Introduction. Hand hygiene is crucial to prevent cross infection. Healthcare students are in a prime position to learn hand hygiene skills. The aim of this study was to analyze hand hygiene behavioral intentions of healthcare students before and after contact with the patient and to compare the knowledge of and attitude towards hand hygiene between medical and nursing students.

Methods. In a descriptive survey research design, convenience selection of a sample of medical students (n=657) and nursing students (n=303) was done from modules taught by the Department of Preventive Medicine and Public Health in both Medicine and Nursing undergraduate degrees in four Spanish universities. The hand hygiene Questionnaire, a validated instrument to evaluate behavior, knowledge, and attitudes, was used.

Results. A significantly lower percentage of students reported always or almost always carrying out hand hygiene before contact with the patient or invasive procedures in comparison to the percentage complying after contact with secretions or with the patient. Although hand hygiene knowledge appears acceptable, its importance is not sufficiently valued.

Conclusions. There are deficiencies in behavioral intention, knowledge, and attitudes related to hand hygiene in medical and nursing students. Better results are observed among nursing students, especially those who have received specific training.
cine and Nursing of four universities (Universities of Granada, Valladolid, La Laguna, and Oviedo) during the academic year 2011-12. These centers were chosen for convenience sampling to ensure a broad geographical distribution.

PROCEDURE
Questionnaires were administered to the students by a researcher during a normal class. The researcher gave a formal presentation of the general aim of the study and the department responsible and then read the questionnaire instructions. The questionnaire took 12 - 18 minutes to complete. The researcher did not respond to any queries from the students, who were asked to write any suggestions at the end of the questionnaire. A convenience sample of 960 students agreed to complete the questionnaire.

INSTRUMENT
The questionnaire gathered sociodemographic data and recorded whether the student had or had not received formal education/training on HH. It incorporated the WHO Hand Hygiene Questionnaire, which has demonstrated adequate validity and reliability to measure behavioral intentions (before and after contact with the patient), knowledge, and attitudes [30]. It contains 50 items measuring 4 dimensions related to HH: behavioral intention before and after patient care, HH knowledge, and attitudes. The first dimension contains 34 items, and the second and third dimensions contain 8 items each. Responses to items are recorded on a Likert scale from 0 = “completely disagree” or “never” to 6 = “completely agree” or “always”.

Ethical considerations
Participants were informed of the purpose of the study, their freedom to volunteer, and the absence of negative consequences for non-participants. The act of filling out the questionnaire and returning it to key personnel was considered to imply consent to study participation. Data collection was conducted after the examination period, ruling out any possible influence on grades.

DATA ANALYSIS
SPSS version 16.0 was used for the statistical analyses. Means with standard deviation (SD) and frequencies were calculated, and the normality of data distribution and the homoscedasticity of variance were tested with Levene’s test. Comparisons were performed using the Student’s t-test for independent samples or Analysis of Variance (ANOVA) with post-hoc Bonferroni’s correction for multiple comparisons (assuming equal variances). P < 0.05 was considered significant.

Results
The study included 960 participants, 657 (68.4%) medical students and 303 (31.6%) nursing students. Their mean (SD) age was 21.91 (3.15) years, ranging from 18 to 46 years; 731 participants were female (76.1%); 431 students (44.9%) were from the University of Granada, 98 (10.2%) from the University of Valladolid, 328 (34.2%) from the University of La Laguna, and 103 (10.7%) from the University of Oviedo.

Table I shows some examples of the responses on HH behavior intention for some of the Five Moments for Hand Hygiene according to the WHO.

| Percentages of response to the question “how often would you wash your hands before or after...?” | Never or very rarely (response 0-1) | Sometimes (response 2-4) | Quite often or always (response 5-6) |
|---|---|---|---|
| **Before patient contact** | | | |
| Placing cables for cardiac monitoring | 21.7 | 47.6 | 30.7 |
| Mobilizing a patient | 15.8 | 47.5 | 36.7 |
| Measuring blood pressure | 33.5 | 52.7 | 13.8 |
| **Before invasive procedures** | | | |
| Administering medication using a three-way stopcock | 7.4 | 38.3 | 54.3 |
| Cannulating | 0.9 | 10.4 | 88.7 |
| **After contact with secretions** | | | |
| Assisting bronchial mucus aspiration | 0.9 | 13.2 | 85.9 |
| Intramuscular injection of medication | 3.2 | 24.8 | 72.0 |
| **After patient contact** | | | |
| Connecting parenteral nutrition | 4.8 | 29.2 | 66.0 |
| Patient hygiene | 1.0 | 10.9 | 88.1 |
| Adjusting glasses or oxygen mask | 13.2 | 45.7 | 41.1 |
| **After contact with patient surroundings** | | | |
| Adjusting the perfusion rate | 33.8 | 45.6 | 20.6 |
| Raising the bed of the patient | 39.6 | 39.2 | 21.2 |
lower percentage of students reported always or almost always carrying out HH before contact with the patient, before invasive procedures, and after contact with the environment in comparison to the percentage complying with good HH practices after contact with secretions or the patient.

Table II gives the results for HH knowledge, which can be considered acceptable, with more than 65% of participants responding correctly to the items “hand hygiene is unnecessary when gloves are worn” and “rubbing hands with alcohol-based handrub before patient contact reduces the risk of infection transmission”. The mean (standard deviation) score for knowledge was 4.59 (0.72) out of six, with only 4.69% of respondents scoring 3 or less and 80% scoring above 4 points.

Table II also summarizes the scores for attitudes toward HH, with 44% of respondents agreeing that peer pressure would improve their behavior. The results suggest that the importance of HH is not sufficiently valued, with over 50% agreeing that they would wash their hands more often if it really was so important. Only 28.1% completely or highly agreed that they would improve their HH practice if asked about their compliance by patients or their families.

The comparative results in Table III show that higher mean scores were obtained in all four dimensions by the nursing students in comparison to the medical students (p < 0.001). Mean scores were also higher (p < 0.001) in students who had received previous education/training in HH in comparison to those who had not (Tab. IV).

Tab. II. Some examples of responses to items on knowledge and attitudes in relation to hand hygiene (Percentage response to the question “Express your level of agreement with each of the following statements ...”) (n = 960).

| Declarative knowledge                                                                  | Completely or highly disagree (response 0-1) | Somewhat agree (response 2-4) | Completely or highly agree (response 5-6) |
|----------------------------------------------------------------------------------------|---------------------------------------------|-------------------------------|------------------------------------------|
| Hand hygiene is unnecessary when gloves are worn                                       | 71.7                                        | 20.3                          | 6.6                                      |
| Hand hygiene is unnecessary after touching the vital signs monitor                      | 23.4                                        | 62.4                          | 14.2                                     |
| Rubbing hands with alcohol-based handrub before patient contact reduces the risk of infection transmission | 4.0                                         | 30.0                          | 66.0                                     |
| Attitudes                                                                             |                                             |                               |                                          |
| I would wash my hands more often if the nurses and / or healthcare professionals did so when we start an activity | 28.2                                        | 30.7                          | 41.1                                     |
| I would wash my hands more often if my colleagues called me out for not doing so       | 24.7                                        | 31.3                          | 44.0                                     |
| I would wash my hands more often if it really was so important                         | 23.8                                        | 25.6                          | 52.6                                     |
| Patients and / or their companions should ask me if I’ve washed my hands before performing any activity | 33.4                                        | 38.5                          | 28.1                                     |

Tab. III. Comparison between medical and nursing students in dimensions of hand hygiene behavioral intention before/after patient contact, knowledge, and attitudes.

|                                                     | Medicine (N = 657) | Nursing (N = 303) | T      | p value |
|------------------------------------------------------|--------------------|-------------------|--------|---------|
| Mean of the dimension formed by items on **behavior intention before patient contact** | 3.79 0.85          | 4.07 0.97         | -4.53  | < 0.001 |
| Mean of the dimension formed by items on **behavior intention after patient contact** | 4.00 0.90          | 4.38 0.94         | -5.96  | < 0.001 |
| Mean of the dimension formed by items on **knowledge of hand hygiene**            | 4.49 0.71          | 4.78 0.69         | -5.91  | < 0.001 |
| Mean of the dimension formed by items on **attitude towards hand hygiene**           | 2.66 0.46          | 3.24 0.98         | -8.65  | < 0.001 |
support the need for improvements in HH training in university 3 for attitudes.

Table V shows the results of comparing the data among the universities. For HH behavioral intention before patient contact, scores were significantly higher for students in universities 1 and 3 versus universities 2 and 4. For HH behavioral intention after patient contact, scores were significantly higher for students in university 4 versus university 1. For knowledge and attitudes, scores were significantly lower for students from university 1 versus university 4 for knowledge and versus university 3 for attitudes.

**Discussion**

In this study, medical and nursing students revealed poor compliance with correct HH behavioral intention for each of the five moments specified in WHO guidelines, especially in regard to HH behavior before contact with patients, before invasive procedures, and after contact with the patient’s surroundings, when less than half of the students reported washing their hands always or almost always. Their responses to the questionnaire reveal a greater concern for HH after than before contact with patients, in line with direct observations of the behavior of healthcare professionals [25, 31-34]. This finding suggests that the principles learned by students are largely directed at self-protection rather than patient protection, as also reported in the units used for clinical placements. Other studies highlighted the need for common guidelines across centers/departments, especially in relation to HH indications, procedures, and skills in healthcare professionals [35, 46, 47]. The study population is a convenience sample and cannot be considered representative, although the universities selected are widely distributed in the North, Center and South of Spain and in the Canary Islands.

The results obtained for attitudes were less conclusive, and no specific trends were observed. However, the responses indicate that a significant percentage of subjects react favorably to behavioral interventions based on external reinforcement and suggest that reference figures may be important for the implementation of correct HH behavior. This is an extremely important factor, because interventions conducted in collaboration with the students can shape positive behaviors and avoid erroneous habits that are later very difficult to change. Major differences in behavior, knowledge, and attitudes were observed between the medical and nursing students. The nursing students obtained higher scores for the two dimensions of behavior, displayed greater knowledge of HH and, perhaps most importantly, a better attitude. This is consistent with findings by observational studies that compliance rates are worse for medical than nursing staff [23, 42, 43, 45], and it underscores the need for an emphasis on the importance of HH and related indications and techniques in the curriculum of medical students. A higher mean score was obtained for all dimensions from students reporting a previous specific training on HH in medical or nursing programs, although this result should be treated with caution due to possible recall bias.

Significant differences in all dimensions were observed among students from the different universities, with a lesser divergence in knowledge. The training of students on HH is heterogeneous among universities and highly influenced by the units used for clinical placements. Other studies highlighted the need for common guidelines across centers/ departments, especially in relation to HH indications, procedures, and skills in healthcare professionals [35, 46, 47]. The study population is a convenience sample and cannot be considered representative, although the universities selected are widely distributed in the North, Center and South of Spain and in the Canary Islands.

In conclusion, there are deficiencies in behavioral intention, knowledge, and attitudes related to hand hygiene in medical and nursing students. Better results are ob-
served among nursing students, especially those who have received specific training in HH, suggesting that current weaknesses can be overcome by appropriate training strategies, which should be a priority issue.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors’ contributions

JC-M and AB-C are responsible for the design of the study. They analyzed the data and wrote the paper. MF-P and JC-C designed and validated the questionnaire. CR-L, AA-G, AL-P and AB-C dealt with the collection of information respectively in the medical and nursing faculties of the universities of La Laguna, Valladolid, Oviedo and Granada.

All authors reviewed and approved the final version of the manuscript.

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