



How Technology Can Help Fire Chiefs Manage The Issue Of Firefighter Fatigue

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Deccan International

Exclusive focus:

Decision support tools for
Fire and EMS

Strong analytical expertise

Passion for Fire/EMS

Established 1995

200+ Clients Across North America

Municipal

FDNY
Los Angeles FD
Toronto FS
San Francisco FD
Detroit FD
Boston FD
Austin FD
Edmonton FRS
Calgary FD

Metropolitan Counties:

Orange County FA, California
Orange County FR, Florida
Austin-Travis County EMS, Texas,
Los Angeles County FD
Fairfax County FR, Virginia

Non Metropolitan Counties

Prince William County FRS, Virginia
Johnson County, Kansas
Seminole County FD, Florida
Clark County, Washington

35+ Employees



DECCAN INTERNATIONAL

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How Technology Can Help Fire Chiefs Manage The Issue Of Firefighter Fatigue

Culture

Clients are partners

Assist until job done

Training

Analysis Assistance

Special Projects



Primary Software Offerings

Coverage Planning:

ADAM (Apparatus Deployment
Analysis Module)



ADAM Optimizer

Realtime Moveup Decisions:

Live MUM (Move Up Module)



Deccan Ongoing Support For Fire Service

- First focus: Assist with improving response performance.
- Second focus: Assist with prevention, with data mining tools for CRR
- New focus: Assist with mitigating fire fighter fatigue.



Agenda

- 1) From Response Performance to Firefighter Fatigue
- 2) Firefighter Fatigue is a serious issue
- 3) Causes of Firefighter Fatigue
- 4) Fire Fighter Fatigue Mitigation Technologies
- 5) Conclusions

Meal Break Requirements

- In 2015, an Australian State EMS RFP for real time coverage monitoring and moveup recommendations
- Also needed to support meal breaks.
- For < 10 hour shifts, one 30 minute break.
- For > 10 hour shifts, two 30 minute breaks.
- First break: No earlier than 2 hours after start
- Second break: No later than 2 hours before end.
- \$ Penalty whenever breaks not enabled within time window.
- **Challenge:** How to maintain response time coverage while ensuring units get breaks within time windows?

Balancing Coverage and Relief Needs

- **Consideration:** Crews on break still on call for high priorities.
- **Challenge:** How to assign breaks so that:
 1. Breaks within specified time windows.
 2. Response coverage maintained.
 3. Minimize getting called while on break.
 4. Preferably, break at home station.
- Manager for meal breaks for Australian state EMS.

Fatigue Manager

- No meal break requirements in US fire and EMS
- However, still needed for relief for fatigue.
- For busy units, as-and-when-possible breaks ineffective:
 1. Fatigue creeps during shift, if crew keeps working unchecked.
 2. Over time fatigue can become chronic, with consequences
 3. After high impact incident, crew needs break ASAP.
 4. On occasions, depression resulting in something more serious.
- Wonder if ensuring crews get relief can mitigate fatigue impact.

Chronic Fatigue

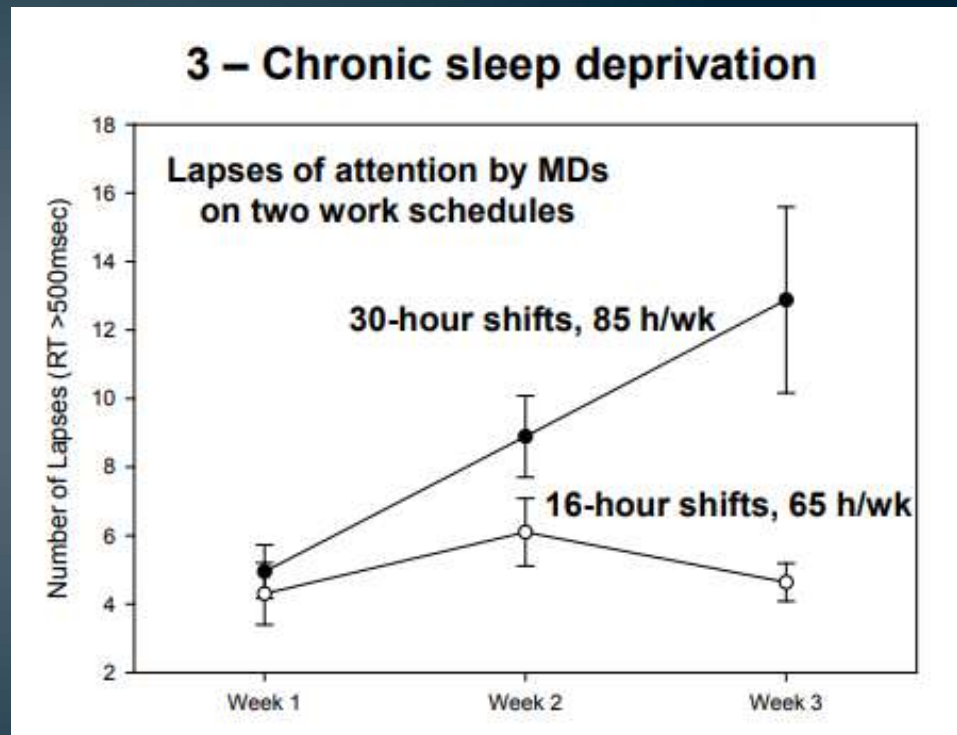
- Fatigue from which normal rest does not produce recovery.
 - Caused by extended periods of stress with inadequate recovery periods.
1. Decreased motivation and low morale
 2. Increased irritability and depression
 3. Confused, poor problem solving
 4. Altered state
 5. Physical reactions
 6. Extreme emotional responses
 7. Social/behavioral changes

Fatigue Is Serious Matter

- Doctors working 24 h straight make:
- 36% more serious medical errors
- 6 times more serious diagnostic errors

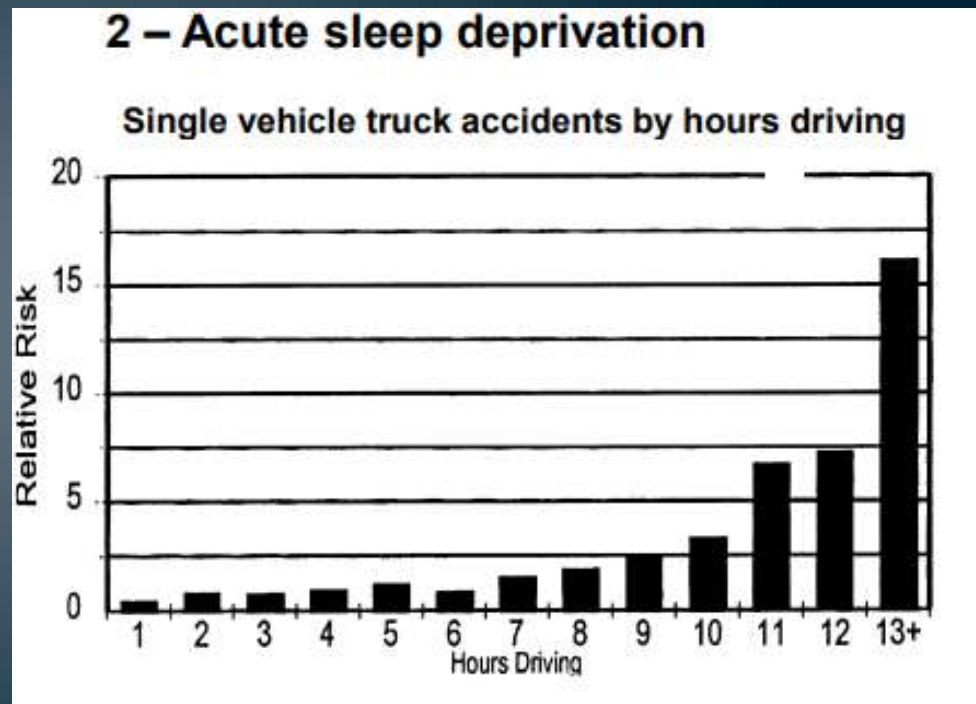
- Being awake for 19 hour == 0.05% blood alcohol.
- 24 hours == 1%

Fatigue Is Serious Matter



Steven W. Lockley, Ph.D, Harvard Work Hours, Health and Safety Group

Fatigue Is Serious Matter



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TABLE. Number and percentage of fatalities among career and volunteer firefighters, by cause/contributing cause — United States, 1994–2004

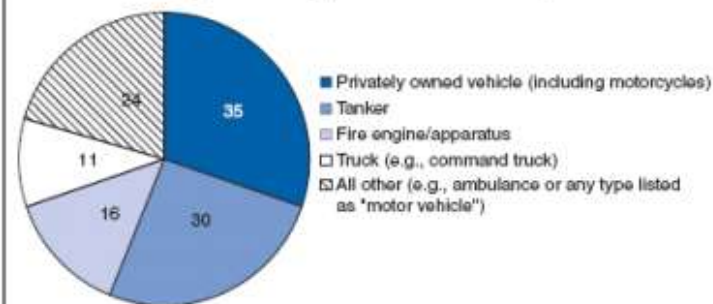
Cause/Contributing cause	Career		Volunteer	
	No.	(%)	No.	(%)
Heart attack*	142	1st (39)	306	1st (50)
Stress/Overexertion	138	(97)	301	(98)
Other	4	(3)	5	(2)
Motor vehicle–related trauma	44	3rd (12)	160	2nd (26)
Vehicle collision/crash	30	(68)	116	(73)
Struck by vehicle	12	(27)	33	(20)
Other vehicle-related (e.g., crushed by or fell from a vehicle)	2	(5)	11	(7)
Asphyxiation	74	(20)	45	(7)
Caught/Trapped	56	(76)	31	(69)
Other (e.g., lost inside a structure or exposed to smoke)	18	(24)	14	(31)
All other†	108	(29)	99	(16)
Caught/Trapped	32	(30)	19	(19)
Fall	8	(7)	15	(15)
Exposure (e.g., to smoke)	9	(8)	14	(14)
Stress/Overexertion	16	(15)	14	(14)
Structure collapse	8	(7)	3	(3)
Other	35	(32)	34	(34)
Total	368		610	

* For example, myocardial infarction or arrhythmia.

† Includes deaths caused by burns, cerebral vascular accidents, drownings, electrocution, heat exhaustion, and trauma.

61% of firefighter fatalities due to heart attack or motor vehicle crash

FIGURE 2. Number* of vehicles involved in volunteer firefighter fatal crashes, by vehicle type — United States, 1994–2004



* N = 116.

35% vehicles privately owned

Centers of Disease Control and Prevention. 'Fatalities Among Volunteer and Career Firefighters -- United States, 1994-2004' *Journal of the American Medical Association* 2006;295(22):2594-6.

Fatigue Factors

- Heavy workload (actual or perceived)
- Knowledge and use of fatigue countermeasures
- Time-of-day operations
- Physical environment (terrain, weather)
- Vigilance requirements

Fatigue Mitigation in Fire Service

Challenge:

- Firefighters look for better work-life balance
- Chiefs weigh operational realities and public safety.
- For specific incident-based fatigue, REHAB and Safety Officer play a key role
- Fatigue education
- ICHIEFS funded study confirmed sleep deprivation impact.

Fire Fighter Fatigue Management Program: Operation Fight Fatigue

- Charles Andrew Czeisler, MD, PhD, Brigham and Women's Hospital
- Four part program:
 1. Sleep Hygiene Education
 2. Caffeine Use Re-education
 3. Sleep Disorders Screening and Treatment
 4. Policy Intervention where appropriate
- 2009 FEMA funded “Operation Stay Alert” Implemented at Columbus Fire
- 2014 Study for program effectiveness with 620 participants
- Awaiting results.

Technology for FF Fatigue Mitigation

1. Fatigue Rules in Staffing Software
2. Tools for Optimal Peak load units identification
3. Real time supervisor alerting of high fatigue score crews
4. Tools for Optimal relief assignments while maintaining coverage.

Fatigue Rules in Staffing Software

- Factors outside of dept:

1. Commute times
2. Outside employment
3. Family life
4. Rest

A place where dept can play a role:

- Avoidable additional fatigue when backfilling crews.
- Fatigue Rules based Weighted order for qualified candidates:
 - Hours already worked
 - Hours remaining on schedule
 - Time spent at rest within specified periods

Tools for Optimal Peak load Units Identification

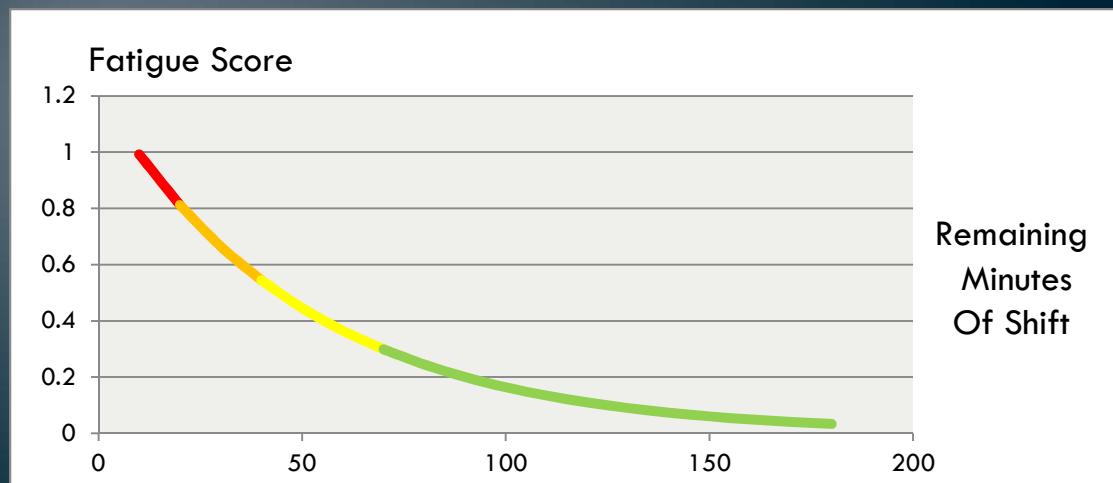
- One factor for chronic fatigue: High run loads every shift.
- Two approaches for mitigating high run loads:
 1. Rotate crews between high and low work load posts across schedule. E.g.:
 - Two 12-hour shifts at busier station,
 - 24-hour shift at slower
 - Four days off.
 2. Add peak units at perfect times to offload high run loads. E.g.:
 - Deccan ADAM Optimizer identifies optimal posts and times to get biggest impact.

Real Time Supervisor Alerting of High Fatigue Score Crews

- Real time calculation of Fatigue Score based on:
 1. How long since start of shift and no break?
 2. How many responses to different incident types?
 3. Total current hours crew has been so far in shift on
 - Calls?
 - Training?
 4. Has crew been on high impact incident?
 - Supervisor and whoever alerted when score hits threshold.
 - Prevent situations when clearly fatigued crews are inadvertently ignored. Crew gets cared.

Tools For Optimal Break Assignments While Maintaining Coverage.

- **Deccan Break Manager** sitting on top of **LiveMUM**, real time coverage monitoring and moveup recommendation software.
- Calculates and uses real time Fatigue Score

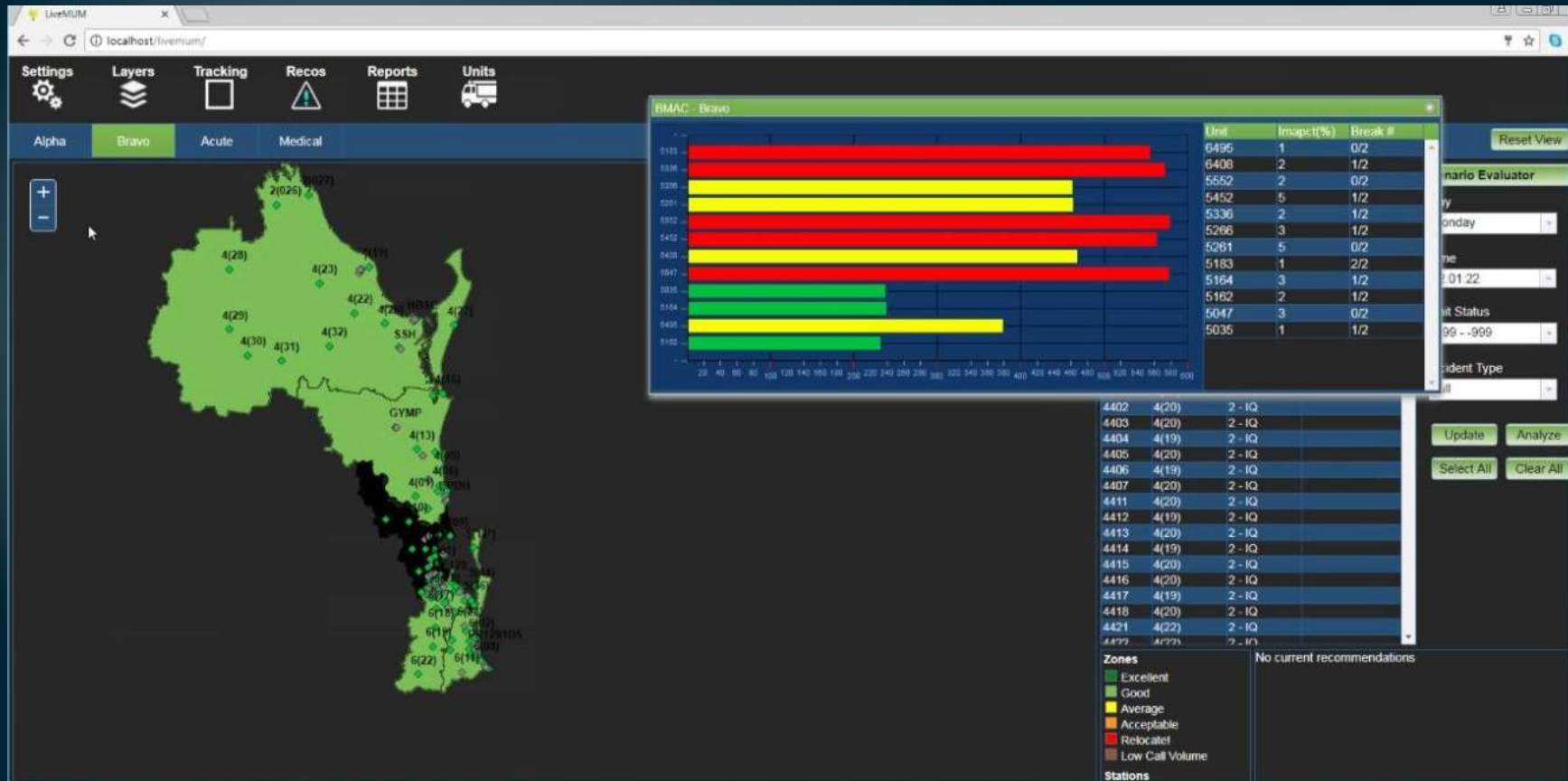


- Final score calculated as a weighted sum of the three scores

Fatigue Manager Approach

- MUM keep tracks of real time response coverage quality by area, **green good**, **red bad**.
- Fatigue Manager keep track of Fatigue Factor (FFR) by crew, green good, red bad.
- When **FFR** is red, time for relief.
- If **coverage** is also red, then **moveup** nearby green **unit** into area. Crew on break less likely to be called.
- When relief recommendation is accepted, crew gets notified.
- When **FFR** is green and **Coverage** is green, unit used for **moveup**, if needed.

Fatigue Manager In Action



Conclusions:

- Leadership must monitor and manage employee fatigue:
 1. Recognize signs of fatigue
 2. Implement fatigue countermeasures
 3. Mandate rest when necessary

Tools are there to help address this issue.



Q&A

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