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Patient Safety Knowledge and Compliance Among Nurses In Public Hospitals In Lebanon

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Abstract
Background
Nurses are the healthcare providers most interactive with hospitalized patients,and most involved withpatients' safety (PS) and health outcomes. Nurses in Lebanon belong to three categories: Nurse Leaders (NL), Registered Nurses (RN), and Practical Nurses (PN). Their interventions differ based on the roles and responsibilities of each category. This study explores PS knowledgeand compliance among nurses in public hospitals in Lebanon, by categories.
Material and Methods
A cross-sectional design was used to assess PS culture in 26 of 28 public hospitals in Lebanon. Data was gathered using a self-administered questionnaire and analyzed with SPSS, to determine the association of nurses' categories with PS knowledge and compliance.
Results
The survey involved 162NLs, 535 RNs, and 67 PNsworking in public hospitals.NLs were more knowledgeable about and compliant with PS recommendations than RNs or PNs. Working in University Hospitals, shorterweekly working hours, lower nurse to patient ratio, presence of a PS committee, PS officer, PS program, and PS periodic training and audit were all significant associations with better PS knowledge and compliance.
Conclusions
Improvement in PS culture is more required at RN and PN levels than at NL level. Hospitals' management will need to create and/or activate the PS oversight structures, and allow the efficient use of resources by controlling nurses' daily workload. Transforminggeneral public hospitals into training university centersmay improve PS culture significantly among nurses. Educational focus on PSC currently the norm in private nursing schools should also be developed in public ones.
Keywords: *International Patient Safety Goals (IPSG), Patient Safety Culture (PSC), accreditation, Arab, Middle-East*

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I. Introduction

A1. BACKGROUND

Compliance withpatient safety culture (PSC) varies across health care disciplines, settings, and professional categories[1]. Nurses are the largest group of healthcare providers,the most interactive with patients and have the greatest impact on their safety and health outcomes[2].The Institute of Medicine (IOM) and the World Health Organization (WHO) believe that nursing interventions are directly related to better PS outcomes and that nursing vigilance can protect patients against injuries and harm [3].A systematic review was conducted in 2013 to identify and assess the effect of PS programs in acute care settings. The results revealed that centers with a PS program reported statistically significant improvements in staff perceptions of patient safety culture and care processes, reduction in length of stay, infection, and mortality rates [4]. Moreover, nurses working in

four-teaching and referral hospitals in southeast Iran introduced the auditing of clinical practices as an important way to evaluate and enhance the safety culture [5].

All nurses have an ethical obligation to follow PS policies and procedures and make decisions that bring the best PS outcomes. However, Singer et al. suggested that the workposition among nurses is significantly associated with theirperception of PSCimportance [6]. Stear believes that it is important to assess PSC from all perspectives because nursing interventions will differ based on the roles and responsibilities of each nurses' category [2]. Unfortunately, most of the research studies about PSC included nurses as a monolithic subset among healthcare professionals, compared to physicians, clinical or nonclinical managers, and technicians[7]. In this paper, we explore the effect of nurses' working positions on their (1) personal adherence and (2) actual compliance with institutional requirements regarding PS recommendations. Other sets of variables are likely to also affect those two outcomes in nurses:

1. Personal and professional factors;
2. Hospital-based structural factors, and
3. Organizational characteristics of the hospital functioning process[2; 8; 9; 10].

Lebanon is a small republic (10,452 km^2) with a population of about 5 million. The implementation of PS is still at an early stage in about 146hospitals currently functioning in Lebanon (total capacity: 15,000 beds). Hospitals are mostly private-run, while the Ministry of Public Heath directly owns and operates 28 facilities[11]. The efficiency of public hospitals is highly dependent on the socio-economic and political stability of the country. In Lebanese hospitals, there are currently three nursing positions:
(1) Nurse Leaders (NL) that include Nursing Managers, Supervisors, or Nurses in Charge: they oversee the integration of patient care, including the development of treatment plans, collecting and evaluating treatment results, and managing patient medical teams;
(2) Registered Nurses (RN) who monitor patients' conditions and assess their needs to provide the best possible nursing care; and
(3) Practical Nurses (PN) who work provide basic nursing care for patients.

The issue of PS has just started to attract the attention of researchers in the Arab world in general, and in Lebanon in particular. So far, only one cross-sectional study has been conducted by El-Jardali et al. (2010) to assess PSC among healthcare professionals, including nurses, in sixty-eight private hospitals, using the Hospital Survey of Patient Safety Culture (HSOPSC) checklist[12]. However, they only focused on nurses as a discrete group, and did not go far enough to examine potential differences among nursing categories.

Considering that nurses have a very pivotal role in promoting patient safety and maintaining safety standards by being active in reducing medical errors, it is critical to understand nurses'approach to various aspects of PSC. This study aims at filling this gap in current evidence and at suggesting avenues for improvement. In particular, we have focused on the effect of nurses' professional categories on their personal adherence and actual compliance with institutional requirements regarding PS recommendations. Figure 1 presents a conceptual model summarizing the direction of our analyses (Figure 1).

A2. OBJECTIVES

The objectives of this study were:

- To measure the knowledge and level of compliance with PSC concepts and the International Patient Safety Goals among nurses in public hospitals in Lebanon.
- To compare results between various working positions, controlling for several categories of intermediate factors.

II. Methods

B1. DESIGN, PARTICIPANTS AND INSTRUMENTS

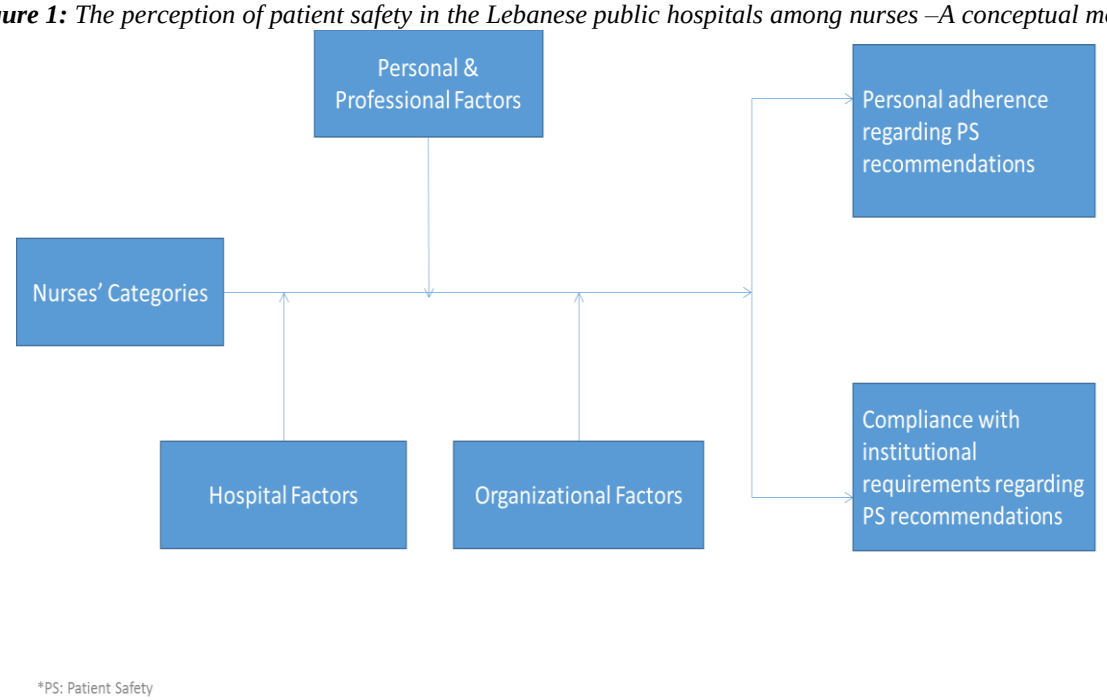
A cross-sectional design was employed to collect data from July to November, 2020. All nurses in public hospitals in Lebanon were contacted and invited to participate. Only two hospitals decided not to participate, arguing logistical issues related to the COVID-19 pandemic. The present study included nurses from all categories, providing they had worked for at least 6 months in the same hospital, to ensure that they had sufficient familiarity with their departments, hospital policies and procedures, work environment, and orientation programs. Data were collected through self-administered questionnaire. The questionnaire was originally designed in English and then translated into Arabic and back into English by another translator, to check the content consistency after translation. The final translation was then reviewed by professional experts. Before starting the actual data collection, a pilot testing phase was conducted to ensure the comprehension of the

Arabic questionnaire, and some wordings were changed to maintain the clarity of the text. Additional details on the study methodology can be found in Al Akoum et al. (2021) [13].

B2. DATA ANALYSIS

Quantitative data were checked, coded, entered and analyzed using the Statistical Package for Social Sciences (SPPS version 22). All variables were described as per their type: nominal variables were presented by frequencies and percentages, and continuous ones by means and standard deviation (SD). The dependent variables of this analysis were the overall scores of institutional PSC with which nurses should compliance, and their personal adherence using the knowledge and practice scores from the "International Patient Safety Goals" (IPSG) checklist. Besides nurses' categories, potential independent determinants included: personal and professional factors, hospital-based and organizational factors, previously listed and defined [13]. All analyses were conducted in the three strata of nurses' positions: "NLs", "RNs" and "PNs". All tests were conducted at a significant p-level of 0.05. Variables found to be significantly associated with the outcomes of interest were entered in a multivariate linear regression model to control for joint effects.

Figure 1: *The perception of patient safety in the Lebanese public hospitals among nurses –A conceptual model*



III. RESULTS

C1. DIFFERENCES IN PERSONEL, PROFESSIONAL AND ORGANIZATIONAL FACTORS AMONG NURSES' CATEGORIES

The study recruited 764 nurses: 162 (21.1%) nurse leaders (NL), 535 (70%) registered nurses (RN) and 67 (8.8%) practical nurses (PN). About two thirds were women (65.6%), with a mean age of 35 years. NLs were significantly older on average (36 years) than the other two categories. About 31% of participants had obtained their degrees from private nursing schools, and had been working for a mean of 12 years, more so among NLs than among RNs and PNs. About half the sample (51.4%) reported obtaining a PS course as part of their nursing curriculum. Details are presented in Table 1.

TABLE 1 ABOUT HERE

Among the participants, 80% worked in general hospitals and 20% in university-affiliated hospitals, of which 47% nurses worked in hospitals that had been accredited as level A. Half of the sample workedin hospitalslocated in rural areas. A larger proportion of RNs (83%) could be found in general hospitals compared to NL (75%) or PNs (76%). More than half the group (58.8%) worked in medical / surgical wards, and the mean daily workload was about 11.5 hours, with no differences across categories of nurses. However, on a weekly basis, the workload including overtime was on average significantly heavier for PNs (53 hours) compared to RNs (49 hours) or NLs (47 hours). RNs and PNs cared for a significantly higher number of

patients in day shifts (14 patients) compared to NLs (11 patients), and the same was found in night shifts (more than 12 versus less than 10 respectively). Details are presented in Table 2.

TABLE 2 ABOUT HERE

PS programs were reported by 25% of the sample, a PS committee by 55%, a PS officer by 55%, a PS periodic training by 40%, and a PS periodic audit by 29%. In general, NLs were more aware of the existence of a PS periodic audit in their hospitals, a PS periodic training, PS officer, PScommittee and program than RNs or PNs. All other details regarding the organizational variables can be found in Table 3.

TABLE 3 ABOUT HERE

C2. DIFFERENCES IN PS KNOWLEDGE, COMPLIANCE AND CULTURE

The mean scores of knowledge of and compliance with items included in the IPSG were generally higher for NLs, decreasing with RNs, and lowest with PNs. Most ofthe items of the PSC questionnaire showed significant differences: perception of "Supervisor support for PS", "Continuous learning/improvement", "Communication openness", "Communication about error", "Reporting PS events", and "Hospital support for PS" were high among NLs but NOT in other categories. "Staffing and work pace", "Teamwork", and "Handoffs and information exchange" were better perceived among PNs, while "Response to error" was better perceived among RNs. The most striking differences appeared on issues of reporting and responding to PS events or errors, where RNs and PNs tended to have lower scores. There was no significant difference in the rest of the items, and those were excluded from the rest of the analysis.Details are presented in Table 4.

TABLE 4 ABOUT HERE

Differences among nurses were stratified according to personal/professional factors and hospital characteristics. Younger nurses and thosewho workedat university hospitals were found to have significantly higher overall knowledge of and compliance with IPSG regardless of the nurses' positions.Recent graduates with lesser years of experience had significantly higher knowledgeand better compliance among RNs and NLs but not among PNs. Caring for a fewer number of patients during day and night shiftsmade a significant difference in the knowledge of and compliance with IPSG among RNs and in knowledge of IPSG only among NLs during night shifts.When comparing personal/professional and hospital characteristics with PSC,a significant association was found between younger age groups, nurses working for fewer hours, and caring for fewer patients during day shifts and PSC among RNs only. Working in a universityhospital was significantly associated with better compliance with institutional PSC among RNs and NLs, but not PNs, while decreased staffing during night shifts was associated with better PSC among PNs and RNs, not NLs. Less years of experience had a significant adverse effect among PNs only. Details are presented in Table 5.

TABLE 5 ABOUT HERE

There is a significant association between most organizational dimensions and personal PS knowledge and adherence to recommended practices. Presenceof a PS officer, committee, and surveys had a significant impact on the PS knowledge and compliance regardless ofnurses' positions. The integration of PS in the orientation program had a significant impact on patient safety knowledge among all nurses' categories.Additionally, there was a significant association between PS periodic audit and knowledge of and compliance with IPSG regardless of nurses' categories, while there was an association between PS periodic audit and PS culture among RN and NL, but not among PN.Details are presented in Table 6.

TABLE 6 ABOUT HERE

Three multivariate linear regression models were conducted to estimateadjusted effects of various independent determinants. Knowledge scores were still significantly higher among NLs, as well as among those working for less than 49 hours per week, in university hospitals (vs. general ones) and with only one PS organizational dimension: the presence of PS training. Higher scores of adherence with recommended practices were also significantly associated with NLs, university hospitals, caring for less than 14 patients during day duty, and all PS organizational dimensions except PS committee. PS culture was significantly associated with younger age, private nursing schools, and the presence of three PS organizational dimensions:PS program, auditsand training. Details are presented in Table 7.

TABLE 7 ABOUT HERE

IV. Discussion

Improved PS knowledge and compliance among nurses in healthcare institutions are obvious determinants for the preventionof accidents and incidents with hospitalized patients. Therefore, it is important to understand those determinants which can be targeted through institutional interventions, to ultimately improve patient safety. In this analysis, we have considered both personal and organizational items which may affect the PS knowledge and level of compliance with personal and institutional practices among, focusing on differences in outcomes among nurses' categories.

In this analysis, PNs displayed high compliance with the set of practices recommended by IPSG, but the detailed exploration of those practices revealed that they did not conform with the indicated optimal procedures. This category of nurses had also the lowestformal knowledge score, which is supposed to inform the reason why those procedures exist. These findings indicate the importance of scientific knowledge in reinforcing adhesion to "best practices", but this kind of formal education remains part of the academic training which may have to be revisited in some nursing institutions. At the level of the hospital, continued on-job training for nurses may not be sufficient to raise their practice to the expected optimal level unless it is also accompanied by refresher to explain the evidence leading to desired procedures. PSC structures have been established as playing a crucial role in improving PS knowledge and practices among nurses in rural and public hospitals in Lebanon [13]. Our results showed that nurses working in university hospitals were more knowledgeable about and compliant with patient safety regardless of their position. University-affiliated hospitals are aware of the recommendations and tend to comply more that non-affiliated ones. Unfortunately, institutional PSC structures, including training and continued education of nursing staff, are not uniformly established in public hospitals in Lebanon. While a university affiliation is desirable for public hospitals, for several important indicators and not only for PSC, it is clear that such affiliations cannot be obtained for all hospitals. The inconsistency in creating and implementing institutional PSC structures must be addressed.

NLs were expectedly more aware of the existence of PSC structures: committees, officers, orientation programs, periodic audits and performance of PS training and surveys than RNs and PNs. These results indicate that PSC structures should address PNs and RNs as a priority, and be less engaged in exclusive communication with NLs, whose direct impact on patients is relatively less prominent. In that same vein, most items composing the PS institutional culture showed higher mean scores among NLs compared to other categories, except in some items related to "staffing and work pace", "teamwork", and "handoffs information and exchange"- which showed higher mean scores among PNs. Present results concur with those published by Singer et al. in an assessment of PSC conducted in 105 hospitals in the US. They reveal that nurses' leaders are more likely to have positive, if not necessarily true perceptions of PSC than frontline workers[14]. Kim et al. also found distinctions in the perceptions of patient safety culture between nurses and health care managers but they did not examine potential differences within categories[15].

The renewed formal interest in PS as a crucial part of nurses' formation in recent years appeared in this analysis where nurses with fewer years of experience were more likely to have positive overall perceptions of patient safety knowledge and practices than nurses with longer experience. Wilson et al. also found in an assessment of differences in PSC perceptions in a large academic medical center in the Midwest that recent graduates with fewer years of experience had more positive overall perceptions of patient safety[1]. It is crucial that formal education in nursing schoolsfocuses on developing critical thinking regarding safety practices as an indirect way of obtaining correct adherence to PSC practices[16; 17].

PSC is compromised in settings where nurses work more than 40 hours per week[18]. A Finnish study conducted in 2018 showed an association between daily workload per nurse and patient safety incidents and mortality [19]. Our results revealed that NLs who appeared more knowledgeable about and compliant with patient safety also worked fewer hours compared to RNs and PNs, independently of all other joint factors. Rogers et al. showed that the risks of making adverse events increased significantly when work shifts were more than 12 h/day or when staff worked for more than 40 h/week [19]. A systematic review carried out in 2018 in Saudi Arabia on factors contributing to PSC found that workload/inadequate staffing,insufficient skills, and poor staff to patient ratios were prominentfactors hindering a positive PSC[21]. In astudy conducted in two hospitals in southeast Sweden in 2014 among registered and practical nurses, both groups stated thathigh workload, causing shortage of time for patients, stress and tiredness, was associated in their opinion with poorer patient safety[22].

The implementation of this survey was very hindered by the COVID -19 pandemic, which limited the number of participants from many main hospitals, too overwhelmed with COVID-19 patients' care to be available. As usual, self-reported questionnaires may carry a "correctness" bias overestimating "good" outcomes. Nevertheless, the large distribution of scores on several outcome variables suggests that the impact of this potential bias may have remained minimal, and that respondents where sincere in their answers.

V. Conclusion And Practical Implications

Findings in this survey lead us to propose the following recommendations:

1. PS education should continue to be offered in nursing schools graduating both PNs and RNs. However, the importance of enhancing the translation of acquired personal knowledge into correct practices remains a crucial responsibility of management in all hospitals, public or otherwise. Active PS institutional structures should target preferentially PN whose formal education on this issue may be lacking. Improvements in public hospitals' PSC can be stimulated through accreditation requirements. It requires also through continued collaboration between the Order of Nurses and the MOPH, the owner and administrator of public hospitals in Lebanon, to ensure that nurses contribute their own experiences in determining the content of PS post-graduate training.
2. It seems to be very useful to twin general hospitals with university ones. This affiliation will make a significant difference in PSC and compliance.The affiliation will likely create momentum towards improvement in all sorts of ways, above and beyond patient safety.
3. Heavy nursing workload has been described as a major determinant of a large array of outcomes affecting both the nurses, their patients and their professional institutions. This chronic feature of the nursing career will continue to prompt all concerned to protect and enhance the prestige of the nursing profession, through better salaries and other items. This in turn will lead to drawing more students into training for nursing, and eventually alleviate the staff shortage which is often a main cause of heavy workload.

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Table1: Personal and professional characteristics of nurses in public hospitals in Lebanon in 2020 by nurses' categories (N= 764)

Characteristic	PN[1]	RN[2]	NL[3]	Total	p-value
n (%)	**67 (8.8)**	**535 (70.0)**	**162 (21.2)**	**764 (100)**	---
Mean age in years (SD)	30.7 (5.0)	34.8 (7.9)	35.9 (6.4)	34.6 (7.5)	<0.01
Gender (n, %)					
Men	22 (32.8)	191 (35.7)	50 (30.9)	263 (34.4)	0.50
Women	45 (67.2)	344 (64.3)	112 (69.1)	501 (65.6)	
Nursing school sector (n, %)					
Public	42 (62.7)	387 (72.3)	102 (63.0)	531 (69.5)	0.03
Private	25 (37.3)	148 (27.7)	60 (37.0)	233 (30.5)	
Patient safety course obtained (n, %)					
Yes	38 (56.7)	274 (51.2)	81 (50.0)	393 (51.4)	0.64
No	29 (43.3)	261 (48.8)	81 (50.0)	371 (48.6)	
Mean years of experience (SD)	9.0 (4.1)	11.5 (6.8)	13.4 (6.4)	11.7 (6.6)	<0.01

[1]PN: Practical Nurse, [2]RN: Registered Nurse; [3]NL: Nurse Leader

Table 2: Hospital characteristics of public health hospitals where participating nurses are working (N= 764)

Characteristics	PN[1]	RN[2]	NL[3]	Total	p-value
n (%)	**67 (8.8)**	**535 (70.0)**	**162 (21.2)**	**764 (100)**	---
Hospital location (n, %)					
Urban	41(61.2)	258 (48.2)	84 (51.9)	383 (50.1)	0.11
Rural	26 (38.8)	277 (51.8)	78 (48.1)	381 (49.9)	
Hospital type (n, %)					
General	51 (76.1)	443 (82.8)	121 (74.7)	615 (80.5)	0.05
University	16 (23.9)	92 (17.2)	41 (25.3)	149 (19.5)	
Accreditation level (n, %)					
A level	28 (41.8)	246 (46.0)	84 (51.9)	358 (46.9)	0.29
All other levels	39 (58.2)	289 (54.0)	78 (48.1)	406 (53.1)	
Work area(n, %)					
Medical / Surgical	42 (62.7)	316 (59.1)	91 (56.2)	449 (58.8)	0.64
Non-ambulatory	25 (37.3)	219 (40.9)	71 (43.8)	315 (41.2)	
Mean daily work in hours (S/D)	11.5 (2.8)	11.4 (2.9)	11.4 (3.3)	11.4 (2.9)	0.97
Work schedule (n, %)					
Day	21 (31.3)	204 (38.1)	68 (42.0)	293 (38.4)	0.60
Night	6 (9.0)	34 (6.4)	11 (6.8)	51 (6.7)	
Alternative	40 (59.7)	297 (55.5)	83 (51.2)	420 (55.0)	
Mean weekly work (including overtime in hours (S/D)	53.2 (14.2)	49.0 (13.3)	47.3 (12.1)	49.0 (13.2)	<0.01
Staffing during day duty in mean number of patients (S/D)	14.2 (8.8)	14.1 (9.9)	11.4 (9.5)	13.5 (9.8)	<0.01
Staffing during night duty in mean number of patients (S/D)	12.5 (6.8)	12.8 (8.4)	9.6 (5.8)	12.1 (7.9)	<0.01

[1]PN: Practical Nurse, [2]RN: Registered Nurse; [3]NL: Nurse Leader

Table 3: Organizational dimensions regarding patient safety (PS) in public hospitals by nurses' categories (N= 764)

Characteristics	PN[1]	RN[2]	NL[3]	Total	p-value
n (%)	**67 (8.8)**	**535 (70.0)**	**162 (21.2)**	**764 (100)**	---
PS[4] officer available					
Yes	29 (43.3)	288 (53.8)	100 (61.7)	417 (54.6)	0.03
No	38 (56.7)	247 (46.2)	62 (38.3)	347 (45.4)	
PS committee present					
Yes	30 (44.8)	289 (54.0)	100 (61.7)	419 (54.8)	0.05
No	37 (55.2)	246 (46.0)	62 (38.3)	345 (45.2)	
PS program available					
Yes	13 (19.4)	134 (25.0)	45 (27.8)	192 (25.1)	0.41
No	54 (80.6)	401 (75.0)	117 (72.2)	572 (74.9)	
Hospital ever performed a PS survey					
Yes	0 (0.0)	49 (9.2)	34 (21.0)	83 (10.9)	<0.01

No	67 (100)	486 (90.8)	128 (79.0)	681 (89.1)	
PS periodic audit					
Yes	7 (10.4)	72 (13.5)	145 (89.5)	224 (29.3)	<0.01
No	60 (89.6)	463 (86.5)	17 (10.5)	540 (70.7)	
PS periodic training					
Yes	13 (19.4)	200 (37.4)	96 (59.3)	309 (40.4)	<0.01
No	54 (80.6)	335 (62.6)	66 (40.7)	455 (59.6)	
PS in orientation program					
Yes	38 (56.7)	327 (61.1)	121 (74.7)	486 (63.6)	<0.01
No	29 (43.3)	208 (38.9)	41 (25.3)	278 (36.4)	

[1]PN: Practical Nurse, [2]RN: Registered Nurse; [3]NL: Nurse Leader; [4]PS: Patient Safety

Table 4: Patient safety knowledge and practices among nurses in public hospitals in Lebanon in 2020 by nurses' categories (N= 764)

Characteristics	**PN[1]**	**RN[2]**	**NL[3]**	**Total**	**p-value**
n (%)	**67 (8.8)**	**535 (70.0)**	**162 (21.2)**	**764 (100)**	**--**
IPSG[4] knowledge (mean, SD)					
Patient identification (/22)	16.7 (4.2)	18.0 (4.6)	19.3 (3.4)	18.2 (4.4)	<0.01
Effective communication (/22)	11.0 (4.2)	14.1 (4.8)	16.6 (4.5)	14.4 (4.9)	<0.01
Safety of high alert medications (/10)	4.3 (2.5)	5.8 (2.8)	6.5 (2.3)	5.8 (2.7)	<0.01
Safe surgery (/8)	4.4 (1.5)	5.0 (1.6)	5.0 (1.4)	4.9 (1.5)	0.01
Infection prevention and control (/24)	11.4 (4.5)	13.4 (4.7)	14.5 (5.1)	13.4 (4.8)	<0.01
Patient risk of falling (/8)	4.3 (2.2)	5.2 (2.2)	6.0 (2.1)	5.3 (2.2)	<0.01
Overall score[5] (/94)	52.2 (12.5)	61.5 (14.3)	67.8 (12.5)	62.0 (14.3)	<0.01
IPSG compliance (mean, SD)					
Patient identification (/20)	14.3 (2.1)	13.5 (2.6)	16.3 (1.9)	14.2 (2.7)	<0.01
Effective communication (/15)	9.0 (1.6)	9.5 (1.8)	10.9 (1.3)	9.8 (1.8)	<0.01
Safety of high alert medications (/15)	8.4 (1.6)	8.8 (1.9)	9.9 (2.3)	9.0 (2.0)	<0.01
Safe surgery (/15)	11.4 (1.3)	11.0 (1.8)	12.3 (1.6)	11.3 (1.8)	<0.01
Infection prevention and control (/20)	9.9 (2.4)	10.5 (2.7)	11.9 (2.6)	10.7 (2.7)	<0.01
Patient risk of falling (/5)	2.7 (1.2)	2.7 (1.2)	3.3 (1.2)	2.9 (1.2)	<0.01
Overall score (/90)	55.7 (5.8)	56.0 (7.9)	64.6 (7.5)	57.8 (8.4)	<0.01
PSC[6] (mean, SD)					
Staffing and work pace (/20)	12.7 (1.7)	12.4 (2.2)	12.0 (1.9)	12.4 (2.1)	0.01
Supervisor support for PS (/15)	8.8 (1.8)	8.7 (1.7)	9.7 (1.5)	9.0 91.7)	<0.01
Teamwork (/15)	10.5 (1.7)	10.2 (2.1)	10.2 (1.7)	10.2 (2.0)	0.36
Continuous learning/improvement (/15)	8.4 (2.1)	8.9 (2.0)	9.3 (1.7)	8.9 (1.9)	<0.01
Communication openness (/20)	11.8 (2.2)	13.2 (2.2)	13.6 (1.4)	13.1 (2.1)	<0.01
Communication about error (/15)	8.1 (3.2)	8.7 (3.3)	11.4 (1.5)	9.2 (3.2)	<0.01
Response to error (/20)	11.9 (1.7)	12.5 (2.0)	10.1 (1.4)	11.9 (2.1)	<0.01
Reporting PS events (/10)	3.8 (2.1)	3.9 (2.1)	6.8 (1.8)	4.5 (2.3)	<0.01
Hospital support for PS (/15)	9.0 (3.1)	8.9 (2.9)	9.3 (2.3)	9.0 (2.8)	0.35
Handoffs information exchange (/15)	9.1 (2.4)	8.9 (2.4)	7.8 (2.2)	8.6 (2.4)	<0.01
Overall score (/130)	74.5 (8.7)	77.2 (8.4)	80.6 (5.7)	77.7 (8.1)	<0.01

[1]PN: Practical Nurse, [2]RN: Registered Nurse; [3]NL: Nurse Leader;[4]IPSG: International Patient Safety Goal[16], [5]Overall score included those sub-scores from items with significant differences.[6]PSC: Patient Safety Culture[23]

Table 5: Determinants of patient safety knowledge and practices by nurses' categories in public hospitals in Lebanon in 2020(N= 764)

IPSG items (mean score, SD)	**PN**	**RN**	**NL**
Overall IPSG Knowledge (range of 94)			
Age			
Younger	53.3 (12.6)*	64.4 (13.4)**	69.8 (12.7)*
Older	44.7 (9.2)	57.4 (14.6)	65.9 (12.1)
Nursing school sector			
Public	53.5 (11.5)	61.7 (14.1)	67.2 (12.4)
Private	50.0 (13.9)	60.9 (14.8)	68.8 (12.8)
Mean years of experience			
11 years and less	52.4 (12.8)	64.0 (13.6)**	71.1 (13.0)**
More than 11 years	51.1 (11.5)	58.1 (14.5)	64.8 (11.4)
Hospital type			
General	43.4 (10.4)**	58.8 (13.7)**	63.7 (11.0)**
University	60.9 (14.7)	74.3 (9.1)	79.8 (8.2)
Mean weekly work (including overtime in hours			
42 hours and less	52.0 (13.5)	62.0 (15.2)	69.8 (11.5)*
More than 42 hours	52.3 (11.9)	60.8 (12.9)	64.6 (13.5)
Staffing during day duty in mean number of patients			
13 patients and less	53.7 (13.3)	63.7 (14.3)**	68.3 (12.6)

More than 13 patients	50.5 (11.5)	58.7 (13.8)	66.2 (12.4)
Staffing during night duty in mean number of patients (S/D)			
12 patients and less	53.9 (13.3)	63.2 (14.2)**	68.9 (12.1)**
More than 12 patients	49.2 (10.7)	57.2 (13.7)	60.0 (12.9)

*P-value ≤ 0.05; ** P-value ≤ 0.01

Table 5: Determinants of patient safety knowledge and practices by nurses' categories in public hospitals in Lebanon in 2020 (N= 764) (continued)

IPSG items (mean score, SD)	PN	RN	NL
Overall IPSG Compliance(range of 90)			
Age			
Younger	56.5 (5.8)**	57.9 (8.2)**	66.1 (7.0)**
Older	51.1 (3.5)	53.4 (6.6)	63.2 (7.7)
Nursing school sector (n, %)			
Public	55.5 (5.9)	55.9 (7.6)	64.7 (7.6)
Private	56.2 (5.8)	56.4 (8.4)	64.5 (7.4)
Mean years of experience (SD)			
11 years and less	56.4 (6.0)	58.0 (8.2)**	67.3 (7.0)**
More than 11 years	53.2 (4.5)	53.4 (6.7)	62.2 (7.1)
Hospital type			
General	54.3 (5.8)**	54.7 (7.4)**	62.7 (7.3)**
University	60.2 (3.2)	62.3 (6.9)	70.2 (4.7)
Mean weekly work (including overtime in hours (S/D)			
42 hours and less			
More than 42 hours	55.1 (6.3)	56.1 (8.3)	64.9 (7.8)
Staffing during day duty in mean number of patients (S/D)	56.2 (5.5)	55.9 (7.2)	64.1 (7.0)
13 patients and less			
More than 13 patients			
Staffing during night duty in mean number of patients (S/D)	56.2 (6.1)	58.7 (8.0)**	64.3 (8.1)
12 patients and less	55.3 (5.5)	52.7 (6.3)	65.4 (5.0)
More than 12 patients			
	56.6 (6.4)	57.1 (8.1)**	648 (7.7)
	54.2 (4.5)	53.4 (6.6)	62.9 (6.2)

*P-value ≤ 0.05; ** P-value ≤ 0.01

Table 5: Determinants of patient safety knowledge and practices by nurses' categories in public hospitals in Lebanon in 2020 (N= 764) (continued)

IPSG items (mean score, SD)	PN	RN	NL
Overall PS culture (range of 130)			
Age			
Younger	75.1 (8.9)	78.0 (8.6)**	80.9 (6.2)
Older	70.8 (6.7)	76.0 (8.1)	80.3 (5.2)
Nursing school sector (n, %)			
Public	73.9 (6.6)	77.3 (7.9)	80.3 (6.2)
Private	75.5 (11.5)	76.8 (9.6)	81.1 (4.6)
Mean years of experience (SD)			
11 years and less	75.6 (8.8)*	77.5 (8.4)	81.2 (5.5)
More than 11 years	70.2 (6.6)	76.8 (8.5)	80.1 (5.9)
Hospital type			
General	74.7 (8.5)	76.7 (8.4)**	79.5 (5.6)**
University	73.8 (9.4)	79.4 (8.5)	83.9 (4.7)
Mean weekly work (including overtime in hours (S/D)			
42 hours and less			
More than 42 hours	75.9 (10.4)	78.2 (9.1)**	81.1 (5.8)
Staffing during day duty in mean number of patients (S/D)	73.5 (7.2)	75.7 (7.1)	79.7 (5.5)
13 patients and less			
More than 13 patients			
Staffing during night duty in mean number of patients (S/D)	74.7 (8.4)	78.2 (8.7)**	80.8 (5.5)
12 patients and less	74.3 (9.1)	75.9 (8.0)	79.8 (6.2)
More than 12 patients			
	76.6 (8.6)*	78.4 (8.5)**	80.8 (5.4)
	71.0 (7.9)	74.1 (7.6)	78.9 (7.2)

*P-value ≤ 0.05; ** P-value ≤ 0.01

Table 6: Patient safety knowledge and practices by nurses' categories controlling for organizational dimensions among nurses in public hospitals in Lebanon in 2020 (N= 764)

IPSG items (mean score, SD)	PN	RN	NL
Overall IPSG Knowledge (range of 94)			
PS* officer available			
Yes	57.5 (15.0)**	67.8 (13.4)**	73.2 (11.4)**
No	48.1 (8.3)	54.2 (11.6)	59.0 (8.7)
PS* committee**			
Yes	57.0 (15.0)**	67.7 (13.3)**	73.2 (11.4)**
No	48.2 (8.3)	54.1 (11.7)	59.0 (8.7)
Ever performed a PS survey			
Yes	0 (0.0)**	75.8 (8.3)**	80.9 (7.7)**
No	52.2 (12.5)	60.0 (14.0)	64.3 (11.2)
PS periodic audit			
Yes	53.57 (14.8)	68.3 (12.4)**	69.2 (12.0)** 55.7
No	52.0 (12.3)	60.4 (14.3)	(10.4)
PS periodic training			
Yes	58.7 (9.7)*	67.6 (12.0)**	70.7 (12.5)**
No	50.6 (12.6)	57.8 (14.3)	63.5 (11.4)
PS in orientation program			
Yes	56.9 (12.1)**	64.2 (13.4)**	69.9 (12.2)**
No	45.9 (10.1)	57.2 (14.7)	61.4 (11.5)

*P-value ≤ 0.05; ** P-value ≤ 0.01

Table 6: Patient safety knowledge and practices by nurses' categories controlling for organizational dimensions among nurses in public hospitals in Lebanon in 2020 (N= 764) (continued)

IPSG items (mean score, SD)	PN	RN	NL
Overall IPSG Compliance(range of 90)			
PS* officer available			
Yes	59.5 (4.8)**	59.5 (8.4)**	69.0 (5.3)**
No	52.8 (4.8)	52.0 (4.6)	57.5 (4.4)
PS* committee**			
Yes	58.9 (5.9)**	59.4 (8.4)**	69.0 (5.3)**
No	53.2 (4.4)	52.0 (4.6)	57.5 (4.4)
Ever performed a PS survey			
Yes	0 (0.0)**	67.2 (6.8)**	73.5 (3.7)**
No	55.7 (5.8)	54.9 (7.0)	62.2 (6.4)
PS periodic audit			
Yes	62.1 (4.7)**	62.4 (9.5)**	65.2 (7.3)**
No	55.0 (5.5)	55.0 (7.1)	59.3 (7.2)
PS periodic training			
Yes	57.5 (5.7)	60.1 (8.5)**	66.7 (7.2)**
No	55.3 (5.8)	53.6 (6.3)	61.5 (6.9)
PS in orientation program			
Yes	56.0 (6.9)	57.6 (8.4)**	65.7 (7.6)**
No	55.4 (4.2)	53.5 (6.2)	61.2 (6.1)

*P-value ≤ 0.05; ** P-value ≤ 0.01

Table 6: Patient safety knowledge and practices by nurses' categories controlling for organizational dimensions among nurses in public hospitals in Lebanon in 2020 (N= 764) (continued)

IPSG items (mean score, SD)	PN	RN	NL
Overall PS culture (range of 130)			
PS* officer available			
Yes	77.8 (10.1)**	79.8 (8.9)**	82.1 (5.5)**
No	72.1 (6.6)	74.1 (6.6)	78.1 (5.3)
PS* committee**			
Yes	77.9 (9.9)**	79.8 (8.9)**	82.1 (5.5)**
No	71.8 (6.5)	74.1 (6.6)	78.1 (5.2)
Ever performed a PS survey			
Yes	0 (0.0)**	83.6 (9.0)**	79.6 (5.6)**
No	74.5 (8.7)	76.5 (8.1)	84.1 (4.7)
PS periodic audit			
Yes	79.0 (10.6)	83.0 (9.6)**	76.8 (6.2)**
No	74.0 (8.4)	76.3 (7.9)	81.0 (5.5)
PS periodic training			
Yes	80.4 (7.0)**	81.9 (8.3)**	81.1 (5.9)
No	73.1 (8.5)	74.4 (7.2)	79.9 (5.4)
PS in orientation program			
Yes	78.6 (8.1)**	80.2 (8.2)**	78.5 (6.8)**
No	69.2 (6.4)	72.5 (6.5)	81.3 (5.1)

*P-value ≤ 0.05; ** P-value ≤ 0.01

Table 7: Patient safety (PS) knowledge and practices among nurses in public hospitals in Lebanon in 2020 (N= 764) by nurses' categories: multivariate linear regression

	PS KNOWLEDGE				
	Unstandardized Coefficients		**p-values**	**95% Confidence Interval**	
	B	**Std. Error**		**Lower**	**Upper**
Nurses' categories (NL vs. RN vs. PN)	3.92	1.35	<0.01	1.27	6.58
University hospital (vs. general)	9.96	1.81	<0.01	6.40	13.51
Weekly work hours (≤ 49.0 hours)	-0.12	0.04	<0.01	-0.21	-0.03
PS periodic training available	4.07	1.23	<0.01	1.66	6.48
	PS PRACTICE				
Nurses' categories (NL vs. RN vs. PN)	1.42	0.63	0.03	0.17	2.66
University hospital (vs. general)	2.94	0.85	<0.01	1.28	4.61
Staffing during day duty(≤14 patients)	-0.17	0.07	0.01	-0.30	-0.04
PS officer present	11.99	5.30	0.02	1.58	22.40
PS surveys ever conducted	7.33	1.07	<0.01	5.23	9.43
PS program implemented	1.59	0.79	0.04	0.04	3.14
PS periodic audit available	3.99	0.78	<0.01	2.46	5.52
PS periodic training available	2.52	0.58	<0.01	1.38	3.65
	ORGANIZATIONAL PS CULTURE				
Younger age-group (≤34 years)	2.55	1.17	0.03	0.25	4.85
Private school (vs.public)	1.76	0.78	0.02	0.22	3.30
PS program implemented	2.48	1.03	0.02	0.46	4.49
PS periodic audit available	2.26	1.01	0.03	0.28	4.25
PS periodic training available	5.00	0.75	<0.01	3.53	6.47