Preliminary assessment of rotating shiftwork risk in a twenty-four hours hospital department

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Key words: Healthcare worker, HCW, Risk assessment, Questionnaire, Organizational interventions, Sentinel events

Parole chiave: Operatore sanitario, Valutazione del rischio, Questionario, Interventi organizzativi, Eventi sentinella

Abstract

Background. The safety and health of healthcare workers employed in twenty-four-hour hospital wards and exposed to rotational shiftwork (RS), including night shift, is an hot topic of international literature; in fact shift workers incur increased rates of burnout, accidents and injuries, absenteeism and, consequently, reduced work efficiency than non-shift workers. The aims of the present study were: 1) to analyze the occupational risk associated with RS in healthcare sector and 2) to detect the consequent interventions effective in minimizing RS risk.

Methods. The authors designed a questionnaire entitled Rotating Shiftwork Questionnaire (RSQ) which is made up of two sections: 1) Sentinel Events; 2) Risk Factors. The authors used the RSQ to evaluate the RS-Risk among homogeneous groups employed in a twenty-four-hour hospital department.

Results. The authors found a medium level of risk among all homogeneous groups. The analysis led to suggest organizational interventions for reducing the sources of RS-risk among healthcare workers.

Conclusion. The proposed questionnaire revealed effective in approaching the assessment of RS-risk; the findings were also useful in prioritizing and implementing strategic interventions aimed to moderate the occupational risk related to RS.

Introduction

The rotational shiftwork including night shift (RS) in 24 hours hospital wards represents a major concern about the safety and the health of healthcare workers (HCWs). In fact, to date, there are many different schedules of RS being used by the same hospital, the same occupation and often the same ward, with different rotation (i.e. clockwise or counterclockwise), variable start and finishing time, and different amounts of night shifts (1-7). Since many schedules exist, it is important to assess the impact of RS on safety and health of rotating shiftwork HCWs. In 2010 the International Agency for Research on Cancer (IARC) has concluded that "shiftwork that involves circadian disruption" is considered

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a Group 2A carcinogen and "probably carcinogenic to humans". Group 2A means that this conclusion was based on "limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals". IARC based its conclusions on studies on long-term night female workers who have shown a higher risk of breast cancer than women who do not work at night. According to the IARC monograph, rotating shiftworkers are defined people alternating more or less periodically on different shifts. In 24 hours hospital wards the RS schedules must guarantee a pattern of work where one HCW replaces another on the same job within a 24-hour period. In the healthcare sector, shift workers have been shown more frequently to report increased accident and injury rates than nonshift workers (8-11); in addition, shiftwork has been linked to occupational stress, burnout, depressive symptoms, reduced work efficiency, poor performance, decreased job satisfaction, increased rates of absenteeism and turnover, decreased quality and quantity of care and ultimately to higher health care costs (1, 12-16).

The aim of this study was to develop a methodological path for a preliminary objective assessment of occupational risk associated with RS in healthcare sector, based on an empirical method.

Methods

The term "rotational shiftwork" (RS) covers a wide variety of work schedules and implies that shifts rotate or change according to a set schedule. In this study the definition of RS was addressed to continuous shiftwork, running 24 hours per day, 7 days per week, with weekends. This definition did not include fixed shifts like straight nights, straight afternoons or straight days and, generally, fixed shifts are not discussed here. In literature, the

occupational risk assessment of RS is most frequently addressed to the interaction between organizational aspects of RS and workers' demographic characteristics, workers' biological responses to RS and job performance indicators (17-26). The authors empirically adapted this approach to the needs of an objective preliminary risk assessment of RS schedules in 24-hours hospital wards, with the aim: 1) to detect, preliminarily, the occupational risk profile for homogeneous groups exposed to RS; and 2) to detect the consequent interventions effective in minimizing this risk. In phase I of this study, the authors designed the Rotating Shiftwork Questionnaire (RSO) with the aim to calculate the objective RS-Risk (RSR) index, empirically defined as the product of the interaction between sentinel events (SE) and risk factors (RF) associated with RS (RSR=SExRF); RSQ was designed after a review of literature to collect recent evidences related to sentinel events (SE) and risk factors (RF) addressed to RS schedules in hospital wards. The RSQ was based on Health and Safety Executive (HSE, United Kingdom) guidance for managing shiftwork (19) and on the multidimensional validated tool developed in Italy by the National Network for the Prevention of Work-Related Psychosocial Disorders (27-30). The questionnaire was addressed to homogeneous groups of HCWs exposed to RS and did not analyze the individual characteristics of exposed workers (i.e. demographics, biological responses).

In order to obtain consensus on the RSQ, the Delphi method was used. The Delphi method involves an iterative process of review by a panel of experts that is designed to achieve consensus regarding the final list of checklist steps/metrics (31).

In phase II of this study, for the validation of RSQ, a panel of eligible experts was selected in Italy; the experts were identified based on specific criteria, including having active involvement in occupational risk assessment, being trainers on safety and health at work, having produced prior publications in the field of shiftwork.

Each expert was asked to rate the steps on a Likert scale from 1 "not important" to 5 "essential"; means and 95 % confidence intervals (CIs) were calculated for each step to identify relevant steps. The 95 % CIs were used to quantify the variability of the experts' responses. Rated on a Likert scale 1–5, the CI were between 1.00 and 5.00. An item was accepted as a key item if the lower confidence limit was \geq 3.00. A step was excluded if the upper confidence limit was \leq 3.50.

In Delphi round 2, a cut off point for consensus was predetermined. Consensus was established when at least 80 % of the respondents rated the step as \geq 3. This step was then accepted as a key step. If the 80 % threshold was not reached, the step was excluded.

A Cronbach alpha was used as a measure of consistency among the opinions of the experts, and a value of ≥ 0.80 was chosen as a cut-off value for determining consensus.

In phase III of the present study, the questionnaire validated by the panelists was used in a pilot study, performed in the period between May and June 2017, to assess the RS risk in a 24-hours working hospital department, in Salento (Italy), in which 130 nurses and 50 physicians were employed; the questionnaire was administered to the head physician of such ward, with the aim to assess the feasibility of RSQ.

The study was performed as part of the obligatory evaluation of occupational risks, which is required by Italian Legislative Decree 81/08. The present study required no formal approval by the local ethics committee.

Results

Eighteen experts were invited to participate; of these, 10 (55,5%) agreed

and completed the first and second round (6 Occupational physicians, 2 Clinical Psychologists, 2 Occupational Safety professionals); Chronback's alpha was calculated and resulted 0.90, showing high internal consistency among the panelists for the items included in the final questionnaire. The results are presented in Tables 1-3. The Delphi round 1 had 25 items to be rated; 23 items reached the consensus (Table 1), the remaining 2 items were reassessed in round 2, but were excluded because they did not reach consensus (Table 2). Therefore, the final RSQ is made up of 23 items (Table 3); the section SE identifies nine indicators of RS-related problems (i.e. work-related injuries, health impairments arising from fatigue and the mismatch of circadian rhythm with the work, impaired work performance, overworking etc.) and identifies three areas of risk: low (a score of 0 - 7), medium (a score of 8 - 13), and high (a score > 13). Low, medium and high risk scores are converted respectively into 0, 1.5, 2. The section RF identifies 14 organizational factors of RS risk (RF).

The questionnaire identifies three levels of RSR: low (score of 0 - 14), medium (score >14 - ≤ 26), and high (score >26).

Discussion and Conclusions

Using a Delphi methodology, the authors achieved consensus among experts in RS risk and a valid, structured and reliable questionnaire was developed. The investigation conducted in a 24-hours hospital ward, using the RSQ, showed a medium level of RSR among both physicians and nurses, susceptible to be minimized through organizational level interventions. In particular, the authors found that among physicians the RSR was related to lack in regularity and predictability of shift work, low speed of shift rotation, low number of free weekends. By the present Table 1 - Delphi round I: Rotating Shiftwork Questionnaire (RSQ) for a 24-hours hospital ward

1.1 Sentinei events (SE) (*).					
		Decreased (score = 0)	Unchanged (score = 1)	Increased (score = 2)	IC 95%
1. Work-related injuries (**)		0	1	2	3,66-4,34
2. Medical Errors (**)		0	1	2	3,86-4,54
3. Sick leave (**)		0	1	2	4,12-4,88
4. Unused vacations (**)		0	1	2	3,57-4,63
5. Over working time (**)		0	1	2	3,23-4,37
6. Staff turnover (**)(No. of employees leaving/total No. of Employees)		0	1	2	3,47-4,73
7. Lack of progress towards strate (in regard to the hospital strategie	gic goals c plan) (**)	0	1	2	3,10-4,10
8. Requests for extra medical che to RS risk (**)	cks related	0	1	2	3,87-4,33
9. Work-related stress notification	ns (**)	0	1	2	4,12-4,88
10. Juridical petitions (**)		0	1	2	2,89-4,10 Reassessed in round 2
11. Disciplinary measures (**)		0	1	2	2,71-3,89 Reassessed in round 2
Conversion of SE scores and detec	tion of areas	of risk.			
SCORE	0 - 9	1	0 - 17	18 - 22	IC 95%
SCORE CONVERSION	1,00		1,50	2,00	3,86-4,54
AREA OF RISK	LOW	M	EDIUM	HIGH	5,00-5,00

1.1 Sentinel events (SE) (*):

1.2 Risk Factors (RF): Organizational factors of Rotating Shiftwork risk (***):

	Good (-)	Ok ()	Critical ()	Problematical ()	IC 95%
1. Regularity of shift cycles	0	1	2	3	3,90-4,90
2. Forward-rotating schedules	0	1	2	3	3,86-4,54
(Morning-Afternoon-Night)					
3. Morning starts after 7.00 a.m.	0	1	2	3	3,23-4,37
4. Working not alone in a shift	0	1	2	3	3,12-4,08
5. Predictability of the shift	0	1	2	3	3,89-4,10
6. Shift Flexibility	0	1	2	3	3,41-4,60
7. Rest periods between consecutive shifts (>11 hours)	0	1	2	3	3,57-4,63
8. Rest day after night shift	0	1	2	3	4,12-4,88
9. A short break of 5-15 minutes within the shift	0	1	2	3	3,12-4,08
10. Speed of shift rotation (number of consecutive days worked before changing chift)	Speed (every	Intermedia- te (every	Slow (15 or 20	Very slow (every 21	
before changing shift)	days)	days)	days)	or plus days)	
Score	0	1	2	3	3,22-4,18
11. Shift duration	<8 hours	8-12 hours	12,1-18 hours	>18 hours	
	0	1	2	3	3,14-4,46

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12. Nights per month (no.)	1-3	3,1-5	5,1-7	>7	
Score	0	1	2	3	3,86-4,54
13. Consecutive nights per week	0	0,1-1	1,1-2	>2	
Score	0	1	2	3	4,12-4,88
14. Free week-ends per month (no.)	>2	1,1-2	0,1-1	0	
Score	0	1	2	3	3,22-4,18

Table legends:

(*) comparison between the current biennium and the previous

(**) if not detected = 0

(***) data of the current biennium

- if detected in 95-100% of the shifts = 0

-- if detected in 75 -94% of the shifts = 1

--- if detected in 50 -74% of the shifts = 2

---- if detected in <50% of the shifts = 3

Rotating Shiftwork Risk Index (RSR) = SE x RF

LOW	MEDIUM	HIGH	IC 95%
≤14	14,1-26	>26	5,00-5,00
	Actions		
Monitoring plan	Corrective measures and new assessment two years later	Corrective measures, eventually in-depth evaluation (*) and new assessment two years later	4,12-4,88

(*) This phase aims to gather important information on the organization's "health" through assessment of employees' perceptions. It is required if corrective measures prove inadequate. However, organizations may also use it to collect further in-depth information.

Table 2 - Delphi round II: reassessed items for RSQ

Sentinel events	Likert score 1-2 (%)	Likert score 3-5 (%)
Juridical petitions	40	60
Disciplinary measures	30	70

Accepted as item: none

Table 3 - Rotating Shiftwork Questionnaire (RSQ) for 24-hours hospital ward: final instrument

3.1 Sentinel events (SE) (*):				
			Decreased (score = 0)	Unchanged (score = 1)	Increased (score = 2)
1) Work-related injuries (**)			0	1	2
2) Medical Errors (**)			0	1	2
3) Sick leave (**)			0	1	2
4) Unused vacations (**)			0	1	2
5) Over working time (**)			0	1	2
6) Staff turnover (**)			0	1	2
(No. of employees leaving	g/total No. of Emp	loyees)			
7) Lack of progress towards strategic goals (in regard to the hospital strategic plan) (**)			0	1	2
8) Requests for extra medical checks related to RS risk (**)			0	1	2
9) Work-related stress notifications (**)			0	1	2
Conversion of SE scores an	d detection of area	s of risk.			
SCORE	0 - 7	8 - 13		14 - 18	
SCORE CONVERSION	1,00	1,50		2,00	
AREA OF RISK	LOW	MEDIUM	[HIGH	

3.2 Risk Factors (RF): Organizational factors of Rotating Shiftwork risk (***):

	Good (-)	Ok ()	Critical ()	Problematical ()
1) Regularity of shift cycles	0	1	2	3
2) Forward-rotating schedules (Morning-Afternoon-Night)	0	1	2	3
3) Morning starts after 7.00 a.m.	0	1	2	3
4) Working not alone in a shift	0	1	2	3
5) Predictability of the shift	0	1	2	3
6) Shift Flexibility	0	1	2	3
7) Rest periods between consecutive shifts (>11 hours)	0	1	2	3
8) Rest day after night shift	0	1	2	3
9) A short break of 5-15 minutes within the shift	0	1	2	3
10) Speed of shift rotation (number of consecutive days worked before changing shift)	Speed (every 1-2 or 3 days)	Intermedia- te (every 4 or 14 days)	Slow (15 or 20 days)	Very slow (every 21 or plus days)
Score	0	1	2	3
11) Shift duration	<8 hours	8-12 hours	12,1-18 hours	>18 hours
	0	1	2	3
12) Nights per month (no.)	1-3	3,1-5	5,1-7	>7
Score	0	1	2	3
13) Consecutive nights per week	0	0,1-1	1,1-2	>2

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Score	0	1	2	3
14) Free week-ends per month (no.)	>2	1,1-2	0,1-1	0
Score	0	1	2	3

Table legends:

(*) comparison between the current biennium and the previous

(**) if not detected = 0

(***) data of the current biennium

- if detected in 95-100% of the shifts = 0

-- if detected in 75 -94% of the shifts = 1

--- if detected in 50 -74% of the shifts = 2

---- if detected in <50% of the shifts = 3

Rotating Shiftwor	k Risk	Index	(RSR) =	SE x	RF
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LOW	MEDIUM	HIGH
≤14	14,1-26	>26
	Actions	
Monitoring plan	Corrective measures and new as- sessment two years later	Corrective measures, eventually in- depth evaluation (*) and new assess- ment two years later

(*) This phase aims to gather important information on the organization's "health" through assessment of employees' perceptions. It is required if corrective measures prove inadequate. However, organizations may also use it to collect further in-depth information.

Table 4 - Problematical issues related to RS-risk among physicians and improvement interventions.

Problematical issue	Intervention
Shift flexibility	Worker's participation to the whole process of designing and implementing the shift schedules
Predictability of shift work	Organizational model in wich the shift schedules were designed with thirty days in advance
Low speed of shift rotation	Slowly rotating shifts over at least a 3-week period
Low workers' awareness of rotating shiftwork risk	Safety training focused on rotating shiftwork risk

Table 5 - Problematical issues related to RS-risk among nurses and improvement interventions.

Problematical issue	Intervention
Shift flexibility	Worker's participation to the whole process of designing and implementing the shift schedules
Forward-rotating schedules (Morning - Afternoon - Night)	Sistematic adoption of the forward-rotating schedules
Low workers' awareness of rotating shiftwork risk	Safety training focused on rotating shiftwork risk

analyses the organization of the ward did not allow the physicians to adopt the fast rotation. According to the Health and Safety Executive recommendations, the authors suggested slowly rotating shifts over a period of at least 3-weeks. Moreover, to ensure the predictability of shift work, the authors suggested an organizational model in which the shift schedules were designed with thirty days in advance, ensuring the regularity of shiftwork model. The number of free week-ends resulted unmodifiable because of the shortage of physicians employed in the studied hospital ward.

The problematical issues detected among nurses were: lack in shift flexibility, high number of night-shifts per month (no. 6-7 per month). The shortage of nurses did not allow to reduce the number of night-shifts per month. Provided this impossibility, the authors suggested to improve the flexibility of shiftwork schedules through the worker's participation to the whole process of designing and implementing the shift schedules. The goal of this intervention was to ensure the adaptability of the shift schedules to the needs of each worker, provided this is compatible with the organizational needs of the ward. About the safety training, the Occupational Prevention and Safety Service of the Local Health Authority organized safety training programs focused on RSR with the aim to assist RS workers in adopting effective safety strategies to manage and minimize the impact of occupational risks, including RSR, on workers' health and wellness.

RSQ showed to be a valid and reliable tool to analyse RSR in 24-hours working hospital wards; the pilot study conducted in a 24-hours hospital ward demonstrated the effectiveness and feasibility of the introduced RSQ in approaching the RSR, through the analysis of quantitative data involving indicators (SE, RF) of RSR; the findings were also useful in prioritizing and implementing strategic interventions aimed to moderate the risk associated with RS.

Further studies will be necessary to verify the effectiveness of the proposed RSQ in the preliminary assessment of RSR among HCWs employed in 24-hours hospital wards. To ensure its applicability, the method should actively involve the occupational safety and health professionals together with head physicians and head nurses.

Limitations

There were several limitations in this empirical study. Firstly, the proposed questionnaire (RSQ) analyzed only the objective risk factors related to RS and did not consider the subjective workers' perception of RSR. Secondly, the preliminary assessment of RS-risk is addressed to homogeneous groups of HCWs and not to each worker. Thirdly, the analysis of SE was conducted through the comparison of two couples of years, and the analysis of RF involved only one biennium, which might influence the precision of the findings.

Author Statements Ethical approval

The study was performed as part of the obligatory evaluation of work related stress, required by Italian Legislative Decree 81/08, and needed no formal approval by the local

Conflict of interests

ethics committee.

The authors declare no financial or personal relationship with people or organizations that could inappropriately influence this work.

Riassunto

Valutazione preliminare del rischio da lavoro a turni in un dipartimento ospedaliero operativo sulle 24 ore

Introduzione. La salute e sicurezza degli operatori sanitari impegnati nel lavoro a turni e notturno (RS) nei reparti ospedalieri rappresentano argomenti frequentemente trattati dalla letteratura internazionale; infatti, tra gli operatori sanitari turnisti è documentata una maggiore frequenza di burnout, incidenti ed infortuni sul lavoro, assenteismo e, conseguentemente, una minore efficienza lavorativa, rispetto agli operatori non turnisti. Gli obiettivi del presente studio sono stati: 1) analizzare il rischio lavorativo associato al lavoro a turni e notturno in ambito sanitario; 2) individuare i conseguenti interventi efficaci nel minimizzare il rischio.

Metodi. Gli autori hanno progettato un questionario denominato "Rotating Shiftwork Questionnaire" (RSQ) suddiviso in due sezioni: 1) Eventi Sentinella; 2) Fattori di Rischio, e lo hanno utilizzato per la valutazione del rischio da lavoro a turni e notturno all'interno di gruppi omogenei di operatori sanitari di un dipartimento ospedaliero.

Risultati. Gli autori hanno individuato un livello di rischio medio per tutti i gruppi valutati. L'analisi ha consentito di suggerire interventi organizzativi mirati a ridurre alla fonte il rischio da lavoro a turni e notturno tra i turnisti.

Conclusioni. Il questionario proposto si è rivelato uno strumento efficace nell'approccio alla valutazione del rischio da lavoro a turni e notturno; le risultanze sono state utili anche per assegnare la priorità agli interventi organizzativi e per implementarli, al fine di moderare il rischio da lavoro a turni.

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