

## ORIGINAL PAPER ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

# Knowledge, perceptions, attitudes and practices of Greek healthcare professionals towards hand hygiene

**OBJECTIVE** To investigate the current knowledge, perceptions, attitudes, and practices of healthcare workers in Greece towards hand hygiene. **METHOD** A cross-sectional study using a randomized sample was conducted in 2023. A total of 177 healthcare professionals working in healthcare settings in Greece participated. The data were collected with web-distributed questionnaires that included the World Health Organization's "Perception Survey and Hand Hygiene Knowledge Questionnaire for Health-Care Workers", the "Knowledge, attitudes, and practices of nurses towards hand washing" questionnaire, and "Adherence to hand hygiene in a hospital setting – a questionnaire survey". **RESULTS** The majority of the participants were women with an average age of 41 years, nurses with a received higher education. A significant deficit of knowledge was recorded on hand hygiene, and 53.7% had some kind of training on this issue in the last three years. The knowledge score was  $70.5 \pm 7.9$  (mean  $\pm$  standard deviation [SD], indicating a mediocre knowledge on hand hygiene. The attitude score was  $98.5 \pm 7.8$ , indicating excellent attitudes towards hand hygiene. The practice score was  $84.5 \pm 16.1$ , indicating fair good practices towards hand hygiene. The score for glove use was  $5.4 \pm 0.8$ , indicating almost excellent practices towards the use of gloves. The first effective intervention for hand hygiene improvement in the workplace was the health-care facility making alcohol-based handrub always available at each point of care (mean  $\pm$  SD =  $3.7 \pm 0.6$ ). Participants who had more knowledge of hand hygiene had better practices ( $p=0.02$ ) and use of gloves ( $p=0.03$ ). Healthcare professionals with a master's/doctorate degree had more knowledge on hand hygiene ( $p=0.003$ ), as well as women ( $p=0.016$ ) and nurses ( $p<0.001$ ) had better glove use. **CONCLUSIONS** The average level of knowledge on hand hygiene raises the need to support and educate Greek healthcare professionals.

Hand hygiene is a general term, which refers to any act resulting in the cleansing of hands, with the aim of natural or mechanical removal of impurities, organic materials and or microorganisms.<sup>1</sup> This process can be carried out by using alcoholic antiseptic product (liquid, gel or foam), antimicrobial soap, antiseptic agent (e.g. alcohol, glyconian chlorhexidine, iodine), antiseptic hand towel, detergent (surfactant) with hydrophilic and lipophilic parts, simple soap (detergent), containing a very low concentration (or even a) antimicrobial agents (as preservatives) and anhydrous antiseptic factor.<sup>2</sup>

The five steps for hand hygiene are now a common

reference point among healthcare professionals on a global scale. They have been numbered according to the flow of the workload and they are: (a) Before contact with the patient, (b) before each clean/aseptic handling, (c) after contact with the patient's body fluids, (d) after contact with the patient, and (e) after contact with the patient's immediate life environment.<sup>2,3</sup>

Healthcare-associated infections stand for a global challenge for patient safety, which raise the burden, extend hospital stays, and threaten the lives of patients. The hands of healthcare professionals are considered the main way of transmitting infections between patients or from

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Γνώσεις, αντιλήψεις, στάσεις  
και πρακτικές των Ελλήνων  
επαγγελματιών υγείας σχετικά  
με την υγιεινή των χεριών

Περίληψη στο τέλος του άρθρου

### Key words

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patient to patient and healthcare associated infections.<sup>4</sup> Hand hygiene of healthcare professionals is considered to be an important low-cost measure to reduce healthcare-associated infections.<sup>5</sup> According to the Center of Diseases Control (CDC), hand hygiene holds the most basic position between the standard precautions, which are applied to all patients, regardless of their microbial condition (suspicious or suspected or confirmed).<sup>6</sup> Hand hygiene protects the professional while at the same time helps in reducing the dispersion of infections among patients. Systematic hand hygiene is the key to reducing hospital infections, and is vital to monitor and record the compliance of healthcare professionals in hand hygiene protocols and guidelines.<sup>7</sup> Nevertheless, globally hand hygiene compliance is poor, at approximately 40–60%.<sup>8</sup>

Many factors contribute to poor compliance on hand hygiene. These include the process of hand hygiene, the knowledge and training of professionals, their acquired clinical skills, their attitudes towards hand hygiene, as well as the ignorance of impending danger, the lack of infrastructure and resources, the increased workload, lack of time, and under-staffing. Also, access to policies and regulatory frameworks for control and prevention of infections is an inhibitory factor for compliance.<sup>9–11</sup>

The World Health Organization (WHO) has implemented a number of initiatives, interventions and strategies to increase awareness of the importance of hand hygiene and to improve compliance.<sup>12</sup> Still, problems and non-compliance exist worldwide. In Greece, findings from medical and nursing students, the future working force, indicate that the majority of them had received education on hand hygiene, but this was mostly theoretical and less practical.<sup>13</sup> At the same time, the hands hygiene in Greece has become a mandatory indicator at the surveillance of compliance for healthcare professionals in the implementation of control measures for the dispersion of hospital pathogens. This index is to be stated at the Hellenic Center for Disease Control and Prevention and is used as a means of assessing the effectiveness and efficiency of healthcare units.<sup>14</sup> Researchers have evaluated the knowledge, perceptions, attitudes, practices of healthcare professionals and students, in various countries and healthcare facilities. However, limited evidence from healthcare professionals is available from Greece.

Thus, the aim of this study was the investigation of the knowledge, perceptions, attitudes and practices of healthcare professionals on the proper implementation of hand hygiene in healthcare settings.

## MATERIAL AND METHOD

### Design

A non-experimental quantitative cross-sectional study was conducted, through January to April 2023 and the use of web-based questionnaires.

### Ethical considerations

The questionnaires of the study were sent to scientific health associations of Greece, from whom approval was sought for the distribution of the questionnaire via email to their members, as well as for posting it on their official website. Formal approval was obtained only from one association, while others shared the questionnaires without issuing a formal approval. So, the study was approved by the responsible committee of the Association of Graduate Surgical Nurses ([www.sydnox.gr](http://www.sydnox.gr); ref-no 1772/24.5.2023). The link for the questionnaire was sent directly from the association as its members have accepted to receive electronic correspondence for scientific and research activities. For the implementation of the research, all the required permissions for use and distribution of the questionnaires were requested and obtained. The participants in this study were informed about the purpose of the research, the confidentiality and anonymity of their responses and the voluntary nature of completing the questionnaires through an introductory note.

### Study sample

Participants included healthcare professionals working in healthcare settings in Greece. Participation was voluntary regardless of their professional specialty (medical, nursing, paramedical, administrative staff), level of education (secondary or higher education) and employment relationship (permanent or non-employees, trainees). The questionnaires were distributed electronically and 300 questionnaires were sent via email, of which 203 were completed (response rate: 68%). In the final statistical analysis of the current study, administrative staff, other healthcare staff and students/trainees were not included, due to the small sample size of the aforementioned, so the final studied population consisted of 177 healthcare workers including physicians, nurses and nursing assistants, working in healthcare settings.

### Data collection

The web-based questionnaires began with demographic items, followed by several validated tools: The WHO's "Perception Survey for Health-Care Workers" and "Hand Hygiene Knowledge Questionnaire",<sup>15,16</sup> the "Knowledge, Attitudes, and Practices of Nurses towards Hand Washing",<sup>17</sup> and the "Adherence to Hand Hygiene in a Hospital Setting" survey.<sup>18</sup> Completion took about 30 minutes. These instruments, previously validated for construct

validity and internal consistency, aimed to comprehensively assess hand hygiene knowledge, attitudes, perceptions, practices, and glove use among healthcare workers.

The WHO Perception Survey included 17 items; 10 on perceptions (awareness and prioritization of hand hygiene rated on a five-point Likert scale, averaged with scores below 3=low, 3–4=medium, above 4=high) and 7 on factual knowledge, converted to a 0–100 scale, with higher scores indicating greater knowledge; perception reliability was high (Cronbach's  $\alpha=0.81$ ).<sup>15,16</sup> The "Knowledge, Attitudes, and Practices of Nurses" survey used seven knowledge items scored 1–3 on a Likert scale (total: 1–21), where higher scores reflected more knowledge, and three selected attitude items scored similarly, converted to a 0–100 percentage scale with higher values indicating positive attitudes; only part of the original attitude scale was used, limiting psychometric strength.<sup>17</sup> Hand hygiene practices were assessed via 18 items scored "No"=1 and "Yes"=2, summed and converted to percentages (0–100) reflecting frequency of hand washing. The "Adherence to Hand Hygiene" survey included four items on hand hygiene and glove use with a seven-point scale (0–6), where higher scores indicated better glove use; completion took 3–5 minutes.<sup>18</sup> Although some overlap exists among instruments, this multi-tool approach enhanced internal consistency, cross-validation, and detailed assessment of subtle differences in knowledge, attitudes, perceptions, and behaviors related to hand hygiene.

### Statistical analysis

Absolute and relative frequencies described categorical variables, while quantitative variables were summarized using mean, standard deviation (SD), median, minimum, and maximum. The Kolmogorov-Smirnov test assessed normality; some variables (e.g., knowledge and glove use scores) approximated normality, but attitudes showed non-normal distributions likely due to ceiling effects, influencing statistical test selection and noted as a limitation. The knowledge score (0–14) combined 14 items from WHO and nursing hand-washing questionnaires, scored as 1 for correct and 0 for incorrect answers, then converted to a 0–100 scale for standardization, with higher scores indicating greater knowledge. The hand hygiene practice scale consisted of 18 yes/no items, summed and converted to a percentage reflecting adherence, where higher values indicated better practice. Bivariate analyses used t-tests for quantitative-dichotomous variable comparisons, ANOVA for quantitative-categorical variables with multiple groups, and Pearson's correlation for continuous, normally distributed variables. Significant predictors from bivariate tests were entered into multiple linear regression models reporting unstandardized coefficients, 95% confidence intervals (CIs), and p-values, though variance inflation factor (VIF), tolerance, and standardized betas were not computed due to data limitations. All tests were two-sided with  $\alpha=0.05$ , and analyses were conducted using the Statistical Package for Social Sciences (IBM SPSS Statistics), version 27.0.

## RESULTS

### Demographic characteristics

The study population included 177 healthcare employees and their demographic characteristics are presented in table 1. The mean age of the participants was 41 years. The majorities of the participants were women (76.7%) and nurses (79.0%). The mean number of years of experience was 17.5 years. Almost all participants worked in hospital settings (96.0%).

### Knowledge about hand hygiene

The Cronbach's alpha coefficient of the knowledge of hand hygiene set was 0.76, indicating excellent reliability. The knowledge score was  $70.5 \pm 7.9$  (mean  $\pm$  SD) and the median was 71.4 (minimum=46.4, maximum=89.3), indicating a mediocre knowledge on hand hygiene. The correct answers of the participants on hand hygiene knowledge are presented in table 2.

**Table 1.** Demographic characteristics.

| Characteristics            | Mean     | SD       |
|----------------------------|----------|----------|
| Age (years)                | 41       | 8.3      |
| Years of experience        | 17.5     | 9.2      |
|                            | <b>n</b> | <b>%</b> |
| Gender                     |          |          |
| Women                      | 134      | 75.7     |
| Men                        | 43       | 24.3     |
| Educational level          |          |          |
| Other secondary education  | 21       | 11.9     |
| University                 | 153      | 88.1     |
| Master or doctoral degrees |          |          |
| No                         | 81       | 45.8     |
| Yes                        | 96       | 54.2     |
| Profession                 |          |          |
| Nurse                      | 140      | 79.1     |
| Physician                  | 11       | 6.2      |
| Nursing assistant          | 26       | 14.7     |
| Healthcare setting         |          |          |
| Hospital                   | 170      | 96       |
| Community centre           | 1        | 0.6      |
| Other                      | 3        | 1.7      |

**Table 2.** Participants' correct answers to questions about knowledge on hand hygiene.

| Question summary                                                   | Correct (n) | %     |
|--------------------------------------------------------------------|-------------|-------|
| Main route of cross-transmission in healthcare                     | 158         | 89.3  |
| Most frequent source of germs for HAIs                             | 26          | 14.7  |
| <i>Hand hygiene prevents transmission to HCW when performed:</i>   |             |       |
| After touching a patient                                           | 176         | 99.4  |
| After body fluid exposure                                          | 177         | 100.0 |
| Before aseptic procedure                                           | 159         | 89.8  |
| After contact with surroundings                                    | 160         | 90.4  |
| <i>Handrub versus handwashing – which statements are true?</i>     |             |       |
| Handrubbing is more rapid                                          | 118         | 66.7  |
| Handrubbing causes more dryness                                    | 68          | 38.4  |
| Handrubbing is more effective                                      | 133         | 75.1  |
| Both should be used in sequence                                    | 60          | 33.9  |
| Minimal time needed for alcohol handrub to kill germs              | 103         | 58.2  |
| <i>Appropriate hygiene method for tasks:</i>                       |             |       |
| Before palpation                                                   | 99          | 55.9  |
| Before injection                                                   | 108         | 61.0  |
| After emptying bedpan                                              | 139         | 78.5  |
| After removing gloves                                              | 105         | 59.3  |
| After making bed/blood exposure                                    | 114         | 64.4  |
| <i>Factors increasing colonization risk:</i>                       |             |       |
| Wearing jewellery                                                  | 172         | 97.2  |
| Damaged skin                                                       | 150         | 84.7  |
| Artificial nails                                                   | 161         | 91.0  |
| Regular hand cream use                                             | 121         | 68.4  |
| Alcohol-based handrub (1.5–3 mL) is effective, if hands not soiled | 112         | 63.3  |
| <i>Hand hygiene prevents transmission of:</i>                      |             |       |
| Antibiotic-resistant pathogens                                     | 165         | 93.2  |
| Herpes simplex virus                                               | 152         | 85.9  |
| MRSA                                                               | 163         | 92.1  |
| RSV                                                                | 122         | 68.9  |
| Hepatitis B virus                                                  | 98          | 55.4  |
| <i>C. difficile</i> , MRSA, VRE survive long in environment        | 172         | 97.2  |

The original set of items was condensed by grouping related questions, shortening repetitive text, and organizing items under thematic categories to improve readability and reduce overall length while retaining all essential data

HAIs: Healthcare associated infections, HCW: Health care workers, MRSA: Methicillin-resistant *Staphylococcus aureus*, RSV: Respiratory syncytial virus, VRE: Vancomycin-resistant *Enterococcus*

## Perceptions of hand hygiene

The Cronbach's alpha coefficient of the WHO Perception Survey on Hand Hygiene<sup>15</sup> was 0.81, indicating excellent reliability. The participants' perceptions of hand hygiene are presented in table 3. Totally, 53.7% of the participants had received some training/education on hand hygiene

**Table 3.** Perceptions of hand hygiene (HH).

| Perceptions of HH                              | n         | %       |
|------------------------------------------------|-----------|---------|
| <i>Received formal training (last 3 years)</i> |           |         |
| Yes                                            | 95        | 53.7    |
| No                                             | 82        | 46.3    |
| <i>Use alcohol-based handrub routinely</i>     |           |         |
| Yes                                            | 146       | 82.5    |
| No                                             | 31        | 17.5    |
| <i>Impact of HAI on clinical outcome</i>       |           |         |
| Very low/low                                   | 5         | 2.8     |
| Medium                                         | 43        | 24.3    |
| High/very high                                 | 129       | 72.9    |
| <i>Importance of HH (institution)</i>          |           |         |
| Low/medium                                     | 41        | 23.2    |
| High/very high                                 | 136       | 76.8    |
| <i>Dept. head values HH compliance</i>         |           |         |
| Not at all/somewhat                            | 11        | 6.2     |
| Probably                                       | 23        | 13.0    |
| A lot/very much                                | 143       | 80.8    |
| <i>Colleagues value HH compliance</i>          |           |         |
| Not at all/somewhat                            | 15        | 8.5     |
| Probably                                       | 34        | 19.2    |
| A lot/very much                                | 128       | 75.6    |
| <i>Patients value HH compliance</i>            |           |         |
| Not at all/somewhat                            | 21        | 11.9    |
| Probably                                       | 32        | 18.1    |
| A lot/very much                                | 124       | 70.0    |
| <i>Effort required to perform HH</i>           |           |         |
| Not at all/somewhat                            | 11        | 6.3     |
| Probably                                       | 17        | 9.6     |
| A lot/very much                                | 149       | 84.2    |
| <i>Self-reported HH compliance</i>             | Mean=78.3 | SD=21.1 |
| <i>Perceived peer HH compliance</i>            | Mean=72.0 | SD=21.4 |

The original set of items was condensed by grouping similar Likert-scale responses, combining "Yes/No" items into single lines, and presenting mean compliance rates with standard deviations, resulting in a more compact and format

SD: Standard deviation, HAI: Healthcare associated infection

in the last three years and 82.5% used an alcohol-based hand rub for hand hygiene on a systematic basis. A total of 72.9% believed that hand hygiene for patient safety in the workplace is a high or very high priority. The majority of the participants (78.3%) stated that the rate of application of hand hygiene when performing procedures is a necessary condition. Lastly, 84.2% stated that the hand hygiene process requires a lot/too much effort during patient care.

### Hand hygiene attitudes

These items include the three items from the attitudes scale of the knowledge, attitudes, and practices of nurses towards hand washing.<sup>17</sup> So, the Cronbach's alpha coefficient of the attitude questionnaire was 0.71, indicating acceptable reliability of the questionnaire.

The attitudes of the participants towards hand hygiene are presented in table 4. Almost all workers (98.3%) stated that hand washing is protective for all healthcare professionals. The hand hygiene attitude score takes values from 0 to 100 and higher values indicate better attitudes. The attitude score was mean $\pm$ SD=98.5 $\pm$ 7.8 and the median was 100 (minimum=33.3, maximum=100), indicating excellent attitudes towards hand hygiene.

### Hand hygiene practices

These items include the eighteen items from the practices scale of the knowledge, attitudes, and practices of nurses towards hand washing.<sup>17</sup> The Cronbach's alpha coefficient of the practices questionnaire was 0.74, indicating acceptable reliability of the questionnaire. The hand hygiene practices of the employees are presented in table 5.

**Table 4.** Attitudes towards hand hygiene (HH).

|                                                                                                   | n   | %    |
|---------------------------------------------------------------------------------------------------|-----|------|
| <i>Hand washing is protective to healthcare workers</i>                                           |     |      |
| No                                                                                                | 3   | 1.7  |
| Yes                                                                                               | 174 | 98.3 |
| <i>It is important to assist or encourage patients to do hand washing after use of bathroom</i>   |     |      |
| No                                                                                                | 1   | 0.6  |
| Yes                                                                                               | 176 | 99.4 |
| <i>It is important to assist or encourage patients to do hand washing before and after eating</i> |     |      |
| No                                                                                                | 4   | 2.3  |
| Yes                                                                                               | 173 | 97.7 |

The hand hygiene practices score ranged from 0 to 100, with higher values indicating better practices. The mean score was  $\pm$ SD=84.5 $\pm$ 16.1 and the median was 89 (minimum=22.2, maximum=100), suggesting fair good adherence to hand hygiene protocols. Also, the top five practices were hand washing after performing an invasive procedure, after handling waste, after body fluids contact, before performing an invasive procedure and after touching contaminated inanimate objects.

### Use of gloves

The "Adherence to hand hygiene in a hospital setting – a questionnaire survey"<sup>18</sup> had Cronbach's alpha coefficient 0.76, indicating acceptable reliability. The glove use score takes values from 1 to 6 and higher values indicate better use of gloves. The mean score for glove use was  $\pm$ SD=5.4 $\pm$ 0.8 and the median was 5.5 (minimum=1, maximum=6), indicating almost excellent practices towards the use of gloves. The first item that scored high was the "I wear gloves when exposure of my hands to body fluids is anticipated" (mean $\pm$ SD=5.7 $\pm$ 0.8) and the item with the lowest score was "I avoid having «foreign» objects on my hands such as

**Table 5.** Hand hygiene (HH) practices.

|                                                                   | n   | %     |
|-------------------------------------------------------------------|-----|-------|
| Do you wash hands before an invasive procedure?                   | 172 | 97.2  |
| Do you wash hands after an invasive procedure?                    | 177 | 100.0 |
| Do you wash hands before a non-invasive procedure?                | 129 | 72.9  |
| Do you wash hands after a non-invasive procedure?                 | 163 | 92.1  |
| Do you wash hands before personal contact?                        | 132 | 74.6  |
| Do you wash hands after personal contact?                         | 161 | 91.0  |
| Do you wash hands before body fluids contact?                     | 124 | 70.1  |
| Do you wash hands after body fluids contact?                      | 175 | 98.9  |
| Do you wash hands before touching contaminated inanimate objects? | 99  | 55.9  |
| Do you wash hands after touching contaminated inanimate objects?  | 172 | 97.2  |
| Do you wash your hands before handling waste?                     | 82  | 46.3  |
| Do you wash your hands after handling waste?                      | 177 | 100.0 |
| Do you wash your hands before using gloves?                       | 114 | 64.4  |
| Do you wash hands after using gloves?                             | 169 | 95.5  |
| Do you wash your hands before administering medications?          | 153 | 86.4  |
| Do you wash hands after administering medications?                | 164 | 92.7  |
| Do you wash your hands before food handling?                      | 165 | 93.2  |
| Do you wash hands after food handling?                            | 165 | 93.2  |



wearing rings, watches, bracelets, etc.” (mean $\pm$ SD=4.8 $\pm$ 1.3).

### Effectiveness of interventions to improve hand hygiene

A separate item from the WHO Perception Survey on Hand Hygiene<sup>15</sup> was further analysed to investigate the effectiveness of interventions to improve hand hygiene. This item was “In your opinion, how effective would the following actions be to improve hand hygiene permanently in your institution?”. The intervention effectiveness score ranged from 0 to 4, with higher scores indicating greater effectiveness of the interventions in improving hand hygiene. The intervention effectiveness score was mean $\pm$ SD=3.1 $\pm$ 0.6 and the median was 3.1 (minimum=1.5, maximum=4), indicating that the participants believed that these interventions are effective in improving hand hygiene. The top intervention was “The health-care facility makes alcohol-based hand rub always available at each point of care” (mean $\pm$ SD=3.7 $\pm$ 0.6), followed by “Each health-care worker receives education on hand hygiene” (mean $\pm$ SD=3.4 $\pm$ 0.9), and “Clear and simple instructions for hand hygiene are made visible for every health-care worker” (mean $\pm$ SD=3.4 $\pm$ 0.8).

### Correlations between the scales

The Pearson correlation analysis identified several statistically significant associations among hand hygiene-related variables (tab. 6). Greater hand hygiene knowledge correlated with better hand hygiene practices ( $p=0.02$ ) and glove use ( $p=0.03$ ), while more positive attitudes were linked to perceiving hand hygiene interventions as effective ( $p=0.01$ ). Stronger glove use was associated with a higher belief in intervention effectiveness ( $p=0.001$ ) and better hand hygiene practices ( $p=0.003$ ). However, despite statistical significance, correlations between knowledge and both practices and glove use were very weak ( $r<0.2$ ),

indicating minimal effect sizes. These findings suggested that although higher knowledge relates to improved self-reported behaviors, the associations are weak and should be interpreted cautiously.

### Correlations between demographics

Bivariate analysis using t-tests and ANOVA showed significant associations between hand hygiene knowledge and both profession ( $p=0.003$ ) and possession of a master's/doctorate degree ( $p=0.004$ ). Consequently, multivariate linear regression revealed that healthcare professionals with advanced degrees scored significantly higher in hand hygiene knowledge ( $b=3.6$ , 95% CI [1.3, 5.9],  $p=0.003$ ), explaining 5% of the variance. No significant relationships were found between intervention effectiveness, hand hygiene attitudes, and participant demographics in either univariate or multivariate analyses. However, a t-test indicated a significant association between gender and hand hygiene practices ( $p=0.04$ ), confirmed by regression analysis showing women practiced better hand hygiene than men ( $b=5.7$ , 95% CI [0.2, 11.2],  $p=0.044$ ), accounting for 5% of variance. Glove use was significantly related to educational level ( $p=0.04$ ), gender ( $p=0.002$ ), and occupation ( $p=0.001$ ) in bivariate analyses, with multivariate regression demonstrating that female gender ( $b=0.3$ , 95% CI [0.06, 0.6],  $p=0.016$ ), university education versus secondary education ( $b=0.9$ , 95% CI [0.4, 1.4],  $p<0.001$ ), and being nursing staff versus doctors ( $b=0.6$ , 95% CI [0.3, 0.9],  $p<0.001$ ) were the strongest predictors of better glove use.

## DISCUSSION

This study explored factors linked to hand hygiene among Greek healthcare professionals, finding generally positive attitudes and moderate knowledge. Over half had

**Table 6.** Correlations between the study's scales.

| Scale                                        | Effectiveness of interventions to improve HH | HH attitudes | HH practices | Use of gloves |
|----------------------------------------------|----------------------------------------------|--------------|--------------|---------------|
| Knowledge on HH                              | 0.15 (0.05)                                  | 0.11 (0.1)   | 0.18 (0.02)  | 0.17 (0.03)   |
| Effectiveness of interventions to improve HH |                                              | 0.19 (0.01)  | 0.04 (0.6)   | 0.26 (0.001)  |
| HH attitudes                                 |                                              |              | -0.1 (0.3)   | 0.02 (0.8)    |
| HH practices                                 |                                              |              |              | 0.22 (0.003)  |

Pearson correlation coefficient

p-values are shown in parentheses

Given the non-normal distribution of the “Hand hygiene attitudes” variable, correlations involving this variable should be interpreted cautiously. Non-parametric alternatives may provide more reliable estimates

HH: Hand hygiene

recent training, with those holding postgraduate degrees showing better knowledge, highlighting the importance of ongoing education for improving practices. Promoting patient safety is an important element of quality in the healthcare services provided, which requires prioritizing and implementing strategies to control and prevent the spread of hospital infections through hand hygiene.<sup>19</sup> Over the years, many studies have been conducted that investigated and identified the factors that contribute to poor hand hygiene, the main ones being the lack of knowledge and appropriate training, the lack of appropriate equipment and materials, the limited time available and the fear of skin irritation.<sup>20</sup>

### Knowledge and perceptions

The average perceived hand hygiene compliance among staff was 72% ( $\pm 21.4$ ), highlighting a persistent gap between awareness and practice. Key knowledge deficits included misunderstanding that antiseptic application and handwashing should be sequential (correct: 33.9%) and that antiseptic causes more skin dryness than soap (correct: 38.4%). Comparable studies have shown similar or worse results; for example, an Iranian study reported 60–80% incorrect responses on these items.<sup>21</sup>

In our study, 76.8% viewed hand hygiene as a high or very high safety priority, and 84% said it requires substantial effort, compared to 97.0% and 47.5%, respectively, in a similar Iranian study.<sup>21</sup> Usage of alcohol-based hand rub was lower in our sample (72.0%) than in Iran (95.0%). A study in Saudi Arabia found moderate knowledge (57.8%) and high perception scores (73.4%),<sup>22</sup> while South Korean infection control nurses showed good knowledge (78.0%) and perception (70.0%).<sup>23</sup> These variations point to a global need for ongoing hand hygiene education.<sup>24</sup>

Significant deviations from a comparable study<sup>17</sup> were found on two items. Only 59.3% in our study correctly identified required hand hygiene after glove removal (versus 90.3%), while 97.2% knew that methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), and *C. difficile* survive in the environment (versus 58.5%). This contrast suggests mixed levels of understanding and possible overconfidence in certain areas. In Cyprus, similar use of the WHO tools showed a 61.0% average knowledge score, with 85.6% rating hand hygiene as highly important.<sup>25</sup> Greek studies reported moderate knowledge, 26 with 54.3% having acceptable knowledge, 55.3% recent formal training, and 74.0% regularly using hand rub.<sup>27</sup> Pediatric settings showed poor knowledge and compliance,<sup>28</sup> though hospital training on handwash-

ing reached 80.0% in some samples.<sup>29</sup> Overall, the results showed moderate general knowledge with gaps in key actions like hand hygiene after glove use. These deficits likely reflect insufficient practical training, inconsistent protocols, and lack of reinforcement. Institutional culture, competing demands, and inadequate feedback might also limit correct practice. Future research should explore these barriers to develop better-targeted education.

### Attitudes

Overall, attitudes toward hand hygiene were positive. Most participants agreed that hand hygiene protects healthcare workers and should be encouraged for patients before/after meals or using the toilet. Those with higher attitude scores also supported interventions more strongly. These findings align with previous studies.<sup>17,30</sup> However, the attitude variable was highly skewed, with many scoring near the maximum. This ceiling effect suggests the tool may lack sensitivity in professional settings. Future studies should consider more nuanced instruments. Moreover, given the non-normal distribution, future analyses should use non-parametric tests like Spearman's correlation.

### Practices

Practice scores were generally fair but revealed specific weaknesses, especially in pre-procedural hygiene and glove use. Women and nurses outperformed men and physicians, echoing trends in other countries. However, compliance with key practices like handwashing before glove use or after handling waste was suboptimal. Self-reported data may overestimate actual behavior due to social desirability bias. Future research should include direct observation or electronic monitoring for accurate assessment. Only 72.9% reported washing hands before non-invasive procedures, and 55.9% after touching contaminated inanimate objects, both below guideline standards. In comparison, a related study<sup>17</sup> reported significantly higher rates: 91.3%, 82.6%, and 85.6%, respectively. Low compliance before glove use is concerning, as gloves do not replace hand hygiene. Proper timing and technique in glove application/removal are critical to infection control.<sup>31</sup> Gaps between reported practices and international standards remain wide.<sup>18</sup>

A multicenter observational study across nine countries showed hand hygiene compliance between 14–76%, with better adherence to “after” than “before” indications.<sup>32</sup> Similar findings in Greek surgical departments showed inconsistent application of proper techniques and glove overreliance.<sup>26,33</sup>

Burnout may also affect hygiene compliance. One Greek study linked nurse burnout with lower hand hygiene adherence.<sup>34</sup> Burnout was already moderate in Greek hospitals pre-pandemic,<sup>35</sup> and worsened during COVID-19.<sup>36,37</sup> A meta-analysis showed a 66.4% likelihood of burnout impacting safety actions.<sup>38</sup> During the pandemic, burnout was negatively associated with hand hygiene compliance.<sup>39</sup> Addressing burnout should be a priority to improve patient safety and hand hygiene practices.

### Use of gloves

Almost all participants (95.0%) reported glove use when exposed to biological fluids, consistent with prior research.<sup>17,18</sup> However, fewer (87.0%) washed hands after glove removal, and only 80.0% avoided wearing foreign objects like rings or watches on their hands. Women reported greater glove use than men, and nurses had higher glove use (91.7%) than doctors (71.7%). A Czech study, where hand hygiene after glove use is not legally mandated, found only 60.8% compliance with hand hygiene post-glove use, though glove use itself was good among many healthcare workers.<sup>18</sup> These differences highlight the strong influence of local and national policies on hygiene practices. While glove use protects against contamination, WHO emphasizes that gloves are not a substitute for hand hygiene, as gloves can get contaminated and must be used properly in conjunction with hand washing to reduce infection risk. Given this is the only study using this specific glove-use questionnaire set, further comparison opportunities are limited.

### Effectiveness of interventions

In a study from Cyprus, the item: *"Patients are invited to remind healthcare workers to perform hand hygiene"* was reported as the least effective and *"The health-care facility makes alcohol-based hand rub always available at each point of care"* the most effective intervention,<sup>25</sup> similar to our findings. While previous studies, including those from South Africa,<sup>17</sup> Cyprus,<sup>25</sup> Iran,<sup>21</sup> and Saudi Arabia,<sup>22</sup> have reported varying levels of compliance and perception, the common thread is the need for a consistent, multimodal strategy. Effective interventions, such as ensuring the availability of alcohol-based hand rubs and ongoing staff education, were supported by participants and are echoed in global hand hygiene frameworks.<sup>5</sup>

### Correlations between demographics and scales

The observed variations in hand hygiene attitudes by age, gender, experience, and education in previous studies,<sup>17</sup> align with broader research indicating gender influences hand hygiene behaviors. Women generally show better attitudes and compliance, while men sometimes report slightly higher knowledge but lower adherence in practice. External factors such as professional specialization and institutional context also shape compliance, with significant behavioral differences even among healthcare professionals within the same setting.<sup>20,33,40</sup> Multivariate analyses, like in the present study, often confirm that women perform hand hygiene practices more effectively than men and that advanced education correlates with greater knowledge. Nonetheless, knowledge alone does not consistently predict compliance due to these additional influencing factors, highlighting the complexity of hand hygiene behavior among healthcare workers.<sup>41</sup>

### Limitations

The limitations of this study included a small, mostly female nurse sample, limiting broader applicability. Voluntary participation and a 68.0% response rate may cause selection bias. Some questionnaires, though WHO-based, lacked formal validation for the Greek context, possibly affecting response accuracy. Overlapping instruments might have caused redundancy, and reliance on self-reported data without direct observation requires cautious interpretation. Despite this, the findings highlight the need for system-level measures like better education, infrastructure, and leadership to improve hand hygiene culture and compliance.

In conclusion, hand hygiene remains fundamental to infection prevention and patient safety, with extensive research over decades. This study found Greek healthcare professionals had moderate knowledge despite positive attitudes and fair practices, with women and those more educated showing better behaviors and glove use. Consistent availability of alcohol-based hand rub was the most effective intervention. A modest link between knowledge and practice highlights the need for ongoing targeted training. Given the study's limitations, further research is needed. Strengthening hand hygiene protocols requires a multifaceted approach including education, infrastructure, monitoring, leadership, and fostering a culture of safety integrated into daily clinical practice.



## ΠΕΡΙΛΗΨΗ

## Γνώσεις, αντιλήψεις, στάσεις και πρακτικές των Ελλήνων επαγγελματιών υγείας σχετικά με την υγιεινή των χεριών

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**ΣΚΟΠΟΣ** Να διερευνηθούν οι τρέχουσες γνώσεις, αντιλήψεις, στάσεις και πρακτικές των εργαζομένων στον τομέα της υγειονομικής περίθαλψης στην Ελλάδα σχετικά με την υγιεινή των χεριών (ΥΧ). **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Το 2023 διεξήχθη μια συγχρονική μελέτη με τυχαίοποιημένο δείγμα. Συμμετείχαν 177 επαγγελματίες υγείας που εργάζονταν σε χώρους υγειονομικής περίθαλψης στην Ελλάδα. Τα δεδομένα συλλέχθηκαν με διαδικτυακά ερωτηματολόγια σχετικά με τις γνώσεις, τις αντιλήψεις, τις στάσεις και τις πρακτικές για την ΥΧ για τους επαγγελματίες υγείας. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Η πλειοψηφία των συμμετεχόντων ήταν γυναίκες με μέσο όρο ηλικίας τα 41 έτη, με ανώτερη εκπαίδευση και νοσηλεύτριες. Καταγράφηκε σημαντικό έλλειμμα γνώσεων σχετικά με την ΥΧ, ενώ το 53,7% είχε λάβει κάποια εκπαίδευση αναφορικά με αυτό το θέμα τα τελευταία 3 έτη. Η βαθμολογία γνώσεων υπέδειξε μέτρια γνώση σχετικά με την ΥΧ, ενώ η βαθμολογία στάσεων εξαιρετική στάση απέναντι στην ΥΧ. Η βαθμολογία πρακτικών κατέδειξε αρκετά καλές πρακτικές ως προς την ΥΧ. Η βαθμολογία για τη χρήση γαντιών ήταν μέση, αναδεικνύοντας σχεδόν άριστες πρακτικές όσον αφορά στη χρήση τους. Η πρώτη αποτελεσματική παρέμβαση για τη βελτίωση της ΥΧ στον χώρο εργασίας ήταν η παροχή αντισηπτικού χεριών με βάση το οινόπνευμα σε κάθε σημείο φροντίδας από το ίδρυμα υγειονομικής περίθαλψης. Οι συμμετέχοντες που είχαν περισσότερες γνώσεις σχετικά με την ΥΧ είχαν καλύτερες πρακτικές ( $p=0,02$ ) και χρήση γαντιών ( $p=0,03$ ). Οι επαγγελματίες υγείας με μεταπτυχιακό/διδακτορικό δίπλωμα είχαν περισσότερες γνώσεις όσον αφορά στην ΥΧ ( $p=0,003$ ) και οι γυναίκες ( $p=0,016$ ) και οι νοσηλεύτριες ( $p<0,001$ ) είχαν καλύτερη χρήση γαντιών. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Το μέσο επίπεδο γνώσεων αναφορικά με την ΥΧ εγείρει την ανάγκη υποστήριξης και εκπαίδευσης των Ελλήνων επαγγελματιών υγείας.

**Λέξεις ευρετηρίου:** Αντιλήψεις, Γάντια, Γνώσεις, Επαγγελματίες υγείας, Νοσοκομειακές λοιμώξεις, Πρακτικές, Στάσεις, Υγιεινή χεριών

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