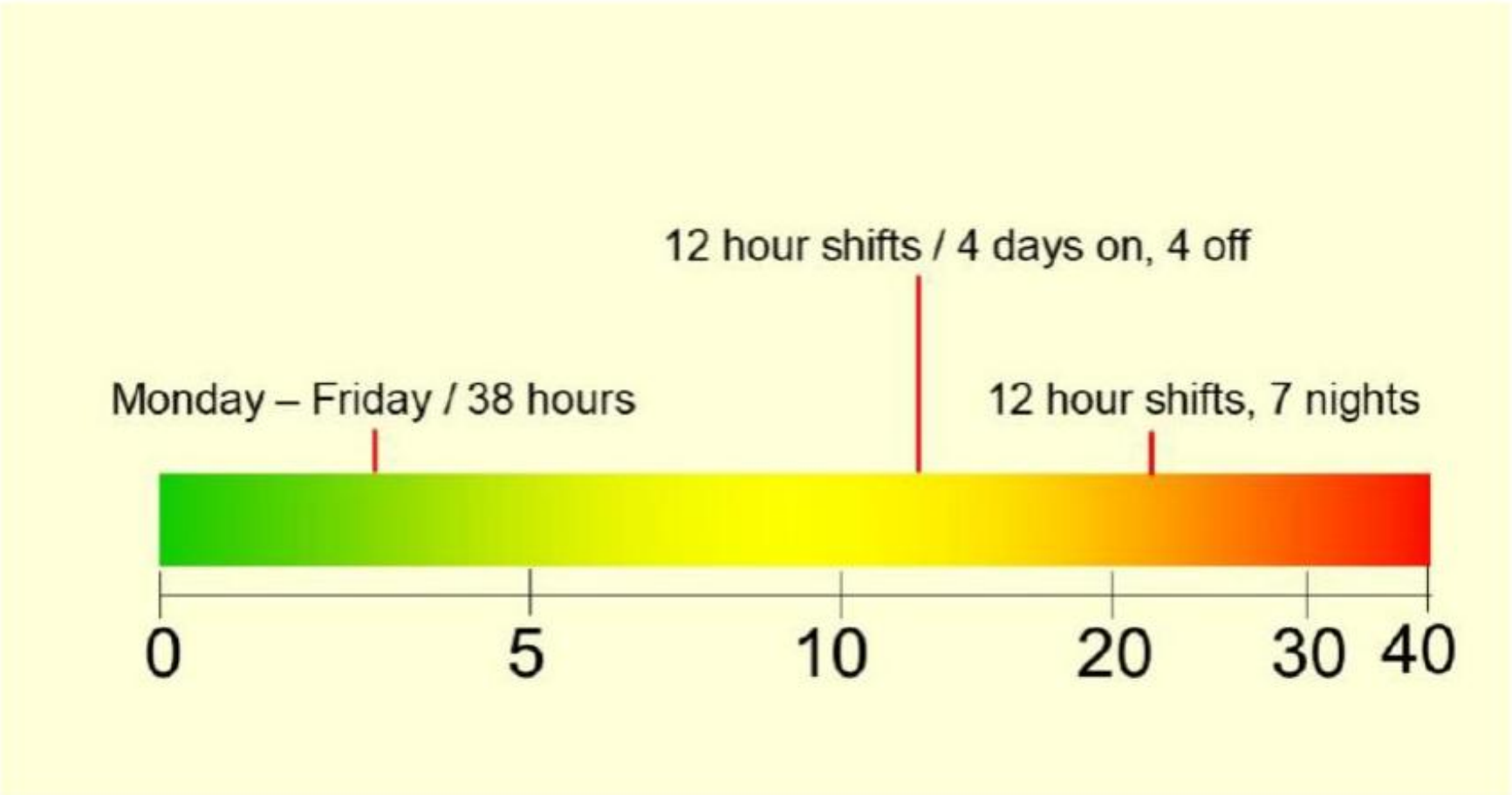
Qualitative = *Why* a schedule contains elevated fatigue risk
Quantitative = *How much* fatigue is expected

DAWSON LEGEND AND SCORING

Dawson Matrix	0	1	2	4	8
Longest duty time	≤ 8 hours	8.1 to 9.9	10 to 11.9	12 to 13.9	≥ 14
Shortest time between duties	≥ 16 hours	15.9 to 13	12.9 to 10	9.9 to 7.9	≤ 8
Working time	≤ 36 hours	36.1 to 43.9	44 to 47.9	48 to 54.9	≥55
Rest days	>1 in 7 days	≤ 1 in 7 days	≤ 1 in 14 days	≤ 1 in 21 days	≤ 1 in 28 days
Night working time	0 hours	0.1 to 8	8.1 to 16	16.1 to 23.9	≥ 24

FAID KSS score (by shift)	<6	6 to 7	>7
Morning shifts (before 7:30)	Few occurrences (0 to 3) nor consecutive shifts	Moderate number of occurrences (4 to 6) or consecutive shifts	Many occurrences (>7) or consecutive shifts
Direction and speed of rotation	Clockwise direction and short (fast) rotation (1 to 3 shifts)	No clear direction and length of rotation	Counter-clockwise direction and long (slow) rotation (>3 shifts)

DAWSON SCORES



Karolinska Sleepiness Scale (KSS)

The **KSS** is a scale of (1–9) of current sleepiness which is used to report fatigue risk in FAID

How it's used in FAID analysis:

Low fatigue risk – scores below 5

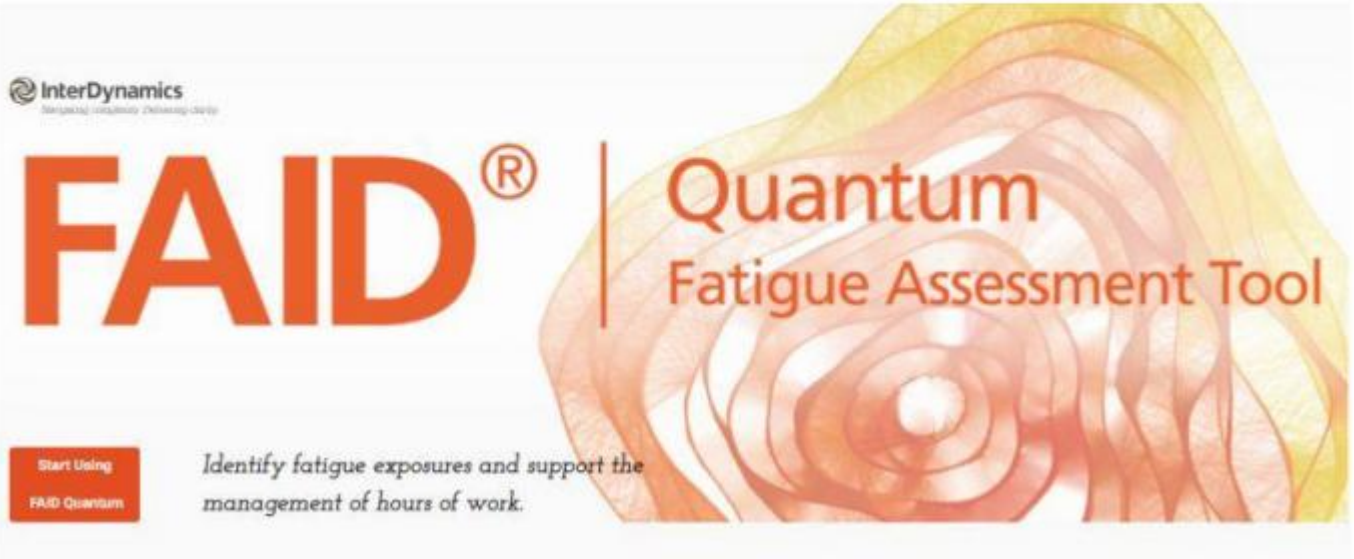
Medium fatigue risk – scores 5-6

High fatigue risk - scores 7–9

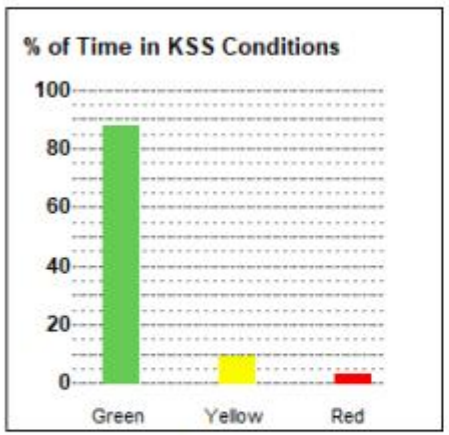


Nine-point Karolinska Sleepiness Scale (KSS)

FAID: monthly breakdown of schedules

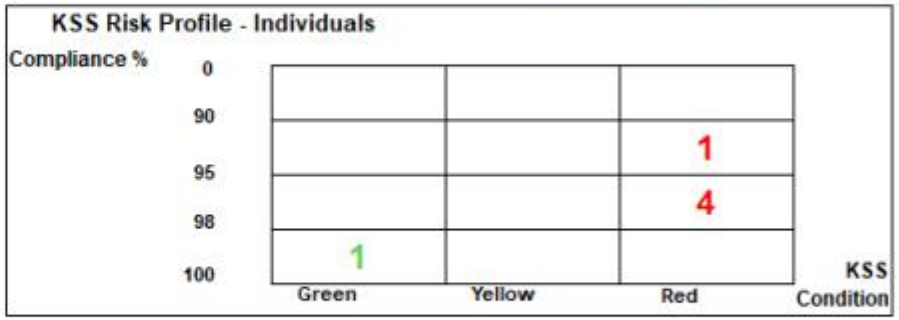


Individuals: 6



Compliance Hours 96.7%
Target 98 %

	Total Hours Worked	KSS Condition Green Hours	KSS Condition Yellow Hours	KSS Condition Red Hours
#	887	778	80	29
%	100%	87.7%	9%	3.3%



Start	End	KSS Condition Green	KSS Condition Yellow	KSS Condition Red	Peak KSS
1 May 25 05:01	1 May 25 14:50	9hr 49min			5.2
2 May 25 04:44	2 May 25 13:06	8hr 22min			5.3
3 May 25 05:01	3 May 25 14:50	9hr 49min			5.2
4 May 25 05:01	4 May 25 14:27	9hr 26min			5.3
5 May 25 05:01	5 May 25 14:57	9hr 56min			5.3
8 May 25 14:03	9 May 25 00:30	10hr 26min	1min		6.0
10 May 25 15:00	10 May 25 23:29	8hr 29min			5.7
11 May 25 14:23	11 May 25 23:29	9hr 6min			5.7
12 May 25 14:03	12 May 25 23:29	9hr 26min			5.8
13 May 25 14:03	13 May 25 23:29	9hr 26min			5.8
15 May 25 22:33	16 May 25 07:23	3hr 44min	2hr 36min	2hr 29min	7.3
16 May 25 20:33	17 May 25 05:11	4hr 22min	2hr 27min	1hr 49min	7.6
17 May 25 22:03	18 May 25 07:00	3hr 8min	2hr 27min	3hr 22min	7.7
19 May 25 09:00	19 May 25 17:00	8hr 0min			4.5
20 May 25 04:44	20 May 25 13:06	8hr 22min			5.3
21 May 25 04:44	21 May 25 13:06	8hr 22min			5.3
22 May 25 05:01	22 May 25 13:06	8hr 5min			5.2
23 May 25 05:01	23 May 25 12:52	7hr 51min			5.2
24 May 25 05:01	24 May 25 12:40	7hr 39min			5.1
25 May 25 05:01	25 May 25 13:42	8hr 41min			5.1
27 May 25 14:50	27 May 25 22:24	7hr 34min			5.2
28 May 25 14:50	28 May 25 23:24	8hr 34min			5.7
29 May 25 14:50	29 May 25 23:24	8hr 34min			5.7
30 May 25 14:50	30 May 25 23:24	8hr 34min			5.7



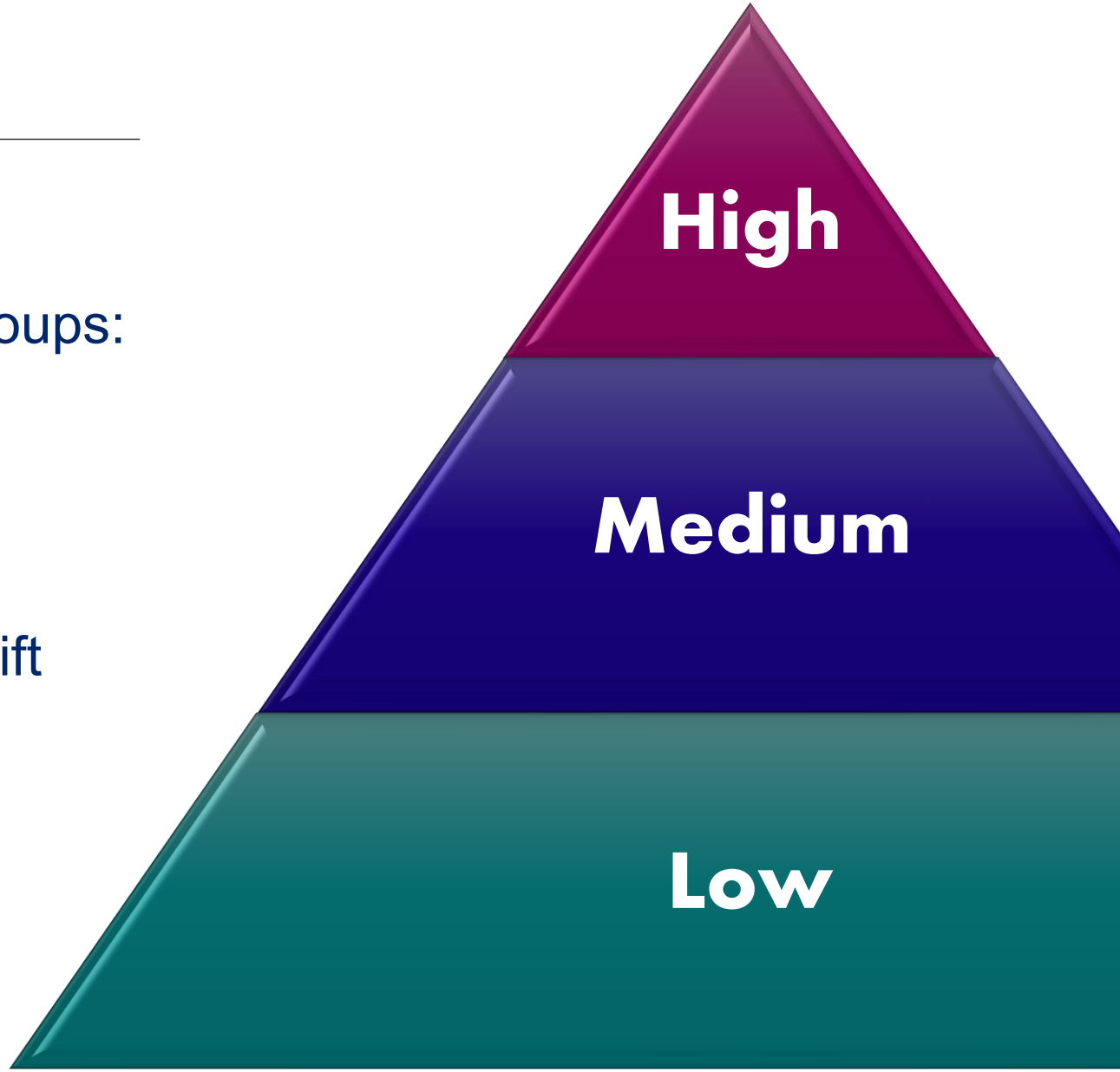
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Prioritised action planning

Prioritised actions

Prioritisation of fatigue factors affecting groups:

- Night working time
- Consecutive shifts
- Overtime
- ‘Lodge shifts’ – late followed by early shift
- Predicted alertness
- Changes between planned and actual rosters



What did we find?





Compliance with legislation and social agreements **do not guarantee that fatigue is managed**

Cultural and ‘location specific’ arrangements can significantly influence fatigue

Not everyone recognises the risk of fatigue, education is crucial at all levels in the business

Taking a prioritised risk-based approach has helped to focus resources

Merci
Thank you
Danke
Dank je wel

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