

# HAND HYGIENE MANAGEMENT AMONG NURSES AND DOCTORS

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## Summary

**Introduction:** The purpose of the study was to assess the knowledge and conduct of nurses and doctors with regard to hand hygiene (HH) in accordance with the guidelines of the World Health Organization (WHO) and the declared level of compliance in the period immediately preceding the COVID-19 pandemic. Frequent and correct HH is one of the most important measures applied to prevent infections. The assurance of good, consistently applied HH practices enables the prevention of transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from one individual to another. Managers should work to enable frequent and regular HH by providing the relevant infrastructure and changes in the manner of conduct.

**Material and methods:** The survey involved 50 nurses and 50 doctors at a specialised hospital in the Pomeranian Voivodeship in Poland. It was conducted by use of a diagnostic survey and a direct observation method. The survey consisted of an original questionnaire along with a basic HH observation form prepared by the WHO.

**Results:** The nurses and doctors were found to have a high level of knowledge of HH. 412 HH possibilities were observed in total. The total HH compliance was 53.08% for nurses and 46.92% for doctors.

**Conclusions:** The high level of knowledge among nurses and doctors does not have a significant impact on the number of correctly performed HH procedures. The level of knowledge of HH is determined by age, education and seniority. It is necessary to improve compliance with HH rules as the spread of COVID-19 in hospital conditions is a problem.

**Key words:** hand hygiene, prophylaxis, coronavirus infection, COVID-19.

## Introduction

Hand hygiene (HH) is a major element for the prophylaxis of infections. Hands constitute a potential source of infection, and HH prevents transmission [1-4]. Given the numerous surveys that confirm the problem, and out of concern for the safety of patients, the World Health Organization (WHO) in agreement with world experts developed a number of strategies that helped to promote and comply with HH rules [5, 6]. The WHO guidelines, including tools that enable the observance of the HH strategy, were published in the form of a working version in 2006 [5] and became a multi-directional strategy improving HH in the whole world in 2009 [6]. The actions that were implemented became efficient contributors to the improvement of the observance of HH rules and to a reduction in the number of infections throughout the world [2]. Healthcare professionals should follow the HH rules in accordance with the 'Five Moments' model developed by the WHO in the *WHO Guidelines on Hand Hygiene in Health Care*: before touching a patient; before a clean/aseptic procedure;

after body fluid exposure risk; after touching a patient; and after touching patient surroundings. As microorganisms are transmitted mainly on the hands of healthcare professionals, HH is considered to be a key procedure in the prevention of infections [5].

SARS-CoV-2 is a virus causing severe acute respiratory syndrome: the disease known as coronavirus disease 2019 (COVID-19) [7]. One of the major ways that SARS-CoV-2 spread in 2019 was via transmission in hospitals [8]. For nurses and doctors who spend most of their time in direct contact with patients, HH is of significant importance to prevent COVID-19 [9, 10].

Therefore, it is necessary to conduct surveys in order to identify factors determining HH in that group of staff. The first incident of COVID-19 was recorded in December 2019 in China. In January 2020, the disease had spread all over China from the epicentre in Wuhan [11]. It transpired that the SARS-CoV-2 virus was highly contagious and, transmitted from one individual to another in droplets of moisture, was quickly "exported" to the farthest corners of the world. Already two

months after the outbreak of the epidemic, COVID-19 had gained the status of a pandemic, announced by the WHO on 11 March 2020. The COVID-19 pandemic has proved that efficient HH is an important element of hygienic procedures and has an impact on preventing the spread of a virus/disease. Nurses, doctors and healthcare professionals should play an important role in the prevention of such infections [7].

The purpose of the work was to assess the knowledge and conduct of nurses and doctors with regard to HH in accordance with the guidelines of the WHO and the declared level of compliance in the period immediately preceding the COVID-19 pandemic.

## Material and methods

### Design

The study was designed as a cross-sectional survey.

### Sample and setting

100 employees were surveyed, consisting of 50 nurses and 50 doctors taking direct care of patients at a specialised hospital in the Pomeranian Voivodeship in Poland. Inclusion criteria included only registered nurses and doctors, working in the hospital at a surgical ward and working at non-surgical wards. The survey was anonymous and voluntary. The hospital holds regular training sessions for all healthcare professionals, including a practical demonstration and practical exercises of HH techniques. In addition, posters were put up in all strategic places and alcohol-based hand gels were made available at bedsides. The training programme is based on the WHO recommendations.

### Questionnaire development

The survey was conducted prospectively for 14 weeks from 6 January to 31 March 2020. It was conducted by use of a diagnostic survey and a direct observation method. The survey consisted of an original questionnaire. The first part of the questionnaire allowed the researchers to collect social, demographic and professional data. The second part contained multiple-choice questions, each with one correct answer, which were intended to identify the level of HH knowledge among the personnel. The second tool used in the survey was a basic HH observation form prepared by the WHO, which enables data to be collected concerning the observance by an employee of HH procedures at the five moments recommended by the WHO. One member of the infection control team measured compliance with HH procedures through direct observation. HH compliance was observed at each ward during ran-

domly selected 30-minute periods. Questionnaires were handed out to the respondents in paper envelopes. The respondents completed them by themselves and returned them to the study manager. The knowledge level was measured in the first week of the research.

### Ethical considerations

The survey was conducted based on consent given by the Independent Bioethical Commission for Scientific Studies at the Medical University in Gdańsk, No. NKBBN/719/2019-2020.

### Statistical analysis

All statistical calculations were prepared by use of the IBM SPSS 23 statistical package and an Excel 2016 spreadsheet. Qualitative variables were presented in the form of sizes and percentage values, and a quantitative variable in the form of the arithmetic mean and standard deviation. The significance of differences between the two groups was tested by use of the Mann-Whitney U test and Student's t-test. To confirm the relationship between a force and a direction between variables, a correlation analysis was used and Spearman's correlation coefficients were calculated. For qualitative variables, chi-squared tests were applied. In all calculations, the statistical significance of  $p \leq 0.05$  was assumed.

## Results

### Study group characteristics

The study involved 62% ( $n = 62$ ) women and 38% ( $n = 38$ ) men. In the analysed group, nurses working at a surgical ward constituted 25% ( $n = 25$ ) and nurses working at a non-surgical ward constituted 25% ( $n = 25$ ). Similarly, 25% ( $n = 25$ ) of the analysed group comprised doctors working at surgical wards and 25% ( $n = 25$ ) doctors working at non-surgical wards. In the analysed group, 27% ( $n = 27$ ) of respondents had secondary education and 73% ( $n = 73$ ) had a university degree. The average age of respondents was 38.52 years, SD 9.45. The average seniority was  $M = 14.59$  years,  $SD = 10.82$ .

### Level of hand hygiene knowledge among personnel

The scale of results in the questionnaire which measured the level of knowledge ranged from 0 to 8. The lowest result obtained by respondents was  $Min = 3$  and the highest result was  $Max = 8$ . The average result was  $M = 6.15$  with a standard deviation of  $SD = 1.28$ . The distribution of results was not consistent with nor-

mal distribution, which was confirmed by the Kolmogorov-Smirnov distribution test ( $K-S_{(100)} = 0.21; p < 0.05$ ). The medium result of  $M = 6.15$  indicates a high level of knowledge among the respondents.

During the study, the personnel declared that they observe HH rules in practice. In the analysed group, 46% of the respondents assessed their knowledge of the Ayliffe handwashing technique as very good. 78% of the respondents declared that they prepare their hands for work and they do not wear any jewellery on their hands when they take care of patients. 84% of

the respondents declared that they do not have painted nails. 78% applied the principle of 'bare below the elbows'. 79% declared that they always disinfect hands after touching a patient and 68% always after taking their gloves off. The nurses and doctors taking part in the study claim that the main reasons for negligence in HH procedures are lack of time/haste (49%), urgent circumstances (38%), fear of an adverse impact of hand disinfecting agents (6%), and a bad example set by their colleagues at work (5%). Detailed results are presented in Tables 1 and 2.

**Table 1.** The level of knowledge of the respondents

Questions checking the level of knowledge	n	%
Before starting work it is necessary		
Take off jewellery,	4	4.0
Remove jewellery, wedding rings are allowed	2	2.0
Wear short-sleeved clothing, have short unpainted nails	1	1.0
A and C are correct	93	93.0
How much time is needed to rub in a hand hygiene product to perform the procedure properly?		
Should last 20-30 seconds	58	58.0
May take two minutes	18	18.0
The time in which we perform the procedure is not important to maintain the right technique	24	24.0
When is hand disinfection required?		
Before and after contact with the patient	100	100
Before a clean aseptic medical procedure	100	100
After contact with the environment and with the patient's body fluids	100	100
Following contact with a patient with <i>Clostridioides difficile</i> , it is necessary to		
Disinfect the hands	3	3.0
Wash with soap and water	21	21.0
Wash your hands first, then disinfect your hands	74	74.0
No action is required	2	2.0
The following procedure should be performed prior to a physical examination of the patient		
Hand disinfection	67	67.0
Wash your hands then disinfect them	30	30.0
Such procedures are not necessary as it is not an invasive procedure	3	3.0
Before putting on the gloves, the following procedure is performed		
Hand washing	10	10.0
Hand disinfection	43	43.0
Washing and disinfecting hands	35	35.0
The procedures are not necessary, as we will be working with gloves	12	12.0
Apply the preparation for disinfecting hands on		
Dry hands	94	94.0
Wet hands	3	3.0
It does not matter	3	3.0
The most important element in the prevention of nosocomial infections is		
Antibiotic therapy	3	3.0
Hand hygiene	86	86.0
Short duration of the patient's stay in the hospital	11	11.0

Table 2. Behaviour of the respondents

Behaviour of respondents	n	%
I believe that the amount of hand hygiene training in my facility is sufficient		
Yes	83	83.0
No	17	17.0
I regularly participate in hand hygiene training		
Yes	74	74.0
No	26	26.0
To broaden my knowledge in the field of hand hygiene, I use		
The Internet	13	13.0
On-the-job training	53	53.0
Information obtained by the staff of the Hospital Infection Control Team	19	19.0
I do not expand my knowledge in this area	15	15.0
I believe that the causes of neglect in the hand hygiene procedure are		
Emergencies	38	38.0
Lack of time/rush	49	49.0
Too few positions for hand hygiene	2	2.0
Fear of the adverse effects of hand sanitiser	6	6.0
Bad example of colleagues from work	5	5.0
While working in the hospital, I wear jewellery on my hands		
Always	9	9.0
Never	78	78.0
Sometimes	13	13.0
While working in the hospital, my nails are varnished		
Always	6	6.0
Never	84	84.0
Sometimes	10	10.0
After taking off the gloves, I disinfect my hands		
Always	68	68.0
Sometimes	32	32.0
Before contact with a patient, I disinfect my hands		
Always	79	79.0
Sometimes	21	21.0
When working in the hospital, I wear short-sleeved clothing		
Always	78	78.0
Sometimes	22	22.0
I assess my knowledge of the Ayliffe hand disinfection technique as		
Very good	46	46.0
Good	46	46.0
Bad	8	8.0
The factor that influences me disinfecting my hands more often is		
Knowing that hand hygiene is an important part of infection prevention	89	89.0
Presence of an employee of the Infection Control Team in the department	5	5.0
Information that the patient hospitalized in the ward is isolated due to colonization/ infection with an antibiotic-resistant strain	6	6.0

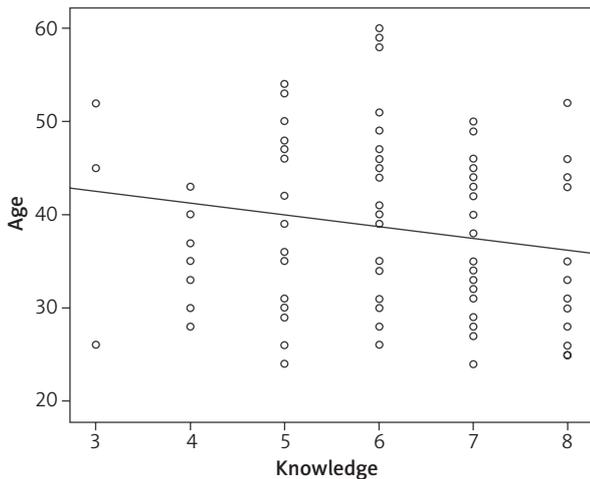


Fig. 1. Level of knowledge versus age

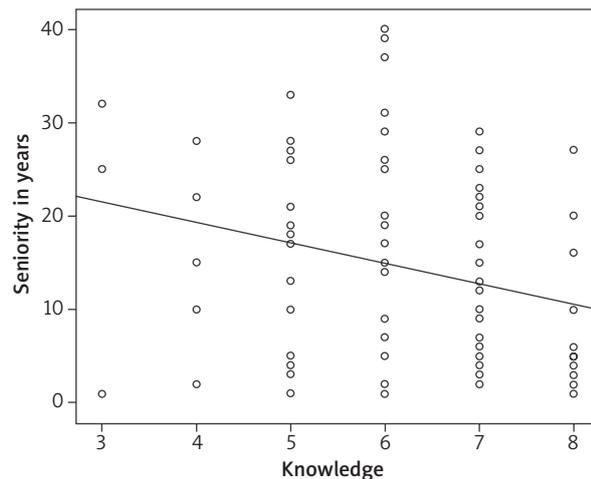


Fig. 2. Level of knowledge versus seniority

### Personnel's manner of conduct with regard to hand hygiene

The personnel's manner of conduct in this field was observed by use of the WHO basic HH observation form. In the analysed period, 412 HH possibilities were observed. HH procedures were complied with correctly in 229 cases.

### Social and demographic variables versus the level of hand hygiene knowledge

#### Education

The Mann-Whitney  $U$  test indicated that the respondents with university education presented a statistically significantly higher level of knowledge than the respondents with secondary education ( $Z = 3.23$ ;  $p < 0.05$ ).

#### Seniority, age of the respondents

The Spearman correlation test revealed a relationship between the variables. The older the respondents ( $\rho = -0.21$ ;  $p < 0.05$ ) and the longer the seniority ( $\rho = -0.25$ ;  $p < 0.05$ ), the lower the level of HH knowledge (Figures 1 and 2).

### Social and demographic variables versus the number of correctly followed hand hygiene procedures

The analysis of variables indicated that there is no significant relationship between education ( $\chi^2_{(4)} = 2.47$ ;  $p = 0.649$ ), seniority ( $\rho = 0.15$ ;  $p > 0.05$ ) and age ( $\rho = 0.16$ ;  $p > 0.05$ ) and the number of correctly followed procedures. No significant differences between doctors and nurses and the number of correctly followed procedures per person were found ( $\chi^2_{(4)} = 3.52$ ;  $p = 0.474$ ).

### Level of knowledge versus the number of correctly followed hand hygiene procedures

To verify the hypothesis, the Spearman correlation test was carried out. The analysis did not indicate any relationship between the variables. There is no relationship between the level of knowledge and the number of correctly followed procedures ( $\rho = -0.04$ ;  $p > 0.05$ ). Nor did the analysis reveal a relationship between the appraisal of the knowledge of the Ayliff hand disinfection method and the number of correctly followed HH procedures ( $\chi^2_{(8)} = 6.29$ ;  $p = 0.614$ ).

### Ward profile versus the level of knowledge and the number of correctly followed hand hygiene procedures

The parametric Student's  $t$ -test did not reveal a relationship between the profile of the ward and the level of knowledge among the respondents ( $t_{(98)} = 0.70$ ;  $p > 0.05$ ).

HH procedures were followed correctly much more frequently at the non-surgical ward ( $\chi^2_{(4)} = 14.91$ ;  $p = 0.005$ ) and by nurses ( $\chi^2_{(12)} = 19.90$ ;  $p = 0.049$ ).

The observance of HH procedures by nurses was 53.28% and by doctors 46.72%. The observance of HH procedures at the surgical ward was 48.90%, and at the non-surgical ward was 51.10% (Table 3).

### Discussion

The purpose of the survey was to assess the knowledge and conduct of nurses and doctors with regard to HH at selected surgical and non-surgical wards in a specialised hospital. The survey results confirmed that the nurses and doctors have a high level of knowledge of HH. Both nurses and doctors believe that cor-

**Table 3.** Observance of hand hygiene (HH) procedures

	Surgical ward HH procedures		Non-surgical ward HH procedures		Total HH procedures	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
<b>Nurses</b>	59	25.76	63	7.51	122	53.28
<b>Doctors</b>	53	23.14	54	23.58	107	46.72
<b>Total</b>	112	48.90	117	51.10	229	100

rect HH is the most important element of infection prophylaxis. It is necessary to point out that in accordance with the WHO's data, regular handwashing protects against COVID-19 infection [7].

Several Polish studies have assessed the level of knowledge of HH among healthcare professionals. In two surveys, the level of knowledge among nurses was found to be good [12] and very good [13]. In another two surveys, the level of knowledge was found to be average [14] or insufficient [15]. In one of the surveys, it was found that the level of knowledge among nurses was much higher than among doctors [15]. Similar results were presented by Kasperczyk *et al.*, who found that the knowledge of HH in a group of future doctors was insufficient as well. In the survey, only one third of future doctors knew the rule of the five moments of HH. In the analysis, 72% of medical students stated that hands are the main factors in spreading infections, which is equivalent to indicating HH as the primary element of infection prophylaxis [16].

Age, seniority and education have a material impact on the level of knowledge of HH. A survey conducted by Cichońska *et al.* indicated a material relationship between the knowledge and education of medical personnel. Similarly to the results of our own studies, it was found that the higher the education level was, the higher was the level of knowledge among the respondents [14].

Also, the longer the seniority was, the lower was the level of knowledge of HH among nurses and doctors. Similarly, the studies conducted by Woźniak-Kosek *et al.* indicated that persons with seniority of around 10 years achieved worse HH results than persons with seniority of up to 5 years. The authors of the study pointed out that this could result from routine and a small amount of training [17]. Our own studies did not reveal a statistically significant relationship between the level of knowledge and the profile of a ward. Such a relationship was confirmed by the study conducted by Ciechońska *et al.*, where the personnel of a non-surgical ward had much better knowledge in comparison to the personnel of a surgical ward [14].

The 'bare below the elbows' (BBE) policy is an approach based on the theory that it is necessary to limit the contact a patient has with the infected clothes of medical personnel and at the same time promote the hygiene of hands and wrists. In 2007, the UK Health Department decided to impose regulations on the dress

of medical personnel who directly take care of patients. As a result, the following rules were implemented: protective clothes with short sleeves, and no watches, bracelets, rings, or ties [18, 19]. In June 2017, in Poland, experts of the Treatment Hygiene Association also prepared a proposal for a BBE strategy to be applied during contact with patients [20]. Although healthcare professionals have knowledge and declare that they comply with HH rules, no significant relationship between the level of knowledge and the correct manner of conduct in terms of HH in practice was found. Similar study results were obtained by Rafa *et al.*, who found that despite the declared good knowledge of HH rules, this was not reflected in practice [21]. Gurus observed that personnel did not comply with the five moments of HH, which the author commented on as alarming [22].

Our own studies indicated that 48.90% of nurses and doctors in surgical wards followed HH procedures and in non-surgical wards 51.10%. In the group of nurses, HH procedures were followed by 53.28% of respondents and in the group of doctors by 46.72%. Similar results were obtained by Pittet *et al.* in studies conducted at one of the hospitals in Geneva, where the researchers found that the WHO-recommended five moments of HH were complied with by 30% of doctors and 52% of nurses [23]. During a study conducted in Ireland, it was found that HH procedures were followed by 56% of nurses and 31% of doctors [24].

Similar results were obtained by researchers in many countries in the years preceding the COVID-19 pandemic. In several surveys, the observance of HH procedures by various groups of professions was compared. In three such surveys, nurses constituted a professional group with a higher level of education on HH procedures [25–27] in comparison to doctors. However, one of the surveys indicated that despite a higher level of education, only 43% of nurses and 18% of medical technicians washed hands during the observation period, which may suggest that knowledge does not translate into better practices [25]. In a survey comparing nurses and other healthcare professionals, the observance of HH procedures was 63% among nurses and 86.5% among similar healthcare professionals [28]. Contrary to the results of one of the surveys [27], it was found that the observance of recommendations was greater among nurses (50%) than doctors (45%) and other healthcare professionals (38.4%). Numerous studies also highlight the fact that the disinfection of hands before touching a patient is the step

that is most frequently skipped in the HH procedure. The survey conducted by Harris indicates that only 14% of personnel disinfect hands before touching a patient and 67% do so after touching a patient [29]. Similar results were presented by Garus-Pakowska, whose survey results indicated that only 5% of personnel disinfected hands before touching a patient and 26% after touching a patient [22].

Our own studies indicate that 79% of respondents disinfect hands before touching a patient, although they do not always follow the correct hand disinfection technique. The failure to follow HH procedures before touching a patient may imply that HH is more important for personnel in terms of their own protection and safety. It must be noted that the period in which the survey was conducted overlaps with intensive reports on the spread of the COVID-19 pandemic in more and more regions of the world, including Europe. In the middle of March, Poland also recorded cases of the disease. Therefore, the reasons declared by employees for not following the HH rules are very important.

The respondents claim that the reasons for change in HH procedures include lack of time/haste, urgent circumstances, fear of an adverse impact of hand disinfection agents, and a bad example from their colleagues at work. In other analyses, a further reason for change in HH procedures is a lack of time [22]. However, urgent circumstances constitute the main reason for such change [13, 22]. It seems necessary to conduct an additional analysis of the time panorama of direct work with patients in strategic groups of professions. Haste and lack of time to meet hygienic procedures must not have an impact on the safety of patients and personnel.

## Conclusions

The high level of knowledge among nurses and doctors does not have a substantial impact on the number of correctly followed HH procedures. The level of knowledge of HH is determined by age, education and seniority. It is necessary to improve compliance with HH rules as the spread of COVID-19 locally and in hospital conditions is a problem. The COVID-19 pandemic should prompt healthcare professionals to wash their hands frequently.

## Implications for practical application

The planning of continuous education of nurses and doctors on HH should take into account their age, level of education and seniority, which have a significant impact on the observance of HH. To implement procedures effectively, it is necessary to appoint responsible persons, educate personnel and provide relevant coordination in hospitals. It is necessary to support the role of epidemiological teams in terms of effective communication and the implementation of quality control mechanisms, which focus on the importance of HH in clinical conditions and improve the observance of recommendations.

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## References

1. von Lengerke T, Lutze B, Krauth C, et al. Promoting hand hygiene compliance. *Dtsch Arztebl Int* 2017; 114: 29-36.
2. Saito H, Kilpatrick C, Pittet D. The 2018 World Health Organization SAVE LIVES: Clean Your Hands Campaign targets sepsis in health care. *Intensive Care Med* 2018; 44: 499-501.
3. Doronina O, Jones D, Martello M, et al. Systematic review on the effectiveness of interventions to improve hand hygiene compliance of nurses in the hospital setting. *J Nurs Scholarsh* 2017; 49: 143-152.
4. Kingston LM, Slevin BL, O'Connell NH, Dunne CP. Attitudes and practices of Irish hospital-based physicians towards hand hygiene and hand rubbing using alcohol-based hand rub: a comparison between 2007 and 2015. *J Hosp Infect* 2017; 97: 17-25.
5. World Health Organization [Internet]. Geneva: The Organization; 2006 [cited 2020 Sept 2]. WHO guidelines on hand hygiene in health care (advanced draft): global safety challenge 2005-2006: clean care is safer care. World Health Organization. Available from: <https://apps.who.int/iris/handle/10665/69323>.
6. World Health Organization [Internet]. Geneva: The Organization; 2009 [cited 2020 Sept 2]. Guidelines on hand hygiene in health care. Available from: [https://apps.who.int/iris/bitstream/handle/10665/44102/9789241597906\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/44102/9789241597906_eng.pdf).
7. World Health Organization [Internet]. Geneva: The Organization; 2019 [cited 2020 Sept 2]. Infection prevention and control during health care for probable or confirmed cases of Middle East respiratory syndrome coronavirus (MERS-CoV) infection: interim guidance, updated. Available from: <https://apps.who.int/iris/handle/10665/174652>.
8. Araghi F, Tabary M, Gheisari M, et al. Hand hygiene among health care workers during COVID-19 pandemic: challenges and recommendations. *Dermatitis* 2020; 31: 233-237.
9. Hillier MD. Using effective hand hygiene practice to prevent and control infection. *Nurs Stand* 2020; 35: 45-50.
10. Gupta MK, Lipner SR. Hand hygiene in preventing COVID-19 transmission. *Cutis* 2020; 105: 233-234.
11. Zhou P, Yang XL, Wang XG, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 2020; 579: 270-273.
12. Mysiakowska A, Ceglińska A, Ługowska M, et al. Higiena rąk w placówkach. *Biuletyn SHL, Stowarzyszenie Higieny i Lecznictwa* 2018; 1-2: 14-24.
13. Jarosik M, Garus-Pakowska A. Knowledge and compliance with hygienic procedures as a part of antiseptic prevention in nurses' work. *Hygeina Public Health* 2012; 47: 215-222.
14. Cichońska M, Ciemięga E, Maciąg D, Borek M. The level of knowledge and awareness of medical staff on the subject of hand hygiene. *Forum Zakażeń* 2019; 10: 227-231.
15. Kołpa M, Grochowska A, Gniadek A, Jurkiewicz B. Poziom wiedzy personelu medycznego szpitala o przenoszenie zakażeń drogą kontaktową – wyniki badania ankietowego. *Przegl Epidemiol* 2015; 69: 615-618.
16. Kasperczyk J, Szczurek W, Szczurek D, Joško-Ochojska J. Knowledge, practice and attitudes regarding hand hygiene among medical and dental students. *Problemy Higieny i Epidemiologii* 2016; 97: 229-235.
17. Woźniak-Kosek A, Cierniak Sz, Dziuk M, et al. Adherence to hand hygiene procedures in employees of the medical diagnostics center of the military institute of medicine in Warsaw. *Forum Zakażeń* 2019; 3: 151-157.

18. Greham J. Uniforms and workwear: an evidence base for developing local policy. Department of Health (online) 2007; <http://www.dh.gov.uk/publications>.
19. Pratt RJ, Pellowe CM, Wilson JA, et al. epic 2: National evidence based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect* 2007; 65 Suppl 1: S1-S64.
20. Rożkiewicz D, Szumska E, Potocka P. "Bare below the elbows". Part 1: Why is it so controversial? *Forum Zakażeń* 2018; 9: 129-134.
21. Rafa E, Olesiak M, Drzyzga S. Ocena znajomości i stosowania zasad higieny rąk jako elementu zapobiegania zakażeniom szpitalnym wśród studentów odbywających zajęcia praktyczne w oddziałach szpitalnych. *Pielęgniarka Epidemiologiczna – Informator* 2019; 1: 25-31.
22. Garus-Pakowska A. Workload impact on compliance with hygiene procedures in medical personnel. *Med Pr* 2011; 62: 369-376.
23. Pittet D, Dharan S, Touveneau S, et al. Bacterial contamination of the hands of hospital staff during routine patient care. *Arch Intern Med* 1999; 159: 821-826.
24. Creedon S. Healthcare workers hand decontamination practices: compliance with recommended guidelines. *J Adv Nurs* 2005; 51: 230-236.
25. Harris A, Samore M, Nafziger R, et al. A survey on handwashing practices and opinions of healthcare workers. *J Hosp Infect* 2000; 45: 134-145.
26. De Vita V, Weisburd G, Beltramino EBD. Conocimiento, actitudes y prácticas del personal de salud relacionados con el lavado de manos clínico en una unidad de cuidados intensivos. *Rev Méd Rosario* 2014; 80: 105-116.
27. Teker B, Ogutlu A, Gozdas HT, et al. Factors affecting hand hygiene adherence at a private hospital in Turkey. *Eurasian J Med* 2015; 47: 208-212.
28. Salama MF, Jamal WY, Al Mousa H, et al. The effect of hand hygiene compliance on hospital-acquired infections in an ICU setting in a Kuwaiti teaching hospital. *J Infect Public Health* 2013; 6: 27-34.
29. Chavali S, Menon V, Shukla U. Hand hygiene compliance among healthcare workers in an accredited tertiary care hospital. *Indian J Crit Care Med* 2014; 18: 689-693.