

Title**NURSING STUDENTS' INVOLVEMENT IN SHIFT-TO-SHIFT HANDOVERS: FINDINGS FROM A NATIONAL STUDY****Short running title****Nursing students and handovers****Authors**

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Criteria	Author Initials
Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data;	AP, AD, IM, VDM, PA, AB, AB, ADP, LDB, AF, SG, FM, OM, RN, GR, MT, FC, LS, LZ, ST, SG
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Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity	AP, LG, AD, IM, VDM, PA, AB, AB, ADP, LDB, AF,

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Background: Effective performance of clinical handovers should be one of the priorities of nursing education to promote efficient communication skills and ensure patient safety. However, to date, no studies have explored to what extent nursing students are involved in handovers.

Objective: To explore nursing students' handover involvement during their clinical rotations and associated factors.

Method: This was a secondary analysis of a large national cross-sectional study that involved 9,607 undergraduate nursing students in 27 universities across 95 three-year Italian baccalaureate nursing programs. The involvement in the clinical handovers was the end point (from 0, never, to 3, always). A path analysis was performed to identify variables directly and indirectly affecting students' handover involvement.

Results: Handover involvement was reported as 'only a little', 'to some extent', and 'always' by 1,739 (18.1%), 2,939 (30.6%), and 4,180 (43.5%) students, respectively; only 749 (7.8%) of students reported never being involved. At the path analysis explaining the 19.1% of variance of nursing students' involvement, some variables emerged that directly increased the likelihood of being involved in handovers. These were being female ($\beta = 0.115$, $p < 0.001$); having children ($\beta = 0.107$, $p = 0.011$); being a 3rd-year student ($\beta = 0.142$, $p < 0.001$) and being a 2nd-year student as compared to a 1st-year student ($\beta = 0.050$, $p = 0.036$); and having a longer clinical rotation ($\beta = 0.015$, $p < 0.001$) in units with high 'quality of the learning environment' ($\beta = 0.279$, $p < 0.001$). Moreover, students who were supervised by the nurse teacher ($\beta = -0.279$, $p < 0.001$), or by a nurse on a daily basis ($\beta = -0.253$, $p = 0.004$), or by the staff ($\beta = -0.190$, $p < 0.001$) reported being less involved in handovers as compared to those students supervised by a clinical nurse. Variables with indirect effects also emerged (model of student's supervision adopted at the unit level, and number of previous clinical rotations attended by students). Moreover, handover involvement explained 11.5% of students self-reported degree of competences learned during the clinical experience.

Conclusions: Limiting students' opportunity to be involved in handover can prevent the development of communication skills and the professional socialization processes. Strategies at different levels are needed to promote handover among undergraduate nursing students.

Keywords: Clinical handover; clinical handoff; clinical competence; [communication](#); nursing [education](#); nursing students; patient handoff; safe patient care

1. Introduction

Clinical handover occurs between one or more staff member(s) who have undertaken the responsibility for care, and one or more staff member(s) who will assume the responsibility of the patient's care (Anderson et al., 2015). According to the different patients' care transitions, handovers can be shift-to-shift, nurse(s)-to-physician(s), physician(s)-to-nurse(s), ward-to-ward, or hospital-to-community, with shift-to-shift handovers documented as the most frequent occurrence of > 15 times during a 5-day hospitalization (Merten et al., 2017). Moreover, handover can be performed in a room away from patients or at the bedside, with the latter promoting patient-centred care and increasing patients' and nurses' satisfaction (Bertoldi and Celi, 2017).

An effective handover has been reported as a key factor in ensuring patient safety (Anderson et al., 2015). However, communication issues (e.g., omission in reporting or unreliable exchange of information) have been documented as among the greatest daily concerns of nurses (Moss et al., 2017), which also affect patient outcomes. Failures in handover communication have been estimated to be responsible for about 40% of adverse events, such as treatment errors, surgery on the wrong area, or patient death (Manias et al., 2016); moreover, around 22% of adverse events associated with nursing care (e.g., administering a wrong medication) have been associated with poor communication during handovers (Tran and Johnson, 2010). Therefore, from the clinical practice perspective, several international institutions have recognized clinical handover as a priority area for improvement (e.g., Joint Commission for Accreditation, 2017; WHO Collaborating Centre for Patient Safety Solutions, 2007). However, from the nursing education perspective, where communication skills and methods of handovers should be effectively considered, little attention has been paid to date on the quality of handover as experienced by students (e.g., Jarvelainen et al., 2018), while no studies on the degree to which students are involved on a daily basis in handovers or factors promoting their involvement have been documented to date.

There is growing recognition that it is essential to promote nursing students' communication skills, allowing them to gain early experience in clinical handover prior to being assigned the responsibility of patient care. However, a few students have been documented to learn handover skills by simulation in a supported educational environment (Malone et al., 2016), by workshops including handover observation and receiving feedback from faculty members (Stojan et al., 2016), or by teaching sessions that include watching video with positive or negative examples of handover followed by guided discussion (Lee et al., 2016). The majority of students have been documented as not having received formal teaching regarding how to perform handover communication (Skaalvik et al., 2010), and on-the-job training represents the main learning strategy (Malone et al., 2016). In the clinical environment, nursing students may gain experience by being involved in the process of clinical handover, witnessing and listening to handover examples, or conducting handovers at the end of shifts (Lee et al., 2016). However, practising handover in a clinical environment is not always possible: in a pre-post study involving 47 US nursing students, a lack of experience in giving formal handover reports was reported as common (Lee et al., 2016); moreover, dissatisfaction with handovers due to the lack of professional discussions emerged as a theme in a qualitative study involving 12 third-year nursing students (Skaalvik et al., 2010). Similarly, in other health care professionals, according to a survey involving 145 third-year US medical

students, only 39% of them reported being assisted in written sign outs, only 26% had given verbal handovers, and only 21% had received verbal handovers during clinical rotations (Arora et al., 2013).

In the present study, we aimed to explore nursing students' handover involvement during their clinical learning rotations and associated factors. Research questions were the following:

- 1) Are nursing students involved in shift-to-shift handover during their clinical rotations?
- 2) Which factors directly and indirectly affect the students' involvement in handover?
- 3) Does handover involvement affect the degree of competence achieved in the clinical context, as perceived by students?

2. Methods

2.1 Design

This is a secondary analysis of data collected inside a large national cross-sectional study performed in 2015–2016 (Palese et al., 2016) and reported here according to the STrengthening the Reporting of OBservational studies in Epidemiology project for cross-sectional studies (Supplementary data, von Elm et al., 2008) and the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) (Eysenbach, 2004).

2.2 Setting and participants

For the primary study, an Italian network of Bachelor of Nursing Science (BNS) degree programs was created by involving all existing nursing programmes at the national level. Thus, the Coordinator Centre launched an open call to participate that was sent to all 208 BNS programmes located in 43 universities spread across the 20 regions. The invitation was closed after two months, in total enrolling 27 universities with 95 BNS degrees in 15 regions (Palese et al., 2016).

The target population was all nursing students attending the involved nursing programme. Inclusion criteria included students who a) were attending or had just completed their clinical learning rotation at the moment of the survey; b) had experienced their rotation in the same unit or department for at least two weeks; and c) were willing to participate in the study.

2.3 Variables, instrument and data collection process

The involvement in shift-to-shift clinical handovers by giving or receiving handovers (hereafter 'handover') in the last clinical rotation was the primary end point of the study, assessed through the following item included in the questionnaire: 'Were you involved in clinical handover(s) by giving or receiving shift-to-shift handovers during your last clinical learning rotation?'. Answers were based upon a 4-point Likert scale (0 = 'not at all', 1 = 'only a little', 2 = 'to some extent', and 3 = 'always').

The questionnaire included further explanatory variables at the individual, unit, and outcome levels as reported in Table 1.

The questionnaire was piloted in one nursing degree program by involving 100 students to ensure feasibility and understandability. No changes were suggested, and the data collected were not included in this

final analysis. Moreover, the Coordinator Centre agreed with the research team that the strategies to be used in data collection provided differences in the resources available in each nursing programme. Therefore, the questionnaire was distributed and students completed it via hard copy or online, according to local resources. The data collection process was launched in the second semester 2015 and ended in the first semester 2016; strategies to prevent bias have been applied as reported in Table 2 and the Supplementary Table 1.

2.4 Data analysis

Descriptive and inferential statistical analysis was performed (SPSS Statistical Package version 24 and R Core Team, 2017), by computing frequencies, percentages, and averages (with Standard Deviations [SD] and ranges; or confidence intervals [CI] at 95%).

A bivariate analysis was performed by considering the primary end point as a categorical variable forming four groups: students who experienced handover involvement as ‘not at all’, ‘only a little’, ‘to some extent’, and ‘always’. A chi-square test, ANOVA, and Kruskal-Wallis test were used to explore differences among groups, according to the nature of the variables.

The Intra Class Correlation (ICC) was computed both under random and fixed effects to identify the clusters effect at the unit level (e.g., students may be engaged in handover to a different extent according to the specific unit—intensive care unit vs. medical unit) and at the nursing programme level (e.g., BNS degree programmes can have different strategies to promote handover involvement of students by asking the wards to offer this opportunity).

Then, a path analysis was performed by introducing the end point as outcome and as explanatory variables. Variables included those significantly associated with the end point in the bivariate analysis; there were selected individual variables as exogenous variables—not influenced by variables introduced in the causal model; and there also were endogenous variables—those that emerged in the bivariate analysis as being associated with the outcome, as well as in previous studies (Palese et al., 2018a, 2018b, 2018c). Thus, direct and indirect effects by sequential multiple regression analyses were tested. The standardized coefficient β was estimated for each variable and, according to Tarling (2009), we also accounted for the total effect by multiplying the path coefficients connecting the causal variable to the outcomes. The entire model was also estimated regarding the total variance of the outcome (R^2). Moreover, at the outcome level, the impact of handover involvement on the degree of competence achieved by students as self-perceived was also introduced in the model by using a linear regression analysis by calculating the R^2 .

The statistical significance was set at $p < 0.05$.

2.5 Ethics

Ethical approval was obtained from the University of Milan (Italy). Participation was voluntary, there was no incentive for the students to enter the study, and each student signed a written informed content.

3. Results

3.1 Participants and end point

A total of 9,607 (91.7%) out of the 10,480 undergraduate nursing students invited to participate completed the questionnaire. Handover involvement was reported 'only a little', 'to some extent', and 'always' by 1,739 (18.1%), 2,939 (30.6%) and 4,180 (43.5%) students, respectively; only 749 (7.8%) students reported not having ever been involved in handovers.

3.2 Bivariate analysis

At the individual level (Table 3), students who were always involved in handovers were more often female ($p = 0.006$) and less often had children ($p = 0.003$). Instead, those students who were never involved in handovers more often attended a high secondary school ($p = 0.013$).

At the nursing programme level, students who were always involved in handovers reported fewer previous clinical experiences ($p < 0.001$); at the unit level, they were more often supervised by a clinical nurse and reported a longer duration of clinical rotation ($p < 0.001$). They also reported higher average scores both in all factors ($p < 0.001$) and in the total CLEQI score ($p < 0.001$).

At the outcome level, students who were always involved in handovers reported having learnt more competences ($p < 0.001$, Table 3) as compared with other groups.

At the unit level, handover involvement accounted for an ICC of 0.10 (random effects) and 0.05 (fixed effects); at the nursing programme level, the ICC was 0.22 (both with random and fixed effects).

3.3 Path analysis

As reported in Table 4, at the individual level, being female ($\beta = 0.115$, $p < 0.001$) and having children ($\beta = 0.107$, $p = 0.011$) directly increased the likelihood of being involved in handovers. Similarly, being a 3rd-year student as compared to a 1st-year student ($\beta = 0.142$, $p < 0.001$) and being a 2nd-year student as compared to a 1st-year student ($\beta = 0.050$, $p = 0.036$) both directly increased the likelihood of handover involvement. In contrast, the lower number of previous clinical rotations attended by students slightly prevented handover involvement ($\beta = -0.041$, $p < 0.001$).

With regard to the most recent clinical rotation attended, its duration in weeks also directly increased the likelihood of being involved in handovers ($\beta = 0.015$, $p < 0.001$) as did the 'quality of the learning environment' ($\beta = 0.279$, $p < 0.001$), 'learning opportunities' ($\beta = 0.208$, $p < 0.001$), 'safety and care quality' ($\beta = 0.190$, $p < 0.001$), 'quality of the tutorial strategies' ($\beta = 0.066$, $p = 0.001$), and 'opportunity of self-directed learning' ($\beta = 0.042$, $p = 0.004$) factors as measured with the CLEQI tool.

The model of student supervision adopted in the unit also had a direct effect on handovers' involvement: students who had been supervised by the nurse teacher ($\beta = -0.279$, $p < 0.001$), by a nurse on a daily basis ($\beta = -0.253$, $p = 0.004$), or by the entire staff ($\beta = -0.190$, $p < 0.001$) were less involved in handovers as compared to those students supervised by a clinical supervisor.

Specifically, in the context of indirect relationships among variables, the 'quality of the learning environment' has been reduced by being supervised by the staff ($\beta = -0.331$, $p < 0.001$), by a nurse on a daily basis ($\beta = -0.306$, $p < 0.001$), or by the nurse teacher ($\beta = -0.302$, $p < 0.001$) as compared to being supervised by a clinical supervisor. Moreover, while the duration of the clinical rotation increased the quality of the learning

environment as perceived by students ($\beta = 0.021, p < 0.001$), having previous university experiences ($\beta = -0.055, p = 0.001$) and more clinical rotations ($\beta = -0.007, p = 0.005$) prevented a quality learning environment as perceived by students.

The degree of 'learning opportunities' as perceived by nursing students at the unit level, have being prevented among those who were supervised by the staff ($\beta = -0.302, p < 0.001$), or by the nurse teacher ($\beta = -0.274, p < 0.001$), or by a nurse on a daily basis ($\beta = -0.203, p = 0.006$), or by the head nurse ($\beta = -0.129, p = 0.018$), as compared to those supervised by a clinical supervisor; in contrast, the 'learning opportunities' was slightly increased by the duration of the clinical rotation ($\beta = 0.019, p < 0.001$) and by the number of previous clinical experiences ($\beta = 0.014, p < 0.001$). Similar patterns emerged for the 'safety and care quality', 'self-directed learning', and 'quality of tutorial strategies' factors of the CLEQI tool, as reported in Table 4 and Figure 1.

By analysing the total effects (indirects*directs; Tarlin, 2009) of those variables with the largest effects, not being supervised by a clinical nurse completely eliminated the positive effects of the quality of the learning environment in increasing handover involvement (e.g., being supervised by the staff $\beta = -.302$ * quality of the learning environment $\beta = 0.279 =$ total effects $\beta = -0.084$).

At the overall level, the model explained 19.1% of the variance of nursing students' involvement in handovers. Moreover, handover involvement as reported by students explained 11.5% of self-reported degree of competences learned during the clinical experience.

4. Discussion

Handovers have been documented as a learning opportunity supporting both clinical competences and professional socialization (Skaalvik et al., 2010), preparing students for their future workplace (Malone et al., 2016; Manias et al., 2016). However, at the Italian national level, about one out of four nursing students has experienced no or poor involvement in handovers during their last clinical rotation, thus potentially affecting the development of a patient-centred safety culture. Those students reporting limited handover opportunities may have been engaged in direct patient care during the shift-to-shift handover involving all staff (e.g., answering bell calls), thus denoting a poor recognition of the educational relevance of handover in understanding the clinical trajectory of patients. By having limited handover exposure, students are limited in understanding the clinical complexity of the patients' care; specifically, when this exclusion occurs at the end of the shift, students' contribution to patient care is undervalued; on the other side, when this occurs at the beginning of the shift, students are thought to not base their decisions and practices upon the clinical history of patients and the previous nursing care delivered. Moreover, preventing student handover involvement can negatively affect their sense of engagement with the team and their socialization with different professional identities (Newton et al., 2009).

Handover involvement has reported poor cluster effects, both at the unit and nursing programme level where a greater influence has emerged. This seems to suggest that there is poor conformity across students attending the same unit in being involved or not in handover. Thus, this reflects an individual decision (e.g., by the clinical supervisor supervising the students) and not a ward culture; the higher degree of ICCs at the nursing programme level (0.22, which also remains poor) can reflect school surveys where cluster sizes are

also likely to be large (Chromy, 2014) or may be explained by the relevance that different BNS programmes ascribe to handover.

Most of the factors affecting handover involvement were explained by the model of around 19% relied at the unit level: students who perceived greater quality of the learning environment and greater learning opportunities reported higher handover involvement. Our findings confirmed a previous thematic analysis identifying an invitational learning environment as vital for developing students' competence in handover, suggesting the relevance of both the learning qualities of the workplace and the clinical staff to develop nursing students' handover skills (Newton et al., 2009). Similarly, we found the pivotal role of the supervision model adopted by the unit—in promoting involvement in handovers by clinical supervisor supervision—as having the greater impact at the end point level directly and also indirectly, by affecting the quality of the learning environment and thus increasing handover involvement. Specifically, the supervision model based upon the staff—a nurse identified on a daily basis, or the head or the teacher nurse—indirectly reduced the quality of the learning environment as a whole, thus reducing handover involvement.

When a clinical nurse is in charge of the supervision, by taking on the clinical teaching role together with having responsibility for the patient, she/he undertakes strategies allowing the student to experience different learning experiences, recognized as essential for the nursing profession, such as handovers (Newton et al., 2009; Lee et al., 2016). Moreover, clinical supervisors have been documented as being more open to allowing students to “jump in and do it” (Newton et al., 2009) by directly engaging them in activities (e.g., handover) and in the meantime creating an environment that, in turn, is likely to generate rich learning. Furthermore, students who feel guidance and support from clinical nurses have been reported as having increased confidence in giving excellent handover (Lee et al., 2016). Good role models are likely to promote a positive student learning experience and emulation in future practice (Eaton et al., 2007; Lee et al., 2016); therefore, students should be exposed to as many handovers as possible and practise by giving handovers in order to improve their confidence in performing the task. Accordingly, the supervision model of the unit is central in directly increasing the involvement of students in handover by also influencing the quality of the learning environment lived by students. Thus, in deciding what supervision model to develop, faculties should train clinical nurses to improve their mentoring competences capable of actively involving the students; faculties should also preliminarily assess the quality of the learning environment, avoiding the assignment of students to those settings where they are engaged in direct care rather than offering them the opportunity to experience handovers.

A few variables emerged at the individual level: female students were more likely to be involved in handovers compared to their male peers, similarly to previous findings in the field (Palese et al., 2018a, 2018b, 2018c). Male students seem to be less exposed to handovers, thus limiting their opportunity to acquire these communication skills; this indicates an emerging pattern of gender discrimination. In addition, students with parental responsibilities perceived more opportunities of handovers. On the one hand, the continuity of care over transitions in their daily life can have increased their appreciation of handovers; on the other hand, due to family responsibilities, they can be more confident in collecting data aimed at prioritizing needs.

Being involved in handovers directly affected the degree of competences as perceived by students, explaining a variance of around 11%. Students are exposed to a variety of learning experiences during their clinical rotations, and no previous studies to our knowledge have linked specific learning opportunities with the competences achieved by students. However, in affecting the 11% of clinical competence achieved at the end of a clinical rotation, the participation in clinical handovers suggests their relevance in the process of becoming a nurse.

4.1 Limitations

At the end-point level, we investigated students' overall involvement in handovers, without differentiating between an 'active' involvement, where students are directly involved in giving or receiving shift-to-shift handovers, and a 'passive' exposure, where students do not contribute to the team discussion and wait for the end of the narrative handover in a corner of the handover room (Newton et al., 2009). We collected the end point and the explanatory variables at the same time, according to the cross-sectional nature of the study; therefore, the phenomena called 'reverse causal effects' (Katz, 2006) should be considered, e.g., the nursing students' involvement in handovers increased the perception of learning opportunities, and not *vice versa*.

We used different data collection methods, according to the resources available in the nursing programme, and this could have affected the amount of missed data as well as introduced a selection bias (e.g., different missed data and attrition rates between students filling in the questionnaire online or in hard copy).

5. Conclusions

One out of four nursing students reported no involvement or poor involvement in handover during their clinical rotations, thus potentially affecting the development of the communication skills that are an essential requisite to practice as future registered nurses. The limited opportunities for handover involvement can also prevent students' sense of becoming part of the team, their professional socialization, and their identity development.

Factors affecting the perception of handover involvement mainly emerged at the unit levels where students attended their clinical experience. The pedagogical atmosphere characterised by the quality of the learning environment, the learning opportunities offered, and the model of supervision adopted strongly influenced handover involvement. When students were supervised by a clinical nurse, they were more likely to be involved in handovers in an invitational learning environment that in turn promoted handover involvement; thus, the clinical nurse acted both directly and indirectly by positively influencing the learning environment. Nursing faculties should assess the supervision model and the quality of the learning environment before deciding about the accreditation of the unit for nursing student clinical rotations. Units should offer students learning opportunities not limited to direct patient care in order to allow the development of a wide range of competences, since being involved in handovers affects the perceived degree of competences learned during the clinical rotation. Moreover, learning environments should be periodically assessed to determine their ability to engage students in handovers. Furthermore, clinical nurses who supervise students should be trained to enhance their competence in promoting students' involvement in handover and should particularly encourage male students to test themselves with handovers.

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Table 1. Variables collected at the individual, unit and at the outcome level

- *Individual level*: This included socio-demographic variables (e.g., age, gender) and working experiences both previously and during nursing education.

- *Individual level, as a nursing student*: This included the year of nursing education attended (1st, 2nd, or 3rd and final year); the amount of previous clinical learning experience attended (clinical rotations, in number); and in which settings the experience occurred (e.g., only in hospital, only in the community setting, or in both).

- *Unit level*: with regard to the last clinical rotation, students were asked about its duration (weeks) and the supervision model adopted by the unit under the following possible solutions used in the Italian context (Brugnolli and Benaglio, 2017):

- (a) under the guidance of a clinical nurses called ‘clinical supervisor’ who has the responsibility of both patients’ care and student(s)’ learning processes for the entire clinical rotation;
- (b) under the guidance of the entire staff who have all the responsibility of both patients’ care and student(s)’ learning processes;
- (c) under the guide of a nurse identified on a daily basis by the head nurse who has the responsibility of both patients’ care and student(s)’ learning processes for the entire day;
- (d) under the guide of the nurse teacher appointed at the university level, and spending some hours a day in the clinicals setting, and
- (e) under the guide of the head nurse who has the responsibility of both managerial issues and student(s)’ learning processes, for the entire clinical rotation.

Moreover, the Clinical LEarning Quality Evaluation Index (CLEQI) tool was employed to assess the perceived quality of the learning processes enacted in the specific environment of the unit (Palese et al., 2017). The tool comprises five factors: ‘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). Each factor as well as the overall CLEQI score may range from 0 to 3, with higher scores indicating a higher quality of the learning processes enacted in the clinical setting, as perceived by students. The psychometric properties of the tool have been published elsewhere (Palese et al., 2017).

- *Outcome level*: this included the degree of competence learned in the last clinical experience as perceived by each student (4-point Likert scale, from 0, none, to 3, very much).

Table 2. Bias control and levels

- (a) Selection bias prevention - at the national level: an open invitation was sent three different times, at two-week intervals, to involve as many BNS programmes as possible.
- (b) Information bias prevention - at the nursing programme level: there were ensured the following strategies: a) data collection was performed after standardized information was offered to all participants by those responsible for data collection at the BNS level; b) students were free to participate with neither benefits nor pressure; and c) study aims and data collection procedures were described at the beginning of the questionnaire as well as in a sheet sent to those responsible for each BNS degree programme.
- (c) Recall bias prevention - at the student level: students were invited to fill in the questionnaire during the last week of the clinical training or at least within the following two weeks, during which time no other clinical placements were initiated. With regard to the data collection process, both hard-copy and online questionnaires were completed. With regard to online data collection, we have strictly followed the good practice procedures as reported in Supplementary Table 1 (Eysenbach, 2004).

Table 3. Handover involvement as experienced by nursing students during their most recent clinical rotation

	Not at all N = 749 (7.8%)	Only a little N = 1,739 (18.1%)	To some extent N = 2,939 (30.6%)	Always N=4,180 (43.5)	p-value[§]
Individual level					
Age, years, mean (95% CI)	23.14 (22.82-23.45)	22.94 (22.74-23.14)	22.93 (22.77-23.08)	22.81 (22.68-22.93)	0.201
Female gender (n = 9596), n (%)	542 (72.5)	1292 (74.3)	2234 (76.2)	3235 (77.4)	0.006
Civil status, n (%)					0.152
Unmarried	707 (94.4)	1644 (94.5)	2775 (94.4)	3919 (93.8)	
Married/cohabitant	28 (3.7)	70 (4.0)	123 (4.2)	214 (5.1)	
Divorced	3 (0.4)	5 (0.3)	10 (0.3)	19 (0.4)	
Widowed	0 (-)	1 (0.1)	2 (0.1)	4 (0.1)	
Missing	11 (1.5)	19 (1.1)	29 (1.0)	24 (0.6)	
With children, n (%)	25 (3.4)	59 (3.5)	122 (4.2)	222 (2.3)	0.003
Secondary education (n = 9442), n (%)					0.013
High school	550 (74.3)	1201 (69.8)	1985 (68.9)	2894 (70.6)	
Technical school	22 (3.0)	88 (5.1)	135 (4.7)	165 (4.0)	
Professional school	114 (15.4)	281 (16.3)	458 (15.9)	665 (16.2)	
Teacher school	41 (5.5)	137 (8.0)	264 (9.2)	326 (7.9)	
Secondary school abroad	13 (1.8)	13 (0.8)	37 (1.3)	33 (1.3)	
Previous academic experience (n = 9515), n (%)					0.065
None	494 (66.6)	1162 (67.8)	2006 (69.0)	2925 (70.4)	
Graduated in other fields	27 (3.6)	73 (4.3)	125 (4.3)	195 (4.7)	
Uncompleted degree	218 (29.3)	457 (26.7)	752 (25.8)	999 (24.1)	
Other	4 (0.5)	20 (1.2)	26 (0.9)	32 (0.8)	
Secondary education grade score (n = 9312), mean (95% CI)					
On a 100-point scale (n = 9,108, 94.8%)	55.52 (76.55-78.29)	76.99 (76.49-77.50)	76.93 (76.55-77.30)	76.66 (76.34-76.97)	0.179
On a 60-point scale (n = 172, 1.8%)	44.13 (40.13-48.49)	45.06 (42.20-47.92)	45.52 (43.55-47.50)	45.75 (44.05-47.46)	0.897
On a 10-point scale (n = 32, 0.4%)	7.60 (5.02-10.18)	8.00 (6.70-9.30)	7.84 (6.92-8.75)	7.84 (7.03-8.66)	0.984
Previous work experience (n = 9553), n (%)	247 (33.3)	586 (33.9)	987 (33.8)	1481 (35.6)	0.314
Nursing programme level					
Academic year attended (n = 9579), n (%)					0.061
First	234 (31.5)	494 (28.6)	847 (28.9)	1334 (32.0)	
Second	248 (33.5)	609 (35.2)	1014 (34.5)	1411 (33.8)	
Third	259 (35.0)	627 (36.2)	1074 (36.6)	1428 (34.2)	
Work experience during the degree (n = 9526), n (%)	150 (20.2)	323 (18.8)	589 (20.2)	880 (21.2)	0.202

Previous clinical experiences , (n = 9498), number, mean (95% CI)	5.62 (5.35-5.88)	5.34 (5.17-5.50)	5.01 (4.89-5.13)	4.53 (4.44-4.62)	<0.001
Settings (n = 9551), n (%)					0.247
Only hospital	525 (70.6)	1204 (69.7)	1965 (67.4)	2812 (67.6)	
Only community setting	10 (1.3)	24 (1.4)	42 (1.4)	77 (1.9)	
Hospital and community setting	209 (28.1)	499 (28.9)	911 (31.2)	1273 (30.5)	
Unit level					
Length of the most recent clinical experience , weeks, mean (95% CI) [†]	5.13 (4.93-5.34)	5.57 (5.43-5.72)	5.82 (5.72-5.93)	6.02 (5.94-6.09)	<0.001
Tutorial model of the more recent clinical experience (n = 9563), n (%) [†]					< 0.001
I was supervised by a clinical nurse	218 (29.3)	664 (38.4)	1547 (53.0)	2667 (63.9)	
I was supervised by the nursing staff	449 (60.4)	924 (53.5)	1161 (39.7)	1270 (30.5)	
I was supervised by nurse identified on a daily basis by the head nurse	11 (1.5)	22 (1.3)	33 (1.1)	27 (0.6)	
I was supervised by the nurse teacher	57 (7.7)	97 (5.6)	128 (4.4)	123 (2.9)	
I was supervised by the head nurse	8 (1.1)	20 (1.2)	52 (1.8)	85 (2.1)	
CLEQI factor scores , mean (95% CI) ^{†,‡}					
Quality of the tutorial strategies	1.29 (1.23-1.35)	1.60 (1.23-1.63)	1.88 (1.86-1.90)	2.31 (2.29-2.33)	< 0.001
Learning opportunities	1.41 (1.36-1.46)	1.60 (1.57-1.63)	1.85 (1.83-1.87)	2.30 (2.29-2.32)	< 0.001
Self-directed learning	0.88 (0.82-0.93)	1.17 (1.14-1.21)	1.43 (1.41-1.46)	1.80 (1.78-1.82)	< 0.001
Safety and nursing care quality	1.63 (1.58-1.67)	1.77 (1.74-1.79)	1.97 (1.95-1.99)	2.36 (2.34-2.37)	< 0.001
Quality of the learning environment	1.31 (1.26-1.36)	1.63 (1.60-1.66)	1.90 (1.88-1.93)	2.40 (2.38-2.41)	< 0.001
Overall CLEQI score ^{†,‡}	1.31 (1.26-1.35)	1.56 (1.53-1.58)	1.81(1.79-1.83)	2.24 (2.22-2.25)	< 0.001
Outcome level					
Degree competence learned the most recent clinical experience , (n = 9577), mean (95% CI) ^{†,‡}	1.52 (1.47-1.58)	1.79 (1.75-1.82)	2.00 (1.97-2.02)	2.34 (2.32-2.36)	< 0.001

[†] The last clinical experience was that under evaluation.

[‡] On a 4-point Likert scale (0 = nothing; 3 = very much).

[§] Chi square for dichotomous variables, analysis of variance and Kruskal-Wallis test for continuous variables.

CI, confidence interval; CLEQI, Clinical Learning Quality Evaluation Index; SD, standard deviation.

Table 4. Being involved in shift-to-shift handovers in my last clinical rotation: path-analysis

Outcome: being involved in handovers (from 0 to 3)^{†, ‡}	β	Std.Err	z-value	P(> z)	Std.lv	Std.all
Gender F vs M	0.115	0.020	5.719	0.000	0.115	0.056
Having child(s)	0.107	0.042	2.544	0.011	0.107	0.025
2nd year vs 1st	0.050	0.024	2.094	0.036	0.050	0.027
3rd year vs 1st	0.142	0.032	4.465	0.000	0.142	0.078
High secondary education vs technical/ professional	-0.016	0.019	-0.862	0.389	-0.016	-0.008
Previous university experience(s)	-0.015	0.018	-0.818	0.413	-0.015	-0.008
Number of clinical rotations attended	-0.041	0.004	-10.314	0.000	-0.041	-0.152
Duration of the last clinical rotation (in weeks)	0.015	0.003	4.465	0.000	0.015	0.045
I was supervised by the nursing staff vs a CS	-0.190	0.019	-10.081	0.000	-0.190	-0.106
I was supervised by nurse identified on a daily basis by the head nurse vs a CS	-0.253	0.088	-2.867	0.004	-0.253	-0.028
I was supervised by the nurse teacher vs a CS	-0.279	0.044	-6.390	0.000	-0.279	-0.063
I was supervised by the head nurse vs a CS	-0.054	0.067	-0.807	0.420	-0.054	-0.008
Quality of the tutorial strategies	0.066	0.020	3.299	0.001	0.066	0.056
Self-directed learning	0.042	0.015	2.887	0.004	0.042	0.038
Learning opportunities	0.208	0.022	9.514	0.000	0.208	0.160
Safety and nursing care quality	0.190	0.020	9.343	0.000	0.190	0.129
Quality of the learning environment	0.279	0.019	14.942	0.000	0.279	0.235
Outcome: Quality of the tutorial strategies (from 0 to 3)^{†, §}						
Previous university experience(s)	-0.027	0.016	-1.653	0.098	-0.027	-0.017
Number of clinical rotations attended	0.000	0.002	0.118	0.906	0.000	0.001
Duration of the last clinical rotation (in weeks)	0.016	0.003	5.564	0.000	0.016	0.059
I was supervised by the nursing staff vs a CS	-0.422	0.016	-26.437	0.000	-0.422	-0.279
I was supervised by nurse identified on a daily basis by the head nurse vs a CS	-0.272	0.079	-3.442	0.001	-0.272	-0.036
I was supervised by the nurse teacher vs a CS	-0.355	0.039	-9.152	0.000	-0.355	-0.096
I was supervised by the head nurse vs a CS	0.145	0.059	2.470	0.014	0.145	0.026
Outcome: Self-directed learning (from 0 to 3)^{†, §}						
Previous university experience(s)	-0.032	0.018	-1.773	0.076	-0.032	-0.018
Number of clinical rotations attended	-0.004	0.003	-1.689	0.091	-0.004	-0.018
Duration of the last clinical rotation (in weeks)	0.016	0.003	5.087	0.000	0.016	0.054
I was supervised by the nursing staff vs a CS	-0.400	0.017	-22.915	0.000	-0.400	-0.244
I was supervised by nurse identified on a daily basis by the head nurse vs a CS	-0.120	0.087	-1.382	0.167	-0.120	-0.014
I was supervised by the nurse teacher vs a CS	-0.283	0.042	-6.650	0.000	-0.283	-0.070
I was supervised by the head nurse vs a CS	0.109	0.064	1.691	0.091	0.109	0.018
Outcome: Learning opportunities (from 0 to 3)^{†, §}						
Previous university experience(s)	-0.024	0.015	-1.549	0.121	-0.024	-0.016
Number of clinical rotations attended	0.014	0.002	6.181	0.000	0.014	0.066
Duration of the last clinical rotation (in weeks)	0.019	0.003	6.968	0.000	0.019	0.074
I was supervised by the nursing staff vs a CS	-0.302	0.015	-20.357	0.000	-0.302	-0.218
I was supervised by nurse identified on a daily basis by the head nurse vs a CS	-0.203	0.074	-2.762	0.006	-0.203	-0.029
I was supervised by the nurse teacher vs a CS	-0.274	0.036	-7.576	0.000	-0.274	-0.080
I was supervised by the head nurse vs a CS	-0.129	0.055	-2.361	0.018	-0.129	-0.025
Outcome: Safety and nursing care quality (from 0 to 3)^{†, §}						
Previous university experience(s)	-0.029	0.014	-2.171	0.030	-0.029	-0.023
Number of clinical rotations attended	-0.001	0.002	-0.717	0.473	-0.001	-0.008
Duration of the last clinical rotation (in weeks)	0.006	0.002	2.714	0.007	0.006	0.029

I was supervised by the nursing staff vs a CS	-0.267	0.013	-20.366	0.000	-0.267	-0.219
I was supervised by nurse identified on a daily basis by the head nurse vs a CS	-0.177	0.065	-2.728	0.006	-0.177	-0.029
I was supervised by the nurse teacher vs a CS	-0.199	0.032	-6.224	0.000	-0.199	-0.066
I was supervised by the head nurse vs a CS	0.056	0.048	1.155	0.248	0.056	0.012

Outcome: Quality of the learning environment (from 0 to 3)^{†,§}

Previous university experience(s)	-0.055	0.017	-3.276	0.001	-0.055	-0.034
Number of clinical rotations attended	-0.007	0.002	-2.831	0.005	-0.007	-0.030
Duration of the last clinical rotation (in weeks)	0.021	0.003	7.314	0.000	0.021	0.078
I was supervised by the nursing staff vs a CS	-0.331	0.016	-20.517	0.000	-0.331	-0.220
I was supervised by nurse identified on a daily basis by the head nurse vs a CS	-0.306	0.080	-3.821	0.000	-0.306	-0.040
I was supervised by the nurse teacher vs a CS	-0.302	0.039	-7.682	0.000	-0.302	-0.081
I was supervised by the head nurse vs a CS	0.065	0.059	1.096	0.273	0.065	0.012

Outcome: Degree of competence learned in the last clinical experience (from 0 to 3)^{†,¶}

Being involved in handovers	0.282	0.008	36.322	0.000	0.282	0.339
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Intercepts	Estimate	Std.Err	z-value	P(> z)	Std.lv	Std.all
Being involved in handovers	0.614	0.048	12.692	0.000	0.614	0.703
Quality of the tutorial strategies	2.080	0.025	83.908	0.000	2.080	2.822
Self-directed learning	1.625	0.027	59.912	0.000	1.625	2.036
Learning opportunities	1.950	0.023	84.544	0.000	1.950	2.886
Quality of the learning environment	2.113	0.025	84.214	0.000	2.113	2.871
Safety and nursing care quality	2.180	0.020	107.004	0.000	2.180	3.663
Degree of competence learned in the last clinical experience	1.484	0.018	82.017	0.000	1.484	2.041

Variiances	Estimate	Std.Err	z-value	P(> z)	Std.lv	Std.all
Being involved in handovers	0.618	0.009	65.845	0.000	0.618	0.809
Quality of the tutorial strategies	0.499	0.008	65.844	0.000	0.499	0.918
Self-directed learning	0.597	0.009	65.845	0.000	0.597	0.938
Learning opportunities	0.432	0.007	65.844	0.000	0.432	0.946
Safety and nursing care quality	0.337	0.005	65.845	0.000	0.337	0.951
Quality of the learning environment	0.511	0.008	65.845	0.000	0.511	0.943
Degree competence learned in the last clinical experience	0.468	0.007	65.845	0.000	0.468	0.885

R-Square	Estimate
Being involved in handovers	0.191
Quality of the tutorial strategies	0.082
Self-directed learning	0.062
Learning opportunities	0.054
Safety and nursing care quality	0.049
Quality of the learning environment	0.057
Degree competence learned in the last clinical experience	0.115

CS, clinical supervisor.

[†] The more recent clinical experience was that under evaluation.

[‡] On a 4-point Likert scale (0 = "not at all" to 3 = "always").

[§] On a 4-point Likert scale (from 0= "never" to 3= "always").

[¶] On a 4-point Likert scale (from 0= "none" to 3= "very much").

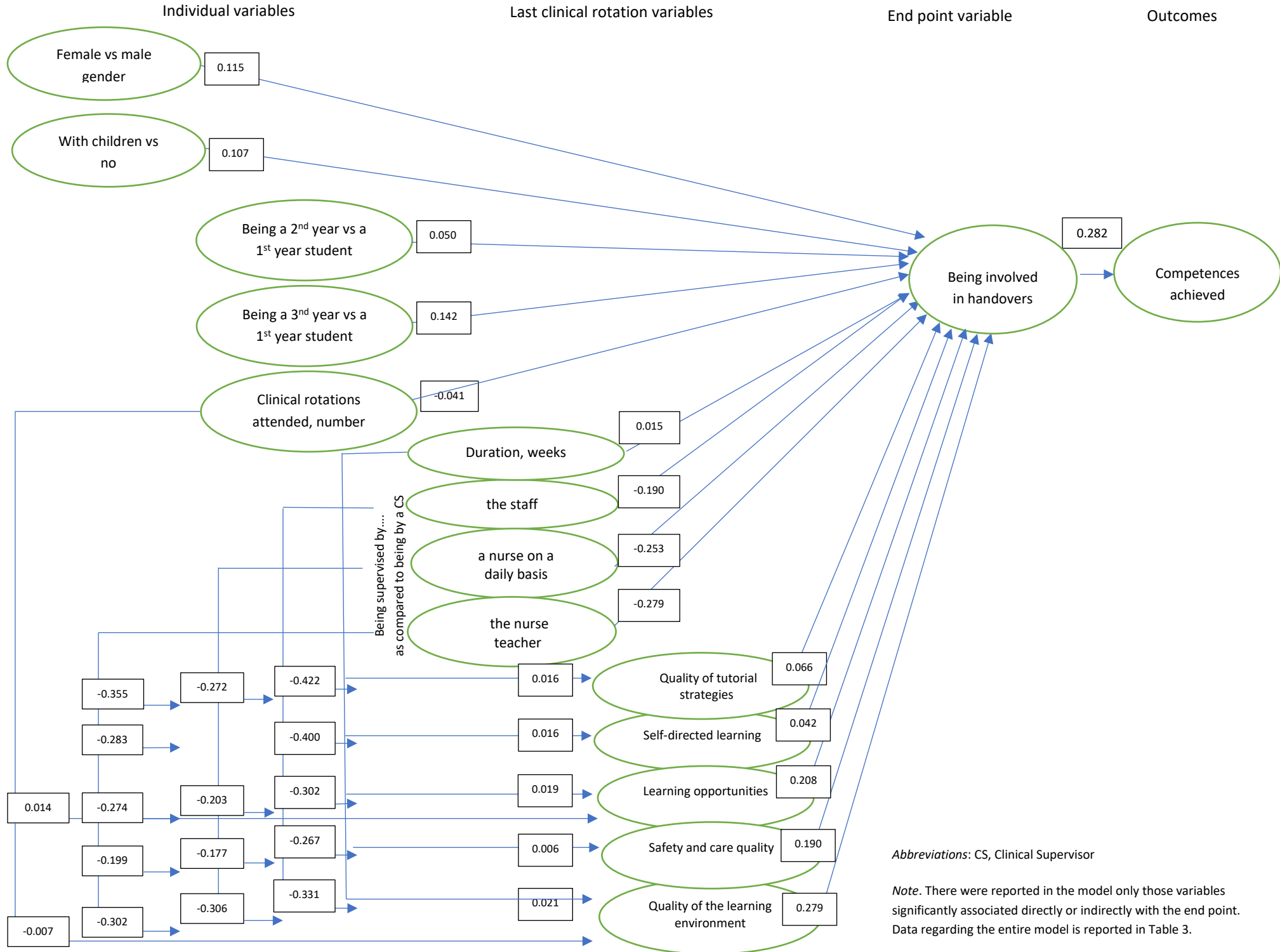
Supplementary table 2. Checklist for Reporting Results of Internet E-Surveys (CHERRIES) (Eysenbach, 2004)

Dimension	Item	Our study
Design	Describe survey design	The target population was composed by all nursing students attending Italian Nursing Programmes. A convenience sample was used.
	Institutional Review Board approval and informed consent process	<p>Approval</p> <p>Ethical approval was obtained from the University of Milan (La Statale) no. 46, Jul 1, 2015.</p> <p>Informed consent</p> <p>Participants were informed regarding the (a) aims of the study; (b) the length of time to complete the survey; (c) who was the Principal Investigator, and (d) who stored the data (the Coordinator Unit, Udine University, Italy).</p> <p>Data protection</p> <p>Students were free to indicate or not personal data (e.g. name surname, age, gender, academic year attended). These data were transferred in a safely manner to the Coordinator Centre for the evaluation of the data quality and its subsequent analysis.</p>
Development and pre-testing	Development and testing	The electronic version of the questionnaire was prepared by using SurveyMonkey(R), which is one of the tools officially used by the University of Milan. The electronic version included compulsory informed consent, which the responders were called to provide before being able to answer the questions. The questionnaire was preliminary tested on a sample of nursing students who volunteered checked the tool and provide their feedbacks. No negative comments were received about technical aspects, ease of use, and understandability of the electronic questionnaire. Therefore, non-changes were introduced.
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	We used a closed survey open only to students attending the nursing programmes surveyed electronically and according to the inclusion criteria.
	Contact mode	The first contact was via email, performed by the Coordinator of nursing programmes, via the official email assigned to each student by the university.
	Advertising the survey	The survey was announced online (through the mailing lists of the universities) as well as at the national levels, among the nursing programmes composing the Network of the research.
Survey administration	Web/E-mail	The survey was sent out through the e-mail: the responses were entered automatically in the database and all responses were captured.
	Context	The survey was administered online, by sending all students an email containing a link to the questionnaire located on the SurveyMonkey website. The official email addresses provided by the Universities using the electronically administration, was used; the responders were not at need to install additional software or to have specific computer equipment. Data were recorded automatically by the SurveyMonkey software and kept on a server, without the responders being able to see other participants' answers.
	Mandatory/voluntary	The participation was voluntary.
	Incentives	No incentives were offered.
	Time/Date	Second Semester 2015.
	Randomization of items or questionnaires	Only one version of the questionnaire was used for the purposes of the study: moreover, given that the items were conceived to map specific dimensions in a predefined order, no randomization was implemented.
	Adaptive questioning	Some items were free in the answer (e.g., the unit attended at the moment of the survey), aiming at ensuring that participants were able to exactly identify the setting where they were attending their clinical rotation.

	Number of Items	The number of items was 23 on the first page, 64 in the second, and 16 in the third. Overall, the questionnaire included 96 items. However, not all of these items were used for the present secondary analysis.
	Number of screens (pages)	The questionnaire was composed by three webpages.
	Completeness check	All items were mandatory, with the exception of those individual (e.g., name, surname, age, gender). The first question asked to provide informed consent and contained a short summary of the study aims, including privacy issues according to the Italian law. No items had non-response options such as “Not applicable” or “I don’t know”.
	Review step	The respondents were allowed to review and change their answers through a “back” button located at the end of each page of the questionnaire.
Response rates	Unique site visitor	The IP address and the email address of each respondent were used to determine the visitors as “unique” (see below).
	View rate (Ratio of unique survey visitors/unique site visitors)	Our SurveyMonkey subscription did not provide data regarding the number of visitors to the first page.
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	
Preventing multiple entries from the same individual	Cookies used	Cookies were not used in this survey.
	IP check	The IP address of the client computer was used to identify the users. No user was allowed to access the survey more than once from the same IP address.
	Registration/ Log file analysis	Given that the survey was “closed” (non-open), each participant entered by his/her personal login first. This prevented duplicates given that the URL of the questionnaire could be reached after the first visit, but the survey could only be completed once.
Analysis	Handling of incomplete questionnaires	The questionnaires were checked for completeness; then, all were submitted to the analysis with those administered via paper and pencil.
	Questionnaires submitted with an atypical timestamp	The timeframe that was used as a cut-off point was at least 30 min after the email was sent to students.
	Statistical correction	We have not used any statistical correction.

Legend: IP, Internet Protocol; URL, Uniform Resource Locator.

Figure 1. Path analysis findings



STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Reported on page
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6-7

		(b) Describe any methods used to examine subgroups and interactions	6-7
		(c) Explain how missing data were addressed	Table 1
		(d) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	None
Outcome data	15*	Report numbers of outcome events or summary measures	9-13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
		(b) Report category boundaries when continuous variables were categorized	8-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10-11

Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	See "Title page"

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.