

1 *Impact of COVID-19 on the degree of compliance with hand hygiene: a repeated Cross-*  
2 *sectional study*

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17 **ABSTRACT**

18 Hand hygiene (HH) is the paramount measure used to prevent healthcare associated infections. A  
19 repeated cross-sectional study was undertaken with direct observation of the degree of  
20 compliance on HH of healthcare personnel during the SARS-CoV-2 pandemic. Between, 2018-  
21 2019, 9,083 HH opportunities were considered, and 5,821 in 2020-2022. Chi squared tests were  
22 used to identify associations. The crude and adjusted odds ratios were used along with a logistic  
23 regression model for statistical analyses. Compliance on HH increased significantly ( $p < 0.001$ )  
24 from 54.5% (95% CI: 53.5, 55.5) to 70.1% (95% CI: 68.9, 71.2) during the COVID-19  
25 pandemic. This increase was observed in four of the five key moments of HH established by the  
26 World Health Organization (WHO) ( $p < 0.05$ ), except at moment 4. The factors that were  
27 significantly and independently associated with compliance were the time period considered,  
28 type of healthcare-personnel, attendance at training sessions, knowledge of HH and WHO  
29 guidelines, and availability of hand disinfectant alcoholic solution in pocket format. Highest HH  
30 compliance occurred during the COVID-19 pandemic, reflecting a positive change in healthcare-  
31 personnel's behavior regarding HH recommendations.

32  
33 **Keywords:** Healthcare associated infections; Hand hygiene; Degree of compliance; Health  
34 personnel; SARS-CoV-2.

35

## 36 INTRODUCTION

37 Healthcare-acquired infections (HAIs) are a worldwide problem that directly affect hospitalised  
38 patients and are, in turn, a complication which can directly affects patient safety. Such infections  
39 represent a challenge for public health due to potential adverse clinical events and prolongation  
40 of hospital stays with a consequent increase in healthcare costs [1, 2]. According to data  
41 provided by the Study of the Prevalence of Nosocomial Infections in Spain (EPINE in its  
42 Spanish abbreviation), the prevalence of HAIs in Spain in 2022 was between 5 and 10%, and in  
43 turn, the prevalence of HAIs in our centre (the General University Hospital of Alicante or  
44 HGUA) in the same year was 8.2% [3]. The most important measure to prevent the transmission  
45 of microorganisms and reduce HAIs is hand hygiene (HH) [4] and its proper compliance [5–7]  
46 according to the ‘5 moments’ for the application of HH as recommended by the World Health  
47 Organization (WHO). These are (1) before touching a patient, (2) before performing an aseptic  
48 task, (3) after the risk of exposure to body fluids, (4) after patient contact, and (5) after contact  
49 with the patient’s environment [8].

50 In the context of the COVID pandemic caused by the severe acute respiratory syndrome  
51 coronavirus 2 (SARS-CoV-2) which is transmitted through close contact and respiratory droplets  
52 or aerosols [9], HH, along with the use of personal protective equipment (PPE) and proper  
53 respiratory hygiene [9–13], became an important part of the measures adopted to prevent the  
54 transmission of the virus. These measures proved to be highly important due to constant  
55 exposure of healthcare staff to infected patients and contaminated surfaces, and consequently  
56 posed a risk of both acquiring and transmitting the infection [12]. Thus, compliance with HH  
57 recommendations and its monitoring were key measures prevent HAIs and, reduce the  
58 transmission of COVID-19 infection [4, 14].

59 Numerous studies have surveyed the HH compliance in different hospital areas and generally,  
60 compliance levels seldom exceeded 50% [5, 7]. In this current study, HH compliance was  
61 monitored through direct observation (the gold standard method) [15], and results were  
62 communicated healthcare staff to better understand how compliance changed with time, and the  
63 factors that may contribute to poor HH practice [11,16–17].

64 After the start of the COVID-19 pandemic, during the first quarter of 2021, Gras-Valentí *et al.*  
65 [18] recorded close to 90% HH compliance in an emergency department. In addition, Wong *et*  
66 *al.* [19] reported from a study in two paediatric hospital units during the pandemic that full HH  
67 compliance by staff was possible. Thus, evaluation of the current situation, post COVID-19,  
68 represents an opportunity to determine the impact of the pandemic on HH compliance on HH  
69 and, make healthcare-personnel more aware of its importance in the quality of patient care and  
70 hence promote better adherence to WHO guidelines.

## 71 **METHODS**

### 72 *Population/measures*

73 This was a repeated cross-sectional study in a tertiary-level hospital. The data on the degree of  
74 HH compliance, through direct observation, from 2005 to 2022 were obtained through the  
75 Epidemiological Surveillance program established by the Center's Preventive Medicine Service.  
76 Observations were carried out of one health professional at a time; without prior notice for 1  
77 hour during working hours at a single fixed moment in time. No interventions were made, or  
78 follow-up over time of the observations. Observers explained the reason for their presence and  
79 requested verbal authorisation of the staff to carry out the observation, and completed an  
80 anonymous form designed to evaluate HH compliance [17, 19], in terms of the measures  
81 performed (positive), and those not performed (negative), as well as recording potential

82 explanatory variables (sex, age, type of healthcare-personnel, area of care, WHO activity code,  
83 knowledge of the HH leaflet, training session attendance, and availability of pocket-sized  
84 hydroalcoholic hand sanitizer PSAS-solution).. HH actions that did not correspond to a ‘WHO  
85 moment’ were not recorded. The method of choice for hand hygiene at the center was mainly  
86 hydroalcoholic solution, some occasions was substituted with soap and water with subsequent  
87 application of hydroalcoholic gel.

### 88 *Statistical analysis*

89 During the first phase of the study, compliance with recommendations on HH with confidence  
90 intervals (95% CI) was calculated as the ratio between the number of HH actions carried out and  
91 the number of WHO HH opportunities: Compliance (%) = (actions carried out/opportunities) ×  
92 100. To study the evolution over time, a trend analysis based on the degree of compliance was  
93 carried out using estimates for 18 periods (from 2005 to 2022) in the different hospital areas. A  
94 permutation test for join point regression (JoinPoint®) was used to detect significant percentage  
95 changes of the period in the prevalence of degree of compliance. The overall statistical  
96 significance level was  $p=0.05$ , allowing a maximum of 7 joining points and 8 line segments.  
97 I year 2018–19 was taken as the reference period prior to the COVID-19 pandemic and from  
98 June 2020 to end of April 2022 was considered the pandemic period. To study the impact of the  
99 pandemic, the degree of HH compliance was compared before and during the pandemic; the  
100 odds ratio (OR) and its 95% CI were calculated for each of the subgroups. Associations between  
101 HH compliance with the study period and possible explanatory variables were investigated using  
102 Chi-squared tests. The magnitude of any observed associations was expressed as OR 95% CI.  
103 Finally, a multivariate analysis was performed with the variables that showed a statistically  
104 significant association in order to estimate the adjusted OR with 95% CIs, using a logistic  
105 regression model. The level of statistical significance in all tests was  $p < 0.05$  and SPSS software

106 (version 25.0; IBM Corp., Armonk, NY) was used for the analyses. The study was approved by  
107 the Drug Research Ethics Committee at the Department of Health (PI2021/181).

## 108 **RESULTS**

109 A total of 9,083 activities in which HH had been indicated were observed in the HGUA in the  
110 pre-pandemic period (2018 to 2019), compared with 5,821 during the pandemic.

111 Table 1 shows the trend in the prevalence of degree of compliance from 2005 to 2022. The  
112 lowest compliance was in 2005 with 31.0% (95% CI: 29.6%-32.5%) in contrast with 66.5% in  
113 2020 (95% CI: 64.0%-69.0%); 73% in 2021 (95% CI: 71.5%-74.5 %) – the highest compliance  
114 in the 18 years studied, and 65.3% in 2022 (95% CI: 62.3%-68.2%), (Figure 1). Joinpoint  
115 regression analysis showed significant inflection points between the periods from 2005 to 2013,  
116 from 2013 to 2014, from 2014 to 2015, from 2016 to 2019 and from 2019 to 2021. Non-  
117 significant inflection points were detected between the period from 2015 to 2016, and from 2021  
118 to 2022.

119 HH compliance increased significantly ( $p < 0.001$ ) to 70.1% (95% CI: 68.9-71.2) during the  
120 COVID-19 pandemic compared to 54.5% (95% CI: 53.5-55.5) in the prior reference period  
121 (Table 2). As shown in Table I, compliance during the pandemic was higher in healthcare-  
122 personnel aged under 35 years at 71.4% (1,471), in 70.5% (3433) of women, 73.4% (224) of  
123 physicians, and 74.3% (1758) of staff carrying pocket-sized alcohol hand sanitizers. There was a  
124 significant increase in the degree of HH compliance at each of the WHO- moments during the  
125 pandemic period ( $p < 0.05$ ), with the exception of moment 4. Compliance with the latter was  
126 66.0% (95% CI: 63.8-68.1) in the period prior to the pandemic and no significant differences were  
127 observed between the first and second periods ( $p = 0.774$ ). Compliance with WHO moment 2  
128 was lowest in both periods (43.2% and 55.4% respectively). (Table 2). The highest degrees of

129 compliance (72.7%; 95%CI: 70.1-75.2) were observed in the critical care unit in medical areas  
130 (72.7%; 95%CI: 68.6-71.9) in the 2020–2022 period (Table 2).

131 As shown in Table 3, the factors that were significantly and independently associated with HH  
132 compliance were the time period (before or during the COVID-19 pandemic), with an ORa of  
133 2.0 (95%CI: 1.8-2.1), knowledge of the HH leaflet (ORa=1.8; 95%CI: 1.3-2.5), training session  
134 attendance (ORa=1.6; 95%CI: 1.4-1.8), and availability of PSAS (ORa=1.4; 95%CI: 1.3-1.5), as  
135 well as medical care areas (ORa=1.2; 95%CI: 1.1-1.3) and critical care units (ORa=1.4;  
136 95%CI:1.3-1.5), and attention to the WHO moments 1,3,4 and 5.

## 137 **DISCUSSION**

138 In recent years, many efforts have been made to monitor the on HH practice in different  
139 healthcare areas around the world, and several have showed a high level of non-compliance with  
140 the recommendations [5, 8, 12, 17]. Infection prevention and control measures, especially HH,  
141 have gained vital importance worldwide in the current context of the COVID-19 pandemic.

142 Indeed, several studies, including a meta-analysis by Ying *et al.* [20], have shown, among others,  
143 a significant increase in HH practice at the beginning of the pandemic (years 2020–2021) [18,  
144 19]. Nonetheless, relatively little research has continuously monitored over time to determine if  
145 compliance was maintained throughout, or varied during the pandemic. Thus, this current work  
146 provides pertinent data that show a significant improvement in HH compliance which was  
147 sustained during the COVID-19 pandemic. In fact, the highest levels of compliance recorded in  
148 recent years (70.1%) were reached during the pandemic, with figures similar to those published  
149 by Qian Zhou *et al* [21]. In contrast, other studies reported a lack of increase [22,23], or even a  
150 decline [24,25], in HH compliance over the period. These results differ from our own  
151 observations, perhaps due to differences in the methodology used to document this metric.

152 Indeed, to our knowledge, all of the previous studies monitored the HH compliance through an  
153 electronic system, which may have led to certain differences in the observed trend. Current  
154 evidence supports such systems as a complement to direct observation for monitoring HH, but  
155 the latter continues to be the gold standard method.

156 In addition, we found that the WHO moment was independently and significantly associated  
157 with the degree of compliance on HH, as evidenced by the observed improvement in practice in  
158 the 2020–2022 period for all, but ‘moment’ 4 which nonetheless, did not reflect a significant  
159 increase in compliance during the pandemic compared with the period beforehand, which stayed  
160 constant at around 65%. This finding might suggest that performing HH ‘after’ direct contact  
161 with patients is a deep-rooted behaviour among healthcare-personnel. Moreover, although there  
162 was an improvement in compliance for all WHO moments, there was a higher degree of  
163 conformance for moments 3, 4, and 5 which all occur ‘after’ contact or exposure to patients, their  
164 fluids, or environment. This view is supported by the lower compliance with moments 1 and 2,  
165 which occur ‘before’ the contact or care procedure [8]. Specifically, moment 2 had the lowest  
166 degree of compliance in both periods, even though it increased by almost 15 percentage points  
167 during the pandemic period. This finding may be of concern considering that the purpose of HH  
168 at moments 1 and 2 is to prevent the transmission of infectious agents to patients, while at  
169 moments 3, 4, and 5, its primary purpose is prevention of the risk of transmission to healthcare-  
170 personnel and contamination of the care area [26].

171 These results coincide with previously published studies [7, 16, 17, 21, 27] and could possibly  
172 reflect a behaviour guided by healthcare-personnel being concerned for their self-protection after  
173 coming into contact with patients, thus making them potential dispersers of microbes to patients.  
174 As a consequence, these data indicate that successive training interventions focused on the  
175 importance of preventing cross-infections through HH performed at WHO moments 1 and 2



176 (those that constitute a greater risk of infection to patients) should be emphasised [8]. In general,  
177 the increase in HH during the COVID-19 pandemic had a positive impact on the reduction of  
178 HAIs and infection resistance rates, as seen in other studies [28-30]. This justifies the  
179 implementation of strategies aimed at markedly improving HH compliance to levels ranging  
180 from 89.8–97.1% [5, 7, 16, 17, 31]. From this perspective, it is of interest to define accurately the  
181 key factors which influence the compliance in the healthcare setting so that strategies which  
182 coincide with the most critical moments for patient safety can be implemented.

183 Factors such as training session attendance, knowledge of the HH leaflet, and carrying pocket-  
184 sized hand sanitizer were also independently and significantly associated with HH compliance.  
185 These results corroborate the data obtained in a previous study [32] which recorded compliance  
186 rates of 66% after carrying out educational and awareness-raising interventions for professionals.  
187 Of note, in general, it is difficult to compare the results between studies due to differences in the  
188 methodology employed or the specific study period. Thus, the results reported here should be  
189 considered with caution as it is too early to know if they will be maintained over time once the  
190 COVID-19 pandemic has ended.

191 The outcomes seen in the data we report here can have an impact on infection prevention and  
192 control strategies for COVID-19 and inform practice in future microbial epidemics. Indeed,  
193 increased information in the media about the importance of HH, and the greater perception of  
194 risk by staff following after the COVID-19 pandemic was declared led to greater awareness of  
195 the value of these measures [33]. Even so, some authors, including Wong *et al.* [19] and Ragusa  
196 *et al.* [34], observed maximum compliance with HH prior to the pandemic, which may suggest a  
197 prior awareness of its importance by healthcare-personnel—a very encouraging finding when  
198 considering how to continue promoting these measures. There was a marked improvement in  
199 hand hygiene practice in our hospital which indicates that the strategies implemented were

200 effective. In future work, the main objective will be to maintain the improvement over time and  
201 focus on factors that can potentially be improved, such as enhancing the hand hygiene  
202 knowledge, awareness and motivation of health care personnel.

203 The limitations of this study were inherent in its design and objective. For example, the decrease  
204 in patients seen in surgical areas during the COVID-19 pandemic (because of the suspension of  
205 non-urgent operations) may have impacted on the number of observation opportunities in these  
206 areas. In addition, the Hawthorne effect – modification of behaviour due to awareness of  
207 observation - and the possible resulting overestimation of compliance must also be considered.  
208 Nonetheless, this effect remained constant in all the study observations. Another possible  
209 limitation was that of selection, but as recorded in a previous study on HH compliance [17], the  
210 rate of non-participation by staff did not exceed 1.2%. The use of multiple observers may have  
211 led to increasing variability in recording and and collection of data. To minimise this effect, all  
212 observers were trained using the same methodology and were all members of the Preventive  
213 Medicine Service.

## 214 **CONCLUSION**

215 The COVID-19 pandemic promoted an increase in the HH compliance reflecting a very positive  
216 change in this practice by healthcare-personnel. Monitoring and evaluation of compliance  
217 allowed us to communicate results to staff, thereby generating active feedback for the  
218 development of strategies to improve the quality of patient care and HH compliance.

219 Considering the role that healthcare-personnel play as health agents both in centres and the  
220 community, we must take advantage of this momentum and direct our efforts towards new  
221 continuous improvement objectives. These include (i) achieving the same or higher HH  
222 compliance in WHO moments 1 and 2 as already recorded for moments 3, 4, and 5; and (ii)

223 maintaining the outcomes from the study to ensure that the healthcare environment is a safe  
224 place for both staff and patients.

225 **Conflicts of Interest:** The authors declare no conflict of interest.

226 **Author Contributions:** Conceptualization, M.G.S, P.G.V. and J.S.P.; methodology, M.G.S. and  
227 I.L.G.S.; software, P.C.S; validation, J.S.P.; formal analysis, M.G.S. and I.L.G.S.; investigation,  
228 G.P.A and R.F.S.A.; resources, C.M.B.M., L.C.L. and M.S.V.; data curation, G.P,A. and  
229 R.F.S.A.; writing-original draft preparation, M.G.S.; writing-review and editing, P.G.V., J.S.P.  
230 and M.G.S.; visualization, C.M.B.M.; supervision, M.F.P.; project administration, P.G.V. All  
231 authors have read and agreed to the published version of the manuscript.

232 **Data Availability Statement:** Data that are not presented in the article are available upon  
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234 **Ethical standard:** The study was conducted in accordance with the Declaration of Helsinki and  
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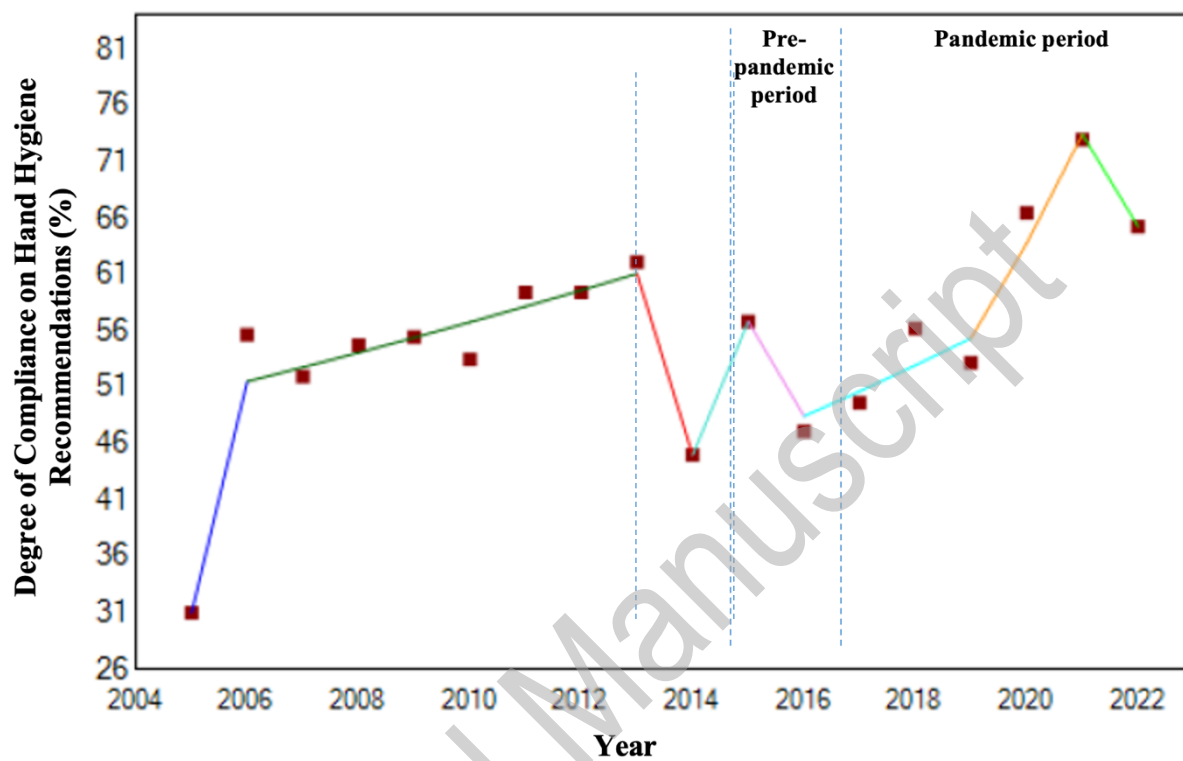
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369 **Figure 1. Evolution of the Degree of Compliance on Hand Hygiene Recommendations pre-**  
370 **pandemic period and during the COVID-19 pandemic period.**  
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375 **Table 1. Period percentage change (PPC) in the Degree of Compliance on Hand Hygiene**  
376 **Recommendations.**

377

<b>PERIOD</b>	<b>PPC</b>	<b>p value</b>
From 2005 to 2013	68,60	0.040
From 2013 to 2014	-26,35	0.049
From 2014 to 2015	26,35	0.030
From 2015 to 2016	-14,78	0.063
From 2016 to 2019	4,56	0.035
From 2019 to 2021	15,16	0.033
From 2021 to 2022	-11,12	0.135

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381 **Table 2. Hand hygiene compliance during the COVID-19 pandemic and in the pre-pandemic**  
 382 **period.**

	DCR during the pandemic (June 2020 to April 2022) % (n/N)	DCR pre-pandemic (years 2018/2019) Ref. % (n/N)	OR (95% CI)	p-value
<b>Total</b>	70.1 (4,079/5,821)	54.5 (4,949/9,083)	2.0 (1.8–2.1)	< <b>0.001</b>
<b>Age</b>				
< 35 years	71.4 (1,471/2,061)	54.4 (1,584/2,914)	2.1 (1.9–2.4)	< <b>0.001</b>
≥ 35 years	69.4 (2,608/3,760)	54.5 (3,365/6,169)	1.9 (1.7–2.1)	< <b>0.001</b>
<b>Sex</b>				
Men	68.0 (646/950)	55.1 (879/1,596)	1.7 (1.5–2.1)	< <b>0.001</b>
Women	70.5 (3,433/4,871)	54.4 (4,070/7,487)	2.0 (1.9–2.2)	< <b>0.001</b>
<b>Sector</b>				
Physicians	73.4 (224/305)	62.8 (589/938)	1.6 (1.2–2.2)	<b>0.001</b>
Nurses/ Physiotherapists	72.7 (2,459/3,382)	55.4 (3,086/5,571)	2.1 (2.0–2.4)	< <b>0.001</b>
Auxiliary nurses	66.8 (1,289/1,929)	50.2 (1,158/2,309)	2.0 (1.8–2.3)	< <b>0.001</b>
Others	52.2 (107/205)	43.8 (116/265)	1.4 (1.0–2.0)	0.070
<b>Health care area</b>				
Medical area	70.2 (2,155/3,068)	54.8 (2,610/4,759)	1.9 (1.8–2.1)	< <b>0.001</b>
Surgical	67.7 (1,041/1,538)	50.5 (1,207/2,391)	2.1 (1.8–2.3)	< <b>0.001</b>
Critical care	72.7 (883/1,215)	58.6 (1,132/1,933)	1.9 (1.6–2.2)	< <b>0.001</b>
<b>WHO HH activity</b>				
Moment 1	67.3 (833/1,238)	47.3 (1,088/2,302)	2.3 (2.0–2.7)	< <b>0.001</b>
Moment 2	55.4 (240/433)	43.2 (390/902)	1.6 (1.3–2.1)	< <b>0.001</b>
Moment 3	66.4 (413/622)	60.7 (693/1,141)	1.3 (1.0–1.6)	<b>0.019</b>
Moment 4	65.4 (663/1,013)	66.0 (1,247/1,890)	1.0 (0.8–1.1)	0.774
Moment 5	76.7 (1,923/2,506)	53.7 (1,526/2,842)	2.8 (2.5–3.2)	< <b>0.001</b>
<b>Knows the HH leaflet</b>				
Yes	70.5 (4,032/5,717)	54.8 (4,924/8,986)	2.0 (1.8–2.1)	< <b>0.001</b>
No	45.2 (47/104)	25.8 (25/97)	2.4 (1.3–4.3)	<b>0.004</b>
<b>Training sessions</b>				
Yes	71.5 (3,737/5,227)	56.3 (4,539/8,063)	1.9 (1.8–2.1)	< <b>0.001</b>
No	57.6 (342/594)	40.2 (410/1,020)	2.0 (1.6–2.5)	< <b>0.001</b>
<b>PSAS</b>				
Yes	74.3 (1,758/2,365)	59.1 (1,913/3,239)	2.0 (1.8–2.3)	< <b>0.001</b>
No	67.2 (2,321/3,456)	52.0 (3,036/5,844)	1.9 (1.7–2.1)	< <b>0.001</b>

383 Ref.: reference category for calculating the magnitude of the association; DCR: degree of compliance with the  
 384 recommendations; PSAS: pocket-sized hydroalcoholic solution; HH: hand hygiene; OR: odds ratio; 95% CI:  
 385 95% confidence interval; *p*: level of statistical significance; *N*: number of opportunities to perform hand  
 386 hygiene; *n*: number of times hand hygiene was performed; Moment 1: before contact with the patient; Moment  
 387 2: before carrying out an aseptic technique; Moment 3: after contact with biological fluids; Moment 4: after  
 388 contact with the patient; Moment 5: after contact with the patient's environment. **Note: Boldface indicates**  
 389 **statistical significance (p<0.05)**  
 390

391 **Table 3. Factors associated with HH compliance according to the characteristics of the health**  
 392 **professionals and activity.**

	DCR with HH % (n)	OR (95% CI)	p-value	ORa (95% CI)	p-value
<b>Period</b>					
Pandemic (Years 2020–22)	70.1 (4,079/5,821)	2.0 (1.8–2.1)	< 0.001	2.0 (1.8–2.1)	< <b>0.001</b>
Pre-pandemic (Years 2018–19)	54.5 (4,949/9,083)	1		1	
<b>Age</b>					
< 35 years	61.4 (3,055/4,975)	1.1 (1.0–1.1)	0.141	1.0 (0.9–1.1)	0.796
≥ 35 years	60.2 (5,973/9,929)	1		1	
<b>Sex</b>					
Men	59.9 (1,525/2,546)	1.0 (0.9–1.1)	0.443	1.0 (0.9–1.1)	0.872
Women	60.7 (7,503/12,358)	1		1	
<b>Sector</b>					
Physicians	65.4 (813/1,243)	2.1 (1.7–2.6)	< 0.001	1.9 (1.5–2.4)	< <b>0.001</b>
Nurses/ Physiotherapists	61.9 (5,545/8,953)	1.8 (1.5–2.2)	< 0.001	1.4 (1.2–1.8)	<b>0.001</b>
Auxiliary nurses	57.7 (2,447/4,238)	1.5 (1.3–1.8)	< 0.001	1.0 (0.8–1.3)	0.699
Others	47.4 (223/470)	1		1	
<b>Health care area</b>					
Medical area	60.9 (4,765/7,827)	1.2 (1.1–1.3)	< 0.001	1.2 (1.1–1.3)	< <b>0.001</b>
Surgical	57.2 (2,248/3,929)	1		1	
Critical care	64.0 (2,015/3,148)	1.3 (1.2–1.5)	< 0.001	1.4 (1.3–1.5)	< <b>0.001</b>
<b>WHO HH activity</b>					
Moment 1	54.3 (1,921/3,540)	1.3 (1.2–1.5)	< 0.001	1.4 (1.2–1.6)	< <b>0.001</b>
Moment 2	47.2 (630/1,335)	1		1	
Moment 3	62.7 (1,106/1,763)	1.9 (1.6–2.2)	< 0.001	1.9 (1.6–2.2)	< <b>0.001</b>
Moment 4	65.8 (1,910/2,903)	2.2 (1.9–2.5)	< 0.001	2.3 (2.0–2.6)	< <b>0.001</b>
Moment 5	64.5 (3,449/5,348)	2.0 (1.8–2.3)	< 0.001	2.1 (1.8–2.4)	< <b>0.001</b>
<b>Knows the HH leaflet</b>					
Yes	60.9 (8,956/14,703)	2.8 (2.1–3.7)	< 0.001	1.8 (1.3–2.5)	< <b>0.001</b>
No	35.8 (72/201)	1		1	
<b>Care training sessions</b>					
Yes	62.3 (8,276/13,290)	1.9 (1.7–2.1)	< 0.001	1.6 (1.4–1.8)	< <b>0.001</b>
No	46.6 (752/1,614)	1		1	
<b>PSAS</b>					
Yes	65.5 (3,671/5,604)	1.4 (1.3–1.5)	< 0.001	1.4 (1.3–1.5)	< <b>0.001</b>
No	57.6 (5,357/9,300)	1		1	

393 DCR: degree of compliance with the recommendations; PSAS: pocket-sized hydroalcoholic solution; HH:  
 394 hand hygiene; OR: odds ratio; 95% CI: 95% confidence interval; p: level of statistical significance; ORa:  
 395 adjusted odds ratio; pa: adjusted level of statistical significance; Moment 1: before contact with the patient;  
 396 Moment 2: before carrying out an aseptic technique; Moment 3: after contact with biological fluids; Moment  
 397 4: after contact with the patient; Moment 5: after contact with the patient's environment. **Note: Boldface**  
 398 **indicates statistical significance (p<0.05)**