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ABSTRACT

CONTEXT Error reporting is considered one of the most important mediating factors for patient safety (PS). However, reporting errors can be challenging for healthcare students.

OBJECTIVES The aims of the study were (a) to describe nursing students' opportunity to report errors, near misses or PS issues that emerged during their clinical learning experience; and (b) to explore associated factors of the process of reporting itself.

METHODS A national survey of 9607 students. The end point was to have reported PS issues in the last clinical learning experience (from 0 – "never" to 3 – "always"). Explanatory variables were set at the individual, at the clinical learning environment and at the regional levels.

RESULTS 4004 (41.7%) students report PS issues from "never/rarely" to "sometimes". In the multilevel analysis, factors increasing the likelihood of reporting events affecting PS have been mainly at the clinical learning environment level: specifically, higher learning opportunities (OR=3.040, 95% CI 2.667–3.466), self-directed learning opportunities (OR=1.491, 95% CI 1.364–1.630), safety and nursing care quality (OR=1.411, 95% CI 1.250–1.594) and quality of tutorial strategies OR=1.251, 95% CI 1.113–1.406). In contrast, being supervised by a nurse teacher (OR=0.523; 95% CI 0.359–0.761) prevented the disclosure of PS issues as compared to being supervised by a clinical nurse. Students attending their nursing programmes in some Italian regions showed a higher likelihood (OR from 1.209 to 2.938) of reporting PS issues as compared to those attending their education in other regions.

CONCLUSIONS Nursing students continue to be reticent to report PS issues. Given that they represent the largest generation of future health-care workers, their education regarding PS should be continuously monitored and improved; moreover, strategies aimed at developing a non-blaming culture should be designed and implemented both at the clinical learning setting and regional levels.

Background

Over the last 20 years, healthcare systems have been focusing on improving patient safety (PS)[1] by developing educational and clinical policies aimed at implementing the safety culture.[2] According to the safety culture theory, different individual, organizational and cultural factors can affect the overall safety of an healthcare institution (HCI).[3] Specifically, among others, non-punitive responses to errors as well as hospital management encouraging auditing critical events have been found to be positively associated with PS, with reporting emerging as the most important mediating factor.[4] On this basis, international agencies have strongly recommended open reporting aimed at allowing HCIs to learn from their mistakes.[5]

Recent literature has documented that healthcare professionals and nursing students value open and honest communication of mistakes if these lead to the improvement of patient care.[6, 7] Specifically, it has been reported that students consider supportive and systems-based PS approaches, as well as the opportunity to openly discuss safety issues with clinical mentors, to be extremely important for their own learning.[8] During clinical learning rotations, they are exposed to both witnessing and being involved in near misses or errors that may have resulted in patient harm.[9] However, a non-blaming culture is still struggling to emerge, given that the fear of "speaking up" is deeply embedded in clinical environments due to the apprehension of appearing incompetent in front of supervisors, colleagues and patients, or the risk of breaking work relationships.[6, 9, 10] As a consequence, in the case of near misses or mistakes that have occurred to other healthcare professionals, nursing students may fix errors by themselves by considering PS issues as being rare or as unavoidable events.[11] Thus, students can progressively become used to these healthcare professionals' behaviours, by learning that poor reporting is acceptable.[7, 10]

On the other hand, with regards to the near misses or mistakes that occur to students, although the majority of them believe that incidents happen to everyone and that they are important learning experiences, it has also been documented that they are afraid of reporting them.[12] Students may be at increased risk of making mistakes, e.g. when administering medication, because of their limited clinical experience,[7, 13, 14] and although hospital policies commonly demand all errors to be reported,[12] students may not disclose them because of their fear of knock-on effects, e.g. passing or failing their clinical placement.[7, 12, 15] Moreover, when no positive feedback is offered, errors can be considered an indicator of individual performance rather than a system's problem, thereby decreasing the likelihood of being reported.[16] Differently, when students have a positive interpersonal relationship with nurses, the likelihood that they will report near misses or mistakes increases.[7]

To date, evidence on nursing students reporting PS issues as near misses or errors has only been documented from a few universities (e.g., one,[7, 9] two,[14, 17] three,[16] four universities[8, 15]); in addition, a limited number of nursing students have been involved in studies available (e.g. from 24[15] to 600[17]) with some restrictions regarding the academic year by including only, for example, one or two years, thereby not reflecting the full range of clinical experience attended during the entire nursing programme.[9, 18] Moreover, despite the fact that reporting PS issues can be affected by cultural factors[4] that can be nested at the unit, university or at the macro levels, no intra-class correlations or multilevel analysis have been performed to date. Furthermore, available research has been focused mainly on the types of errors,[7, 12, 14] on their antecedents,[13] reporting rates[7, 12, 17] and on barriers of reporting among healthcare students.[7, 12, 15, 16] Differently, to our best knowledge, no data on the extent to which students perceived themselves as being free to report near misses or mistakes to the members of the team have been documented.

Therefore, the purpose of this Italian-national wide study was (a) to describe nursing students' opportunity to report errors, near misses or PS issues that emerged during their clinical learning experience; and (b) to explore associated factors of the process of reporting.

Methods

Design

A national cross-sectional study design was performed between 2015 and 2016 and here reported according to the STrengthening the Reporting of OBservational studies in Epidemiology guidelines cross-sectional studies.[19] The research protocol was approved by the Ethical Committee of the University of Milan (Italy).

Setting and participants

On a preliminary basis, an Italian network of Bachelor of Nursing Science (BNS) degrees was formed by including all degrees available at the national level.[20] By law, the theoretical education is attended at the university levels, while clinical rotations at the healthcare institutions (HCIs) located in each Regional Health Service in which the National Health Service has been federalized.

Students from each nursing programme (=208) at each of the 43 existing universities were invited to participate; they were involved after having presented the aims of the study and the data collection procedures at the nursing programme level. The students who were: a) doing or had just finished their clinical learning practice at the time of the survey; b) had experienced the same unit or department for at least two weeks; and c) were willing to participate in the study as expressed by giving written informed consent, were eligible.

End point and explanatory variables

The opportunity to report and discuss errors, near misses or PS concerns/issues to nurses (hereafter "PS issues") in the last clinical learning experience was the end point of the study assessed through the following question included in the questionnaire: "Did you have the opportunity to report and discuss errors, near misses or PS concerns/issues to the staff during your last clinical learning experience?" Answers were based upon a four-point Likert scale (from 0 – "never" to 3 – "always"). Explanatory variables were collected at the individual, nursing programme and regional levels, as reported in Table 1.

Data collection process

In a preliminary fashion, the questionnaire was piloted in one nursing degree by involving 100 students with the aim of ensuring that the questionnaire's items were understandable and feasible. No changes were required after the pilot phase and the questionnaires collected were not included in the final database. The piloted questionnaire including the end point and the explanatory variables was used and administered via paper and pencil or via Google Drive, according to the resources available in each nursing programme. Different interventions aimed at addressing and preventing potential sources of bias have been also performed (Supplementary file 1).

Data analysis

The SPSS Statistical Package (version 24) and the R Core Team[23] was used to perform descriptive and inferential statistics. First, frequencies, percentages and averages (with standard deviations [SDs] and ranges, or confidence intervals [CIs] at 95%) were calculated. The end point variable was considered as a continuous variable when correlations were searched for with other continuous variables by using Spearman's rank-order correlation (rho). The end point was instead considered as a categorical variable in the bivariate and multilevel analysis: for these analysis, two groups were created, that including (1) those students who reported and discussed PS issues with the staff as "never/rarely" or "sometimes"; and (2) those who reported and discussed PS issues as "very often" or "always".

Aiming at identifying the cluster effect, the Intra Class Correlation (ICC) was computed both under random and fixed effect assumptions at the following levels: a) unit level (e.g. reporting PS safety issues in medical or other units can express different cultural patterns); b) nursing programme level (e.g. a different curriculum can develop different aptitudes with regard to PS reporting); and c)

regional level (e.g. different policies at the regional level can affect PS issues reporting at the HCI levels where students attend their clinical rotations).

As the final analysis, a multilevel analysis was performed by using the Generalized Linear Mixed Model by calculating the odd ratios (ORs, CI 95%). The end point was introduced as a dichotomous variable while only those variables significantly associated with the end point in the bivariate analysis were included, in addition to the regional dummies. Specifically, according to the ICC findings, the regional level cluster was considered given that, since the reforms federalizing healthcare delivery a decade ago, 20 distinct health systems have developed – with markedly divergent patterns of care and outcomes, which can also affect the PS issues reporting culture in the HCIs attended by students.[24,25] Statistical significance was set at $p < 0.05$.

Results

Participants and end point

A total of 9607 (91.6%) out of the 10480 undergraduate nursing students invited to participate completed the questionnaire. A total of 95 nursing programmes participated out of the existing 208 belonging to 27 Italian universities out of the 43 available. These nursing programmes were spread across 15 regions out of the 20 available in the Italian context: specifically, one region in the north, one in the centre, and three in the south, did not take part in the study.

Overall, 4004 (41.7%) students reported and discussed PS issues that emerged during their clinical practice as "never/rarely" to "sometimes". Specifically, safety issues were reported to be discussed "sometimes", "very often" and "always much" by 3904 (33.4%), 3204 (41.6%) and 1603 (16.7%) students, respectively; the remaining 800 (8.3%) answered not having ever reported and discussed PS issues with the staff.

Bivariate analysis

As reported in Table 2, at the individual level, students who reported and discussed PS issues as being from "never/rarely" to "sometimes" were more often female (78.1% vs 74.7%, p<0.001), older (23.1 vs 22.8 years, p<0.001), attending the 1st year of nursing education (32.7% vs 28.7%, p<0.001) and more often had previous academic experiences, completed or not (30.6% vs 29.4%, p=0.021), as compared to those who reported it as "very often" or "always".

At the nursing programme level, the students who reported and discussed PS issues from "never/rarely" to "sometimes" more often attended previous clinical experiences at the hospital level (70.8% vs 66.2%, p<0.001) and a shorter clinical rotation in their last placement (5.71 vs 5.88 weeks, p=0.002), where they were more often supervised by the nursing staff (47.6% vs 34.1%, p< 0.001) as compared to those who reported PS issues as "very often" or "always". Moreover, those

who disclosed and discussed "never/rarely" to "sometimes" PS issues also reported the perception of having learned less competences (1.80 [from 0, nothing to 3, very much] vs 2.27, p<0.001). Furthermore, in all factors and in the total score of the CLEQI tool, they reported a significantly lower average scores (1.56 vs. 2.16, p<0.001) as compared to those students who disclosed and discussed PS issues "very often" or "always". Significant correlations have emerged also between the increased opportunity to report and discuss PS issues that emerged in the clinical practice and both the overall CLEQI score (*Rho*=0.505, p<0.01) and each score of the CLEQI factors, as reported in Table 3.

At the regional level, the students who disclosed and discussed PS issues "very often" to "always" ranged from 33.1% (region 11) to 78.7% (region 2) as reported in Table 3.

In Table 4, the ICCs at the unit, nursing programme and regional levels have been reported: according to the findings, the ICCs were lower at the level of units attended by students (e.g. medical, surgical, intensive care units) and higher at the nursing programme and at the regional levels (0.076 and 0.050, respectively) thereby indicating that around 7.6% and 5.0 % of the residual variability can be attributable to each nursing programme and region cluster.

Factors affecting PS issues reporting

The multilevel analysis performed by using the Generalized Linear Mixed Model presented an acceptable value for the pseudo R square (19.3%).

As reported in Table 5, at the nursing programme level, experiencing a clinical environment offering increased learning opportunities (OR=3.040, 95% CI 2.667–3.466), self-directed learning opportunities (OR=1.491, 95% CI 1.364–1.630), safety and nursing care quality (OR=1.411, 95% CI 1.250–1.594) and a higher quality of tutorial strategies (OR=1.251, 95% CI 1.113–1.406) promoted the disclosure of PS issues that emerged in the clinical practice. In contrast, being supervised by a nurse teacher (OR=0.523; 95% CI 0.359–0.761) prevented to report and discuss PS issues as compared of being supervised by a clinical nurse.

At the individual level, male gender (OR=0.845, 95% CI 0.747–0.955) and older age (OR=0.969; CI 95% 0. 955–0.982) were negatively associated with the perception of having had the opportunity to report and discuss safety issues.

At the regional level, students attending their nursing education in some regions (n. 2, 4, 5 and 6) showed a higher likelihood (OR from 1.209 to 2.938) of reporting PS issues than those attending the programme in other regions.

Discussion

This study explored nursing students' opportunity to report and discuss PS issues and associated factors during their most recent clinical training. Although incident reporting has been considered essential in improving patient safety,[6] a consistent proportion of errors, near misses or PS issues is not usually reported by students[7, 11, 12, 16] and healthcare practitioners[11, 26].

At the Italian national level, nursing students reported of having disclosed and discussed PS issues as poor, with 41.7% of them disclosed "never/rarely" or "sometimes". Witnessing their clinical instructors, students can learn about "fixing and forgetting" mistakes instead of "fixing and reporting";[11] moreover, students may not be able to fix the mistake by themselves and thus do not report it to anyone.[7, 12] The lack of reporting emerged can threaten caring ethics, increasing the likelihood of patient harm, unmanaged stress among nursing students and the development of ineffective professional relationships with other members of staff.[18]

Students who perceived greater learning opportunities in clinical settings have reported a threefold increase in the disclosure and discussion of PS issues. Offering different learning experiences has been recognized as one of the most useful and effective strategies in the clinical setting,[27] because students have more opportunities to transfer their knowledge at the bedside, while experiencing the complexity and risks embodied in this process.[15]

Moreover, students who were encouraged to be independent in the learning process reported an increased likelihood of disclosing and discussing PS issues. According to Garrison,[28] self-directed learning involves self- monitoring, management and motivation, all processes based upon critical thinking, which can promote accountability and caring ethics, improving awareness regarding the value of clear communication in improving PS.

Furthermore, students who have perceived a high level of safety and quality of nursing care delivered in the unit attended, have reported an increased likelihood of safety issues being discussed. In conditions of understaffing or poor quality of care, students are more likely to be left alone in tackling PS issues, without discussing safety issues and receiving constructive feedback from their instructors.[29] In addition, overworked nurses fail to report errors[26] and have an increased likelihood of making mistakes due to the higher workloads.[14] Therefore, students may be exposed to negative role modelling, that may facilitate the learning of unsafe professional behaviour, in which different interventions are prioritized rather than protecting patient safety.[8]

Also, the quality of the tutorial strategies as well as the tutorial model employed to supervise nursing students in the clinical practice have affected the likelihood of reporting safety issues. Students can learn safe practices by discussing PS issues with instructors[8] and registered nurses are the ones to whom nursing students would report errors.[7, 14] Conversely, being supervised by a nurse teacher of the faculty was associated with a lower likelihood of reporting and discussing PS issues.

Students may feel uncomfortable sharing safety issues with them, also because they perceive teachers as evaluators and fear negative repercussions in their academic career; in addition, teachers are not directly involved in front-line care and students may perceive them as being unable to understand their feelings and concerns regarding safety issues.

A few factors emerged at the individual level, with male students being less likely to engage in reporting mistakes than females. Gender differences have never been documented thus far in the field, suggesting that this point should be addressed in future research. Also, older students perceived less opportunity to report PS issues, and reasons should be studies, e.g. the role of fear regarding the implications of disclosure for academic success. Recognizing, and managing PS issues should be considered among those complex situations where the sense of control seems to be a key factor influencing students' emotional and behavioral responses thus,[30] in turn, in the attitude to report and discuss with staff, or not.

Finally, our findings showed that contextual variables can have a role in affecting PS issues disclosure among students; specifically, a consistent variability at the regional level has emerged, with the likelihood of reporting safety issues being prevented in some regions and increased in others. This suggested that different healthcare systems with different policies regarding PS issues can develop different sensitivities at the HCI level, which may reflect the culture of reporting, and thus influence the education of future nursing generations.[24]

Our study is affected by several limitations. First, students reported their self-perceptions and different subjective views regarding PS issues disclosure can have affected the findings; moreover, no questions differentiating whether the lack of reporting includes not witnessing any mistakes or a lack of confidence to speak up have been included in the questionnaire. Second, some relevant data, such as the nurse-to-patient ratio and the nurse-to-student ratio, as well as the role of the students (i.e. supernumerary or fully involved in nursing care), were all not assessed.

Third, the cross-sectional nature of the study design suggests the need to be cautious in considering factors that emerged in the multilevel analysis as predictors, given that they have been measured in the same moment of the end point variable.

Finally, in the multilevel analysis, only the regional effect was included, given that several nursing programmes have their clinical rotations in different regions exposed to different policies, which may have influenced PS issues at the clinical environment levels. However, this was a national study involving a large number of nursing programmes, thereby potentially fostering the generalizability of the findings, although other factors such as motivations, values and culture driving professional behaviour can have influenced students' perception.

Conclusions

Nursing represents the largest professional community globally, with nurses staying with patients 24 hours a day. Therefore, nursing students represent the largest future generation of healthcare workers and their education regarding patient safety issues should be continuously monitored. Spending several hours at the bedside with a view to learning clinical competences, nursing students are involved early in witnessing or directly experiencing PS issues. Reporting and discussing PS concerns can contribute to the development of a culture of safety.

According to the findings, 3978 (41.7%) students reported and discussed PS issues that emerged during their clinical practice from "never/rarely" to "sometimes". Factors promoting the reporting of PS issues have emerged mainly at the clinical environment and regional levels, while factors preventing reporting have emerged at the individual level, thereby suggesting that interventions should be set at different levels.

At the individual level, older and male students should receive more support encouraging them to report and discuss safety issues, and to reflect on the barriers. At the clinical environment level, faculties should first assess the learning opportunities and the overall quality of nursing care offered; the quality of the tutorial strategies and the tutorial model adopted based upon clinical instructors should also be assessed, as well as the principles of clinical learning that should be based on self-directed learning. Moreover, given that not all countries have positioned their nursing programmes at the university level, principles of self-directed learning, which is the basis of academic education, should be considered, with care also taken in those programs based upon vocational training. Ensuring that students can have the opportunity to discuss PS issues with clinical nurses as soon as they emerge in clinical practice may help students to develop a safe practice.

At the regional level, different PS policies and their implementation may have modified the culture of reporting over the years, by enhancing the non-blaming culture in some regions and not in others, thereby affecting the sensitivity of reporting among staff and, consequently, among nursing students. The variability in sharing safety policies and the implementation processes undertaken across regions should be urgently considered. Only when students can share and reflect freely on PS issues that have emerged during their clinical placement with a competent support can they develop a culture of PS.

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Table 1. Explanatory variables and their levels

a) individual level: socio-demographic variables (age, gender, civil status [e.g. unmarried, married] and children, if any [yes/no]); previous education (secondary school attended and final evaluation obtained; university degrees attended, concluded or not); and working experience gained both previously and during the nursing education.

b) nursing programme level: the year of nursing education attended (1st, 2nd or 3rd); the amount of previous clinical learning experience attended (clinical rotations, in number) and in which settings (e.g. only in hospitals, only in the community setting or in both). Specifically, with regard to the last clinical learning experience, the following data was required: its duration (weeks); the supervision model adopted by the unit (e.g. under the guidance of the clinical instructor, under the guidance of the entire staff,[21] and its effectiveness in terms of the degree of competence learned, upon four-point Likert scale, 0 = none; 3 = very high). Moreover, aiming at evaluating the quality of the learning processes enacted in the clinical setting as perceived by nursing students, the *Clinical LEarning Quality Evaluation Index* (CLEQI) tool was used.[22] The tool is composed of five factors, namely the: "Quality of the tutorial strategies" (6 items), "Learning opportunities" (6 items), "Self-directed learning" (3 items), "Safety and nursing care quality" (4 items), and "Quality of the learning environment"' (3 items) based upon a four-Likert scale (0 = none; 3 = very high). Overall, the CLEQI score may range from 0 to 3; a higher score indicates that higher quality of learning processes has been perceived by students in the specific clinical environment. The tool has been validated nationally and recommended as a gold standard for evaluating the quality of the clinical environment as perceived by students; its psychometric validity measures have been published elsewhere.[22]

c) regional level: there were collected the region where each participating nursing programme was offered. The regions were consecutively numbered (e.g., Region 1, 2), aimed at ensuring confidentiality.

Legend. CLEQI, Clinical Learning Quality Evaluation Index

Table 2. Participants according to their perception of PS issues reporting

	I have reported PS issues during the clinical learning experience		
	Never/rarely to sometimes N=4004 (%)	Very often to always N=5603 (%)	p-value[c]
Individual level			
Age, years, mean (SD)	23.1 (4.4)	22.8 (3.7)	<0.001
Female gender (n=9596), n (%)	3123 (78.1)	4180 (74.7)	<0.001
Civil status (n=9524), n (%)			0.286
Unmarried	3748 (93.6)	5297 (94.5)	
Married/cohabitant	200 (5.0)	235 (4.2)	
Divorced	14 (0.3)	23 (0.4)	
Widowed	4 (0.1)	3 (0.1)	
With children, n (%)	182 (4.6)	246 (4.5)	0.769
Secondary education (n=9442), n (%)			0.555
High school	2776 (70.8)	3854 (69.8)	
Technical school	610 (15.5)	908 (16.5)	
Professional school	311 (7.9)	457 (8.3)	
Teacher school	172 (4.4)	238 (4.3)	
Secondary school abroad	54 (1.4)	62 (1.1)	
Academic year attended (n=9579), n (%)			<0.001
First	1304 (32.7)	1605 (28.7)	
Second	1368 (34.3)	1914 (34.2)	
Third	1315 (33.0)	2073 (37.1)	
Secondary education grade (n=9312), mean (95% CI)			
On a 100-point scale (n=9, 108, 94.8%)	77.1 (76.7-77.4)	76.8 (76.5-77.0)	0.167
On a 60-point scale (n=172, 1.8%)	45.2 (43.6-46.8)	45.7 (44.2-47.2)	0.625
On a 10-point scale (n=32, 0.4%)	7.69 (7.04-8.35)	7.96 (7.26-8.67)	0.555
Previous academic experience (n=9515), n (%)			0.021
None	2704 (68.3)	3883 (69.9)	
Graduated in other fields	187 (4.7)	233 (4.2)	
Uncompleted degree	1024 (25.9)	1402 (25.2)	
Other	46 (1.2)	36 (0.6)	
Previous working experience (n=9553), n (%)	1385 (34.8)	1916 (34.4)	0.639
Working experience during the degree (n=9526), n (%)	816 (20.5)	1126 (20.3)	0.755
Nursing programme level			
Previous clinical experiences, (n=9498), number, mean (95% CI)	4.92 (4.81-5.03)	4.90 (4.81-4.98)	0.712
Setting (n=9551), n (%)			<0.001
Only hospital	2820 (70.8)	3686 (66.2)	
Only community setting	63 (1.6)	90 (1.6)	
Hospital and community setting	1099 (27.6)	1793 (32.2)	
Length of the last clinical learning experience, weeks, mean (95% CI)[a]	5.71 (5.62-5.80)	5.88 (5.81-5.95)	0.002
Tutorial model of the last clinical experience (n=9563), n (%)[a]			<0.001
I was supervised by a clinical nurse	1767 (44.4)	3329 (59.6)	
I was supervised by the nursing staff	1897 (47.7)	1907 (34.1)	
I was supervised by a nurse identified on a daily basis by the head nurse	198 (5.0)	207 (3.7)	
I was supervised by the nurse teacher	76 (1.9)	89 (1.6)	
I was supervised by the head nurse	40 (1.0)	53 (0.9)	
Degree of competences learned in the last clinical experience, (n=9577), mean (95% CI)[a,b]	1.80 (1.77-1.82)	2.27 (2.25-2.29)	<0.001

CLEQI factor scores, mean (95% CI)[a,b]			
Quality of the tutorial strategies	1.60 (1.57-1.62)	2.24 (2.22-2.26)	<0.001
Learning opportunities	1.58 (1.56-1.60)	2.24 (2.23-2.26)	<0.001
Self-directed learning	1.13 (1.11-1.15)	1.77 (1.75-1.79)	<0.001
Safety and nursing care quality	1.79 (1.78-1.81)	2.28 (2.26-2.29)	<0.001
Quality of the learning environment	1.67 (1.65-1.70)	2.27 (2.26-2.29)	<0.001
Overall CLEQI score[a,b]	1.56 (1.54-1.58)	2.16 (2.15-2.18)	<0.001
Regional level			
Region 1	304 (43.4)	397 (56.6)	<0.001
Region 2	100 (21.3)	369 (78.7)	
Region 3	387 (37.5)	646 (62.5)	
Region 4	687 (34.4)	1313 (65.7)	
Region 5	14 (25.9)	40 (74.1)	
Region 6	414 (37.7)	682 (62.3)	
Region 7	450 (35.8)	806 (64.2)	
Region 8	325 (51.9)	301 (48.1)	
Region 9	74 (41.3)	105 (58.7)	
Region 10	527 (53.9)	450 (46.1)	
Region 11	111 (66.9)	55 (33.1)	
Region 12	127 (61.4)	80 (38.6)	
Region 13	103 (60.9)	66 (39.1)	
Region 14	243 (59.7)	164 (40.3)	
Region 15	140 (52.0)	129 (48.0)	

[a] The last clinical experience was that under evaluation.
[b] On a 4-point Likert scale (0 = none; 3 = very high).
[c] Chi-square for dichotomous variables, t-test for continuous variables.
CI, confidence interval; CLEQI, Clinical Learning Quality Evaluation Index; PS, patient safety; SD, standard deviation.

Table 3. Correlations between the PS issues disclosure[a] and the CLEQI tool scores[b]

CLEQI factors	Rho
Quality of the tutorial strategies[b]	0.455*
Learning opportunities[b]	0.496*
Self-directed learning[b]	0.319*
Safety and nursing care quality[b]	0.377*
Quality of the learning environment[b]	0.373*
Overall CLEQI score	0.505*

* $p < 0.01$.
[a] as continuous variables: never/rarely, sometimes, very often, always
[b] on a 4-point Likert scale, 0 = none; 3 = very high.
CLEQI, Clinical LEarning Quality Evaluation Index.

Table 4. Intra-Class Correlations at the unit, nursing programme and regional levels

ICC	ICC random effects	ICC fixed effects
Unit level	0.013	0.001
Nursing programme level	0.084	0.076
Regional level	0.073	0.050

ICC, Intra-Class Correlations

Table 5. PS issues disclosing from "very often" to "always": multilevel analysis of associated factors

	Estimate	Std. Error	z-value	Pr (>|z|)	OR	CI 95%	
(Intercept)	-2.781	0.226	-12.303	0.000			
Age, years	-0.032	0.007	-4.525	0.000	0.969	0.955	0.982
Male gender vs female	-0.168	0.063	-2.689	0.007	0.845	0.747	0.955
Year of nursing education attended, 1st vs 2nd vs 3rd	0.063	0.035	1.777	0.076	1.065	0.994	1.142
Previous academic experience yes vs no	0.024	0.030	0.804	0.421	1.025	0.966	1.087
Context of previous clinical learning experiences							
Only hospital	§						
Only community setting	-0.075	0.211	-0.356	0.722	0.928	0.613	1.403
Hospital and community setting	-0.100	0.064	-1.565	0.118	0.905	0.799	1.025
Last clinical learning experience, length weeks	0.001	0.011	0.111	0.912	1.001	0.981	1.022
Last clinical experience, tutorial model							
I was supervised by a clinical nurse	§						
I was supervised by the nursing staff	0.028	0.065	0.441	0.659	1.029	0.907	1.168
I was supervised by a nurse identified on a daily basis by the head nurse	0.001	0.278	0.005	0.996	1.001	0.580	1.729
I was supervised by the head nurse	-0.077	0.136	-0.567	0.570	0.926	0.709	1.209
I was supervised by the nurse teacher	-0.649	0.192	-3.386	0.001	0.523	0.359	0.761
Degree of competences learned in the last clinical experience [a]	0.047	0.046	1.022	0.307	1.048	0.958	1.147
CLEQI factors							
Quality of the tutorial teaching strategies (0-3)[a]	0.224	0.060	3.749	0.000	1.251	1.113	1.406
Self-directed learning (0-3)[a]	0.399	0.045	8.789	0.000	1.491	1.364	1.630
Learning opportunities (0-3)[a]	1.112	0.067	16.630	0.000	3.040	2.667	3.466
Safety and nursing care quality (0-3)[a]	0.345	0.062	5.560	0.000	1.411	1.250	1.594
Quality of the learning environment (0-3)[a]	0.028	0.058	0.477	0.633	1.028	0.917	1.153
Regional level							
Region 1	§						
Region 2	0.855	0.188	4.556	0.000	2.352	1.628	3.399
Region 3	0.135	0.144	0.937	0.349	1.144	0.863	1.518
Region 4	0.523	0.128	4.075	0.000	1.688	1.312	2.171
Region 5	1.078	0.411	2.621	0.009	2.938	1.312	6.577
Region 6	0.297	0.141	2.102	0.036	1.346	1.020	1.775
Region 7	0.190	0.139	1.365	0.172	1.209	0.920	1.589
Region 8	-0.004	0.161	-0.025	0.980	0.996	0.727	1.365
Region 9	0.343	0.240	1.431	0.152	1.409	0.881	2.254
Region 10	0.128	0.144	0.889	0.374	1.136	0.857	1.506
Region 11	0.101	0.245	0.412	0.680	1.106	0.684	1.790
Region 12	-0.067	0.214	-0.315	0.753	0.935	0.615	1.422
Region 13	-0.221	0.258	-0.856	0.392	0.802	0.483	1.330
Region 14	0.264	0.184	1.431	0.152	1.302	0.907	1.868
Region 15	-0.114	0.235	-0.484	0.629	0.893	0.564	1.414

Legend. CI, confidence interval; CLEQI, Clinical LEarning Quality Evaluation Index; OR, odds ratio; Std. Error, Standard Error.
§ reference group.
[a] on a 4-point Likert scale, 0 = none; 3 = very high.

Supplementary file 1.

Efforts to address potential sources of bias

Selection and information bias

a) Several strategies at the national level were used to involve all nursing programmes with the aim of preventing selection bias.

b) The data collection process was carried out after provided the study aims information, which was provided in a standardized manner by those responsible at the nursing programme level for collecting data; moreover, students were left free to participate in the survey without any pressure or no benefits were offered. A precise description of the study procedure was also described in the questionnaire.

c) Given that not all students can have witnessed or occurred in safety incidents during their clinical placements, there were requested to indicate the opportunity to report and/or discuss all PS issues, from those near miss or mistakes occurred, to PS concerns.

Chronological bias

d) With the intent of preventing chronological bias, the data collection was performed in the same period, when students were attending their clinical training.

Recall bias

e) Students were invited to fill in the questionnaire during the last week of their clinical training or at least within the following two weeks, during which time no other clinical placements were initiated.

Blinding

f) Data were analysed by the coordinating centre (Udine University) while ensuring the anonymity with regard to the units, the nursing programmes and the universities, by working in a blinded fashion.