Keeping Patients Safe: Evaluating Predictors of Nurse Fatigue and the Moderating Effect of Inter-shift Recovery

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Background and Impact

- About 37.9% of the working population in the United States suffer from occupational fatigue.[1]

- Occupational fatigue is a multi-causal and multidimensional phenomenon that is intensified easily by excessive work demands and inadequate recovery.[2]

- Employers pay up to $136.4 billion annually in health-related lost productive time, and $45 billion annually in lost productivity.[1,3]

- Fatigued workers are subject to musculoskeletal disorders, needle stick injuries, drowsy driving, accidents and near accidents, slow reaction time, altered cognitive function, turnover, and medical errors.[4-12]

Nurse Fatigue

- Nurses are the largest professional group in acute care settings.
- About 60% of US nurses work in hospitals.
- According to some national and international studies[4-12]
  - 75%-95% of nurses experience fatigue.
  - Fatigue is more prevalent among female (93%) than male nurses (87.5%).
  - 92 episodes of drowsy driving, and 5 accidents or near accidents were reported among 30 nurses who were monitored for a 2-week period.

Gaps in the Literature

▸ Whereas multiple studies were conducted to evaluate predictors of nurse fatigue, there are limited studies that proposed a comprehensive model to evaluate fatigue predictors.

▸ There is limited understanding of:
  ◦ Fatigue patterns within and between shifts.
  ◦ The relationship between nurse fatigue, medication error and near-miss and the moderating effect of inter-shift recovery.
  ◦ Fatigue recovery measures used by nurses while working and during their off-days.

System Engineering Initiative for Patient Safety (SEIPS)
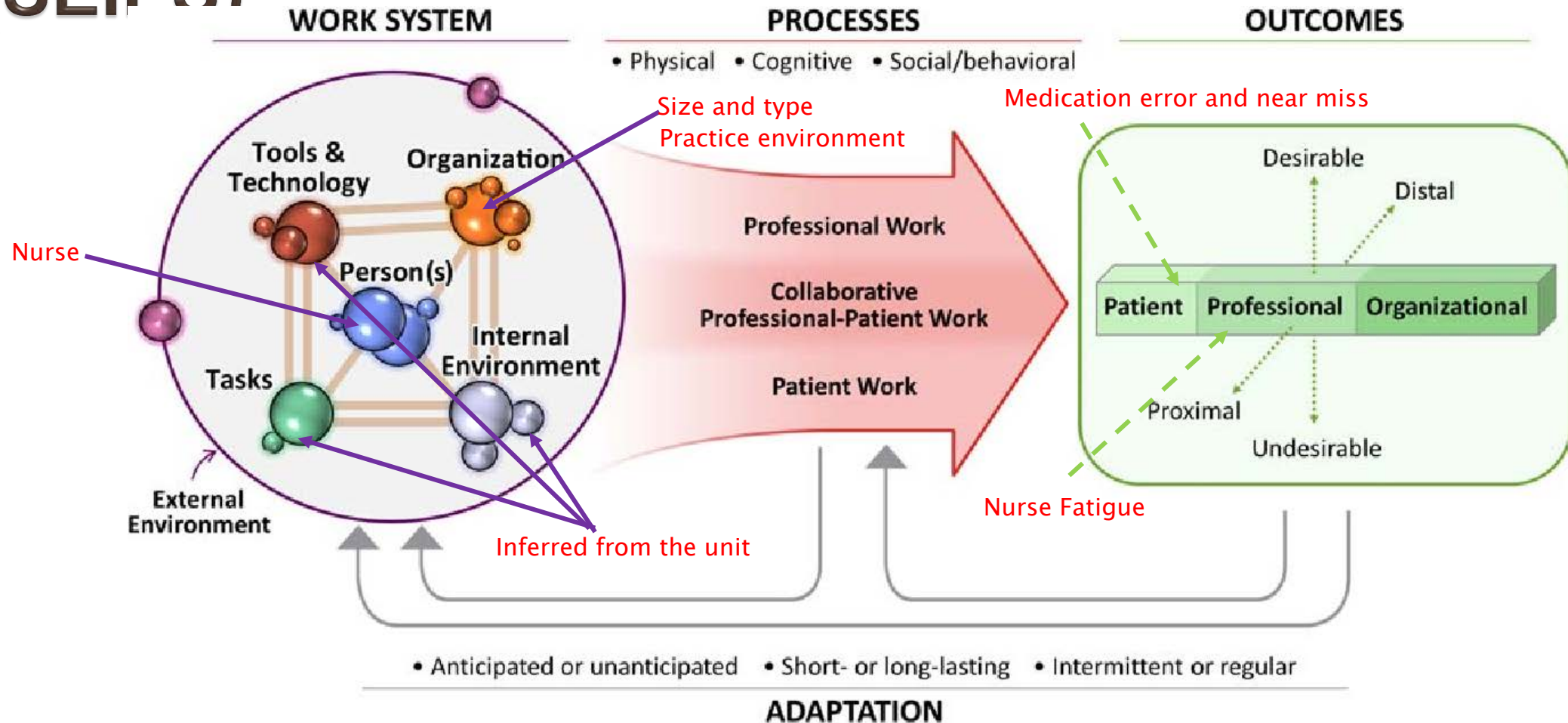
Carayon P, Schoofs Hundt A, Karsh T, Gurses P, Alvarado C, Smith M, Flatley Brennan P

Study Model
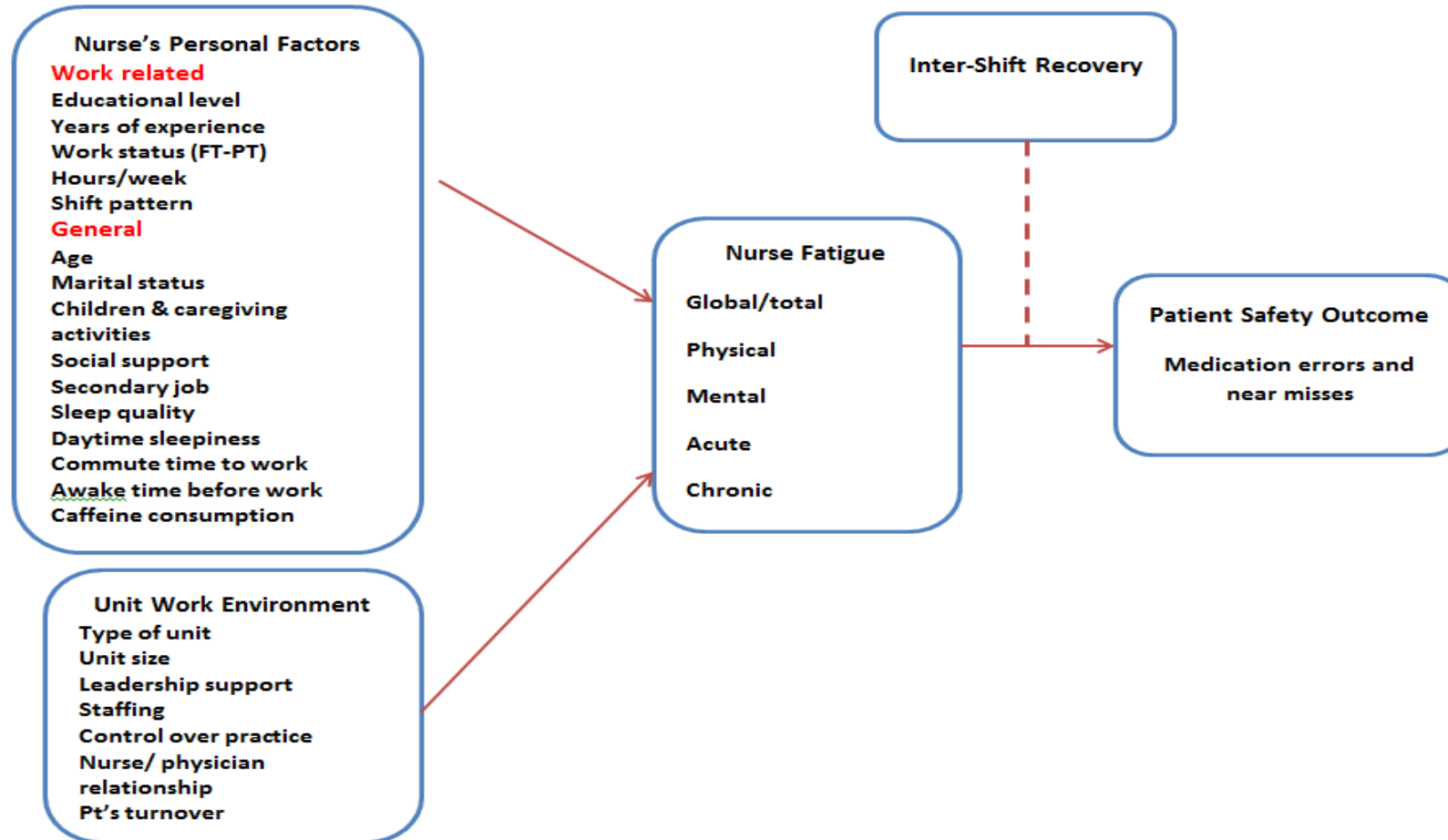
Method

- Design
  - ◦ Multi-phased mixed method design.
- Setting
  - ◦ All in-patient units within a convenience sample of 8 hospitals across one Midwestern state.
- Sample
  - ◦ All registered nurses employed at the selected study sites regardless of their educational background and years of experience were invited to the study.
  - ◦ Nurses who are not involved in direct patient care, agency nurses, and in administrative positions were excluded from the study.
  - ◦ The final study sample consisted of 1137 nurses.

Method (cont).

- Measurements

Study Variable	Measurement	Description
Demographics and personal factors	Investigator developed questions	Age, gender, employment status, years of experience, working hours/week, shift work, marital status, secondary job, No. of children, one-way commute time, exercise, caffeine consumption, and perceived social support.
Work environment	The Practice Environment Scale (PES) Lake (2002) and Aiken (2002)*.	Three subscales of leadership support (5 items), collegial nurse-physician relationship (3 items), and Staffing and resource adequacy *(4 items) were used. Nurses completed each item using 4-point Likert scale ranging from (0) strongly disagree to (3) strongly agree. High score means better environment.

Method (cont).

- Measurements

Study Variable	Measurement	Description
Sleep Quality	Pittsburg Sleep Quality Index (PSQI) Buysse, Reynolds, Monk, Berman & Kupfer (1989)	PSQI consists of 19 items covering 7 subscales of: sleep duration, disturbance, latency, efficiency, day dysfunction, need for medication, and overall sleep quality. subscales score range from 0-21; a lower score indicates better sleep quality, cut off point is 5.
Day time sleepiness	Epworth Sleepiness Scale (ESS) Johns (1991)	Nurses used 4-point Likert scale ranging from (0) would never doze to (3) high chance of dozing, to indicate the chances of dozing while engaged in 8 different daily situations. Score ranges from 0-24, lower score is better, cut off point is 8.

Method (cont).

- ## Measurement

Study Variable	Measurement	Description

Fatigue
      Physical
      Mental
	The Swedish Occupational Fatigue Inventory (SOFI)
	Ahsberg (2000).
		Nurses responded to 20 items covering four subscales : lack of motivation, physical exertion, physical discomfort, and lack of energy. Each subscale consists of 4 items rated on a 7-point Likert scale ranging from (0) not at all to (6) very high; a high score indicates higher fatigue level.

Acute Chronic Inter-shift recovery	The Occupational Fatigue, Exhaustion, and Recovery Scale (OFER) Winwood, Lushington &Winefield (2006).	15 items covering three subscales of acute and chronic fatigue and inter-shifts recovery. Each subscale consists of 5 items rated on a 7-point Likert scale ranging from (0) strongly disagree to (6) strongly agree. A high score indicates higher fatigue level. Better recovery for inter-shift recovery items.
Fatigue Pattern over Time	Investigator developed text using Ecological Momentary Assessment (EMA).	Nurses received 4 texts over a 14- day period to rate their fatigue during work and non-work days. Nurses rated their fatigue using 0-10 scale. High scores mean more fatigue.

Method (cont).

▸ Measurement

Study Variable	Measurement	Description
Medication error and near miss	Investigator developed questions.	Nurses used two dichotomous questions (Yes-No) and cannot remember to indicate if they have a medication error or near miss. If the answer is yes, nurses are prompted to answer a second question asking them to indicate if the error was at the beginning, middle, or end of the shift.

Procedure

- ## Phase one (Survey)
  - The PI attended all the staff meetings, introduced the study, and distributed the study package in the nurses' mailboxes.
  - The study package contained invitation to the second and third phases of the study.
  - Weekly reminder flyers and a last call flyer were distributed over 3 weeks period.
  - Each participant received a $20 compensation after receiving the completed survey.
  - A total of 1137 completed the study surveys and mailed it back.

Procedure

- Phase two (text messaging- EMA) Initiation of texting activities.
  - Participants who agreed to participate in the second phase were called and entered into specifically designed texting platform.
  - To account for possible schedule change, the first text was intended to verify if the participant is still working as scheduled or not.
  - Each participant received $ 90 for participating for 14 days and $10 bonus for complete texting (at least 75%)
  - A total of 1031 consented to the second phase, however, only 675 were successfully enrolled.

Procedure

▸ Phase 3 (Qualitative interview)

◦ Nurses fatigue scores and their medication error responses were used to classify nurses into 4 groups of High fatigue/ had error; high fatigue/ no error; low fatigue/ had error; low fatigue/ no errors

◦ A random sample of nurses (30 from each group)were invited to a 20-30 min qualitative interview about fatigue recovery measures used during work and off-work days.

◦ Participants' compensation ($40).

◦ A total of 120 invitation were mailed to nurses; 42 responded and completed the interview.

Results

Variable	Mean (SD)	Min-Max
Age	35.11(11.87)	20-72
Years of RN experience	9.58(10.63)	.08-54
Years of experience in the unit	6.16 (7.82)	.02-38
Years of experience with the nurse manager	2.95(3.88)	.02-34
Working hours/ week	35.23(7.25)	3-73.5
One way commute time in minutes	24.67(18.07)	5-120
Perceived social support (high score more support)	5.29(3.25)	0-10

Results

| *Variable	No	%
Marital status (n=1137): Married	**599**	52.6
Single	321	28.2
Education (n=1137): Associate	329	28.9
BSN	**721**	63.3
Type of Unit (n=1133): Medical/Surgical	259	22.7
Critical care	**293**	25.7
Pediatrics	206	18.1
Mother baby	123	10.9
Specialty units	129	11.4
Employment status (n=1131): Full time	799	70.1
Living with children (n=1137): No	665	58.4
Age of youngest child (n=472): Toddler 1-3y	132	27.9
Secondary Job (n=1133): No	984	86.4

*only high percent are reported

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Results

| Variable	Mean (SD)	Min-Max
Sleep Quality (less than 5 is desirable)	7.38(3.18)	1-19
Day time sleepiness (less than 8 is desirable)	8.31(4.23)	0-24

Fatigue:
    Acute
    Chronic
    Physical
    Mental
	
	67.31(20.36)
	41.37(23.7)
	1.61(1.03)
	3.13(1.31)
		
		10-100
		0-100
		0-4.88
		0-6

Inter-shift recovery	48.97(21.11)	0-100

Work environment:
    Leadership support
    Nurse/ physician relationship
    Staffing and resource adequacy
	
	2.10(0.66)
	2.14(0.62)
	2.04(0.54)
		
		0-3
		0-3
		0.14-3

Clusters of Fatigue Patterns
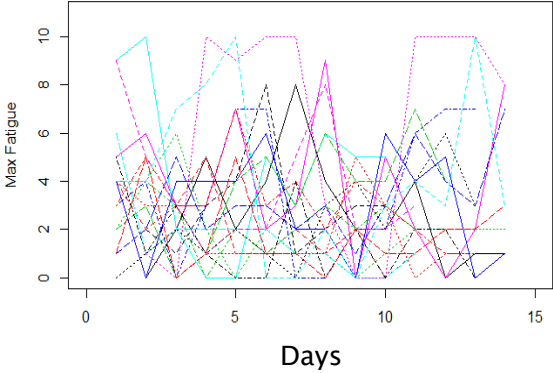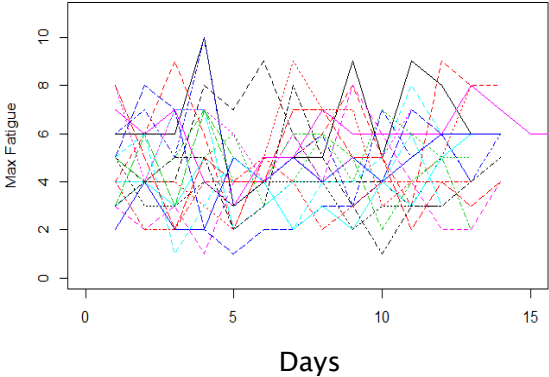

Cluster 1 (n=9)
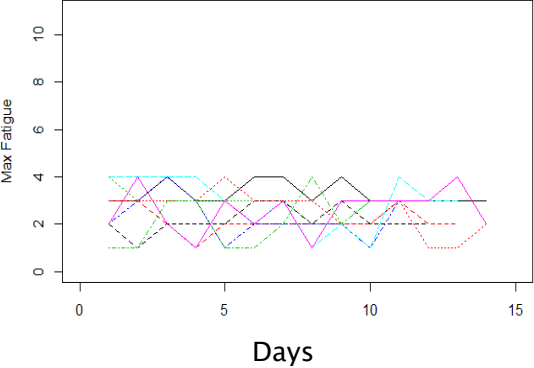
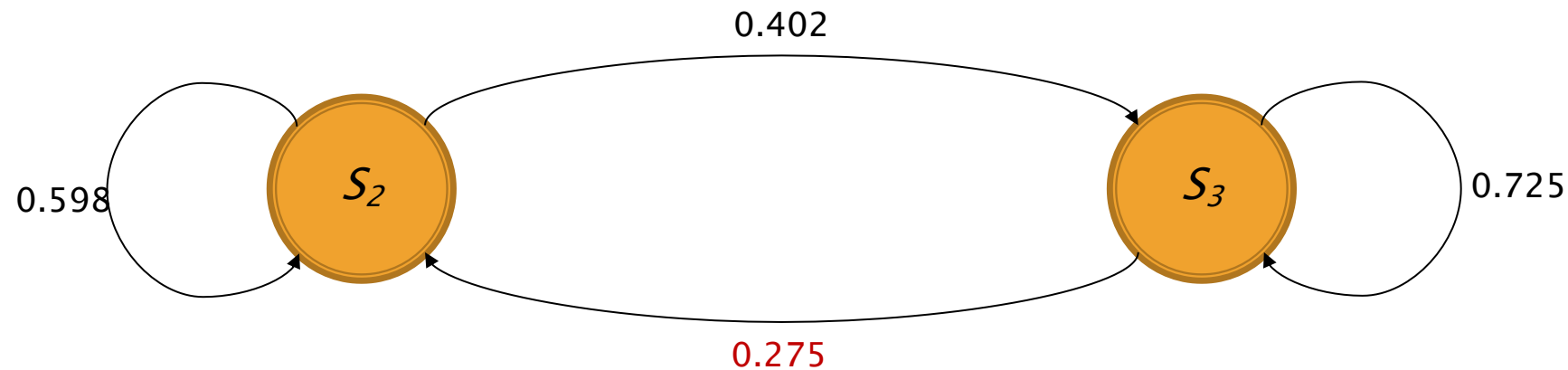Cluster 2 (n=23)
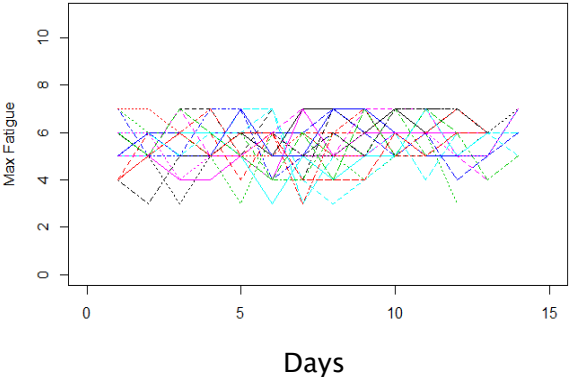
Cluster 3 (n=14)
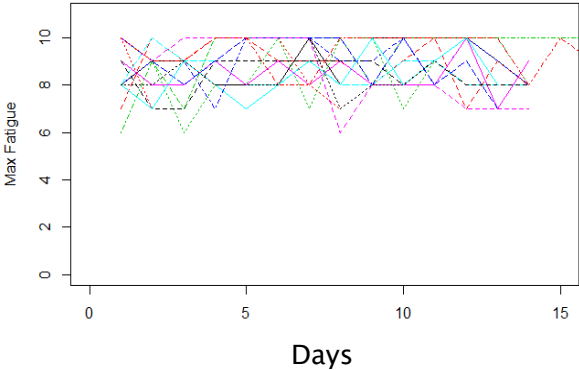
Cluster 4 (n=204)
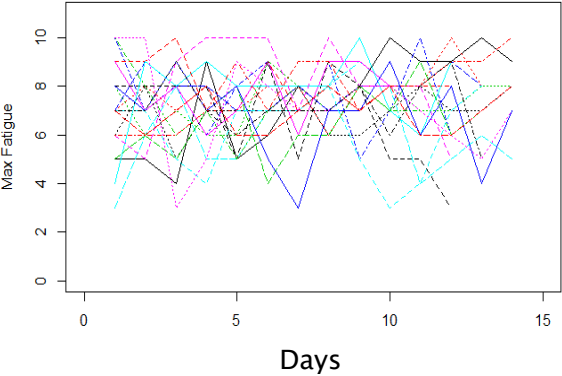
Cluster 5 (n=92)

Cluster 6 (n=323)

Two State Cluster

▶ Cluster 4

  ◦ Consists of moderate fatigue state S_2 and high fatigue state S_3

0.402

0.598 S_2 S_3 0.725

0.275

For nurses in cluster 4, there is 40% probability of moderate fatigue to build up to high fatigue, and 27.5% chance of recovery

Results-Two State Cluster

o Nurses starting with moderate fatigue will have 47% probability of fatigue build up. Having off-shift afterwards will result in 27% probability of recovery.

Shift	Prob
Day	0.323
Night	**0.478**
N/W	0.380

Shift	Prob
Day	0.217
Night	0.246
N/W	**0.274**
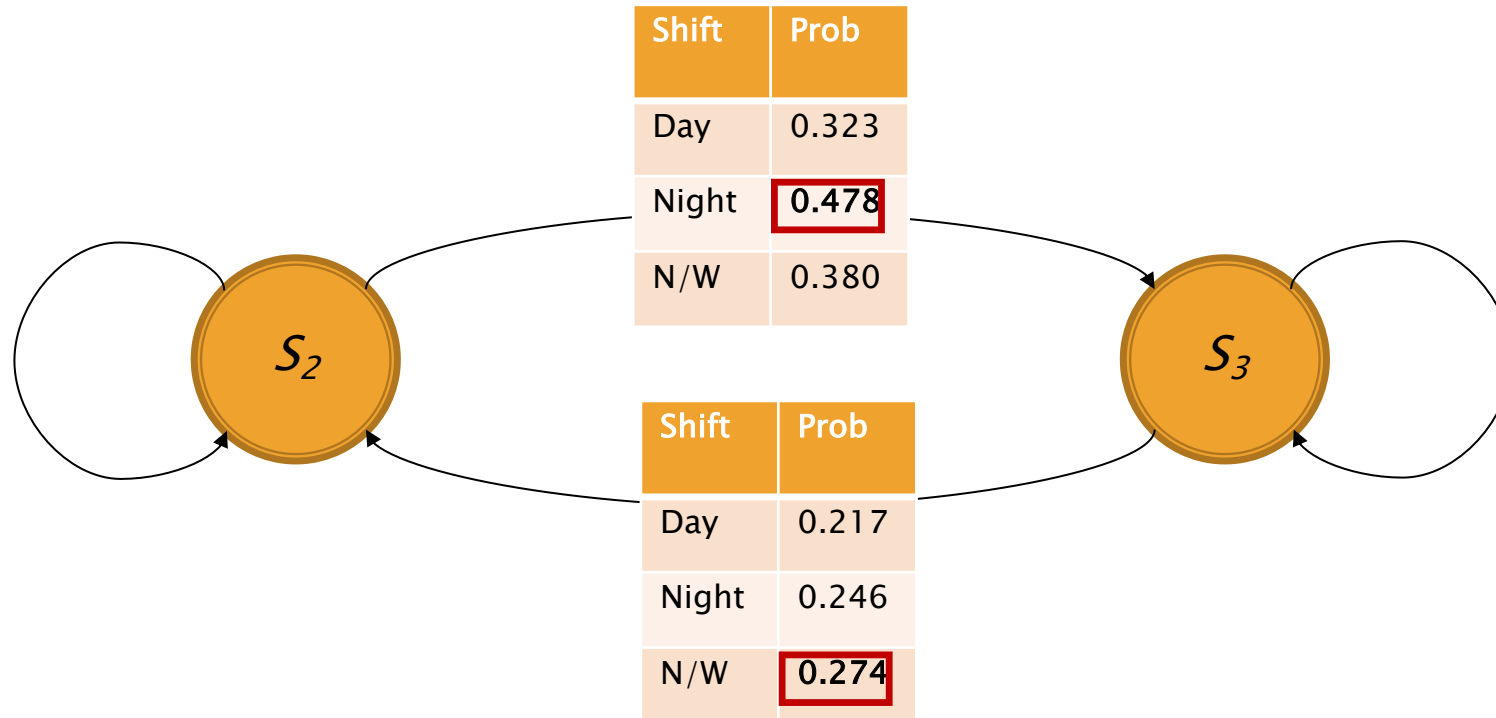
Results-Three State Clusters

○ Nurses in clusters 5 and 6 displayed three fatigue sates low, moderate, and high.
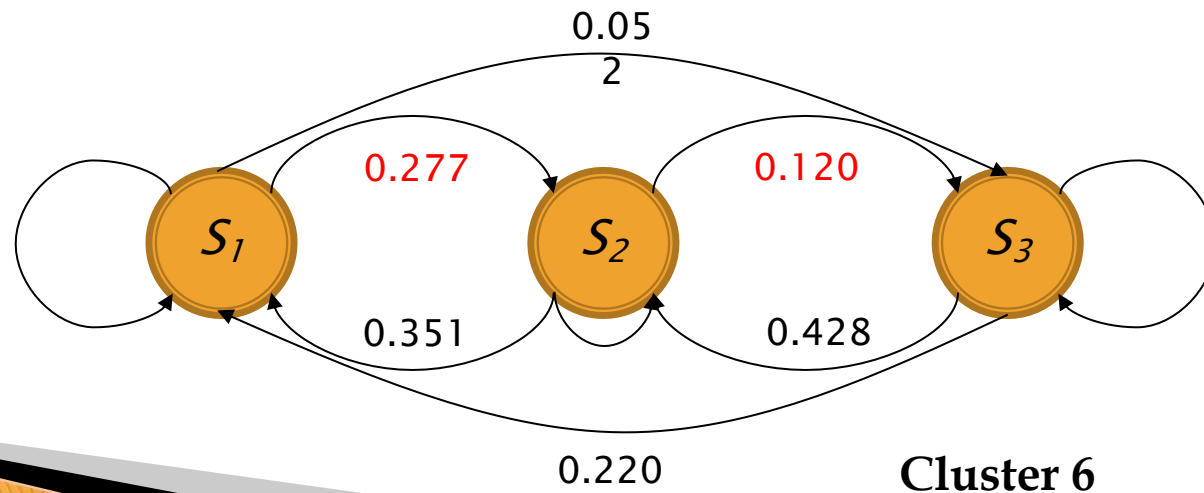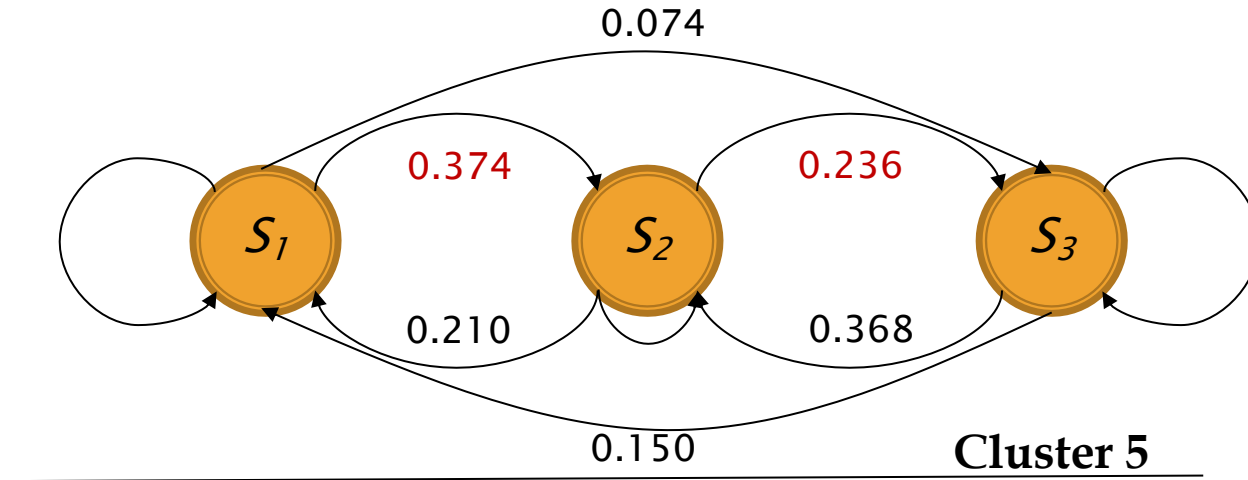
Cluster 5

Cluster 6

Medication Error and Near-miss Per Cluster

Conclusion

- Fatigue is a multicausal multidimensional phenomenon.
  - Sleep quality, exercise, caffeine consumption before work, staffing and resource adequacy were among the strongest predictors of various fatigue types.
  - Nurses are more mentally than physically fatigued.
  - Surprisingly, day shift nurses were more fatigues than nightshift nurses, however, night shift delayed nurse recovery.
  - Caregiving responsibilities and second job were not associated with fatigue.
  - Nurse fatigue was associated with medication error and near-miss.
  - Workload and the prevailing nursing culture are some of the barriers to fatigue management.

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