

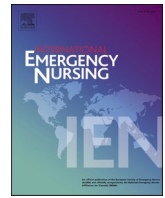


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## Do we need a pandemic to improve hygiene routines in the ambulance service? A cross-sectional study

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## ABSTRACT

**Background:** We know that ambulance staff may have sparse knowledge on how to comply with care approaches that ensure appropriate hygiene in the ambulance, but we do not know if and how the COVID-19 pandemic has affected ambulance staff's perceived compliance with hygiene routines.

**Aim:** To investigate ambulance staff's self-reported hand hygiene (HH) perceptions and compliance; and to explore if and how the COVID-19 pandemic has affected ambulance staff's perceived compliance with hygiene routines.

**Methods:** A cross-sectional study design using the WHO-validated Perception Survey for Healthcare Workers regarding hygiene. Thematic analysis and descriptive statistics were used for analysis.

**Results:** 204 surveys were analysed, 92% of participants stated that their hygiene routine compliance had improved during the COVID-19 pandemic, and some participants also described that their colleagues' practice had improved. These improvements were reportedly driven by the need to acquire new knowledge to deal with the pandemic and sometimes with fear.

**Conclusions:** Experience acquired during the pandemic needs to be sustainable if we are to increase HH and hygiene routine compliance in ambulance services. Interventions aimed at changing ambulance staff's perceived behaviour are warranted, and stakeholders should try and identify the personal motivations that lead these staff to seek self-betterment regarding HH and hygiene routine compliance. Otherwise, the risk of patients suffering from healthcare-associated infection may not decrease as wished.

## 1. Introduction

By definition, the ambulance service is a high-risk patient safety environment [1–4]. Nonetheless, it is necessary to ensure the provision of appropriate care for a high number of patients presenting with undifferentiated illnesses/injuries with wide variation in level of severity. Being a part of the emergency medical services (EMS) of each country, ambulance services naturally differ internationally in many aspects; however, patients' journeys in the EMS tend to be similar in urbanised countries, regardless of the specific roles of ambulances, and the ambulance service is always at the front line of public health emergencies, such as the one brought about by the COVID-19 pandemic.

Currently, we have little knowledge on how and if COVID-19 has affected patient safety in the ambulance service; however, we do know that healthcare-associated infections (HCAI) are a major patient safety risk that can cause extended hospital stays, economic strains for both patients and society, and increased patient suffering [5,6]. To fight off this major patient safety risk, we know that infection prevention through hand hygiene (HH) routines, such as those described by the World Health Organization (WHO) [7] can help reduce HCAs; still, infection protection in the EMS context remains a challenge as the ambulance service inherently presents an unpredictable and complex caring environment [8]. Moreover, although we currently have little [9] to no knowledge on if - and to what extent - ambulance staff cause HCAs, we

**Abbreviations:** EMS, Emergency medical service; HCAI, Healthcare-associated infection; HH, Hand hygiene; EMT, Emergency medical technician; RN, Registered nurse.

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do know that compliance with HH routines in the ambulance service can easily be overtaken by other, and sometimes life-threatening, behaviours [10–13]. Furthermore, previous literature has shown that ambulance staff may have sparse knowledge on how to comply with care approaches that ensure appropriate hygiene in the ambulance setting [14–17]. Meanwhile, and regardless of the lack of compliance with HH routines by ambulance staff, other studies have found that ambulance staff acknowledge the importance of such compliance in the ambulance service [17,18]. We believe that these studies highlight the need for research that analyses possible quality improvements that may help increase staff's compliance with both HH and other hygiene-related routines in the ambulance service.

Nevertheless, before planning and implementing multimodal interventions in this regard, we consider it important and necessary to identify the unique difficulties exclusive to the ambulance service and its staff. Therefore, this study had two major aims: To investigate ambulance staff's self-reported HH perceptions and compliance; and to explore if and how the COVID-19 pandemic has affected ambulance staff's perceived compliance with hygiene routines.

## 2. Methods

During the peak of COVID-19 in Sweden, we used a cross-sectional study design to describe ambulance staff's self-reported HH perceptions and compliance and how the COVID-19 pandemic has affected ambulance staff's perceived compliance with hygiene routines. We based our study methods on previous literature [18] and used a questionnaire for collecting data.

### 2.1. Setting

While the Swedish ambulance service is regulated by the Swedish National Board of Health, it is provided by either the county or private companies contracted by the county council [19]. On average, approximately 800 ambulances operate in the 21 regions of Sweden; however, during the COVID-19 pandemic, the regions that had the highest infection ratios had an increased number of operative ambulances.

The national regulations stipulate that there should be at least one registered nurse (RN) in each ambulance team. Some regions have also stipulated that the RN needs to have a one-year additional university training course in emergency care. The other professional in the two-person team is often an emergency medical technician (EMT) with one year of higher vocational training. In the Swedish ambulance teams, the medical responsibility is assigned to either the specialist nurse or the RN, with the latter being assigned such responsibility only if there is no specialist nurse staffing the ambulance [19]. The Swedish ambulance service routines related to basic hygiene and HH comply with the WHO guidelines [7], and these routines are also part of RN's and EMT's curricula. Moreover, in Sweden, infection protection guidelines abide by national regulations, which describe that all healthcare professionals are obliged to work to limit and prevent the spread of any type of infection, anywhere in the country.

### 2.2. Participants and data collection

We identified participants by virtual snowball sampling [20,21] in a closed Facebook group intended for ambulance staff. At the time of sampling, there were approximately 1600 members in this group. Data collection was carried out using an online electronic questionnaire (the KI-web survey) that was published in the group on 27 March 2020. One week after the post, we sent a reminder to all group members and the data collection ended on 13 April 2020. To our knowledge, more than 10 individuals shared the original post via Facebook, which is a well-known outcome of virtual snowball sampling and means that the questionnaire could have reached participants outside the initial group [20,21].

### 2.3. Questionnaire

Data was collected using the WHO-validated Perception Survey for Healthcare Workers regarding hygiene, [22] which had previously been adapted to a Scandinavian setting [18]. The questionnaire was forward- and backward-translated from the English version into Swedish, and the translated questionnaire was content validated by four pre-hospital emergency care students. The questionnaire we utilised comprised 22 questions that covered the following areas: Demographics including the participant's knowledge about infections and self-assessment (11 items), the effects of good hand hygiene (three items) scored on a scale that ranged from 1 (very low) to 4 (very high), the importance of HH (seven items) scored on a scale that ranged from 1 (no importance) to 7 (very high importance), and finally there was an open-ended question concerning the COVID-19 pandemic: "Has the on-going pandemic of COVID-19 affected your compliance with hygiene routines and if so, how?".

### 2.4. Quantitative and qualitative analysis

Data were retrieved from the KI-web survey into an Excel database, in which the frequency distributions and descriptive statistics (i.e., median and percentages) were computed. For the qualitative variables, we conducted a thematic analysis based on the methods proposed by Braun and Clark, [23] which included different phases. The first phase comprised data familiarisation, in which the answers were read and re-read to achieve a greater comprehension of the content. The second phase comprised exhaustive text coding and/or division into meaningful units until all data were extracted. In the third phase all the identified codes were grouped into preliminary themes and subthemes. The fourth phase comprised a review of the identified themes and subthemes by discussing and adjusting them until the research group reached consensus. In the fifth phase, themes and subthemes were further refined by identifying the essence of what each theme captured. The sixth and final phase involved defining and naming the finalised themes and subthemes. The process of moving back and forth, together with the discussions, were conducted to maintain a balance between researchers' pre-understanding and openness to the content. In this study, researchers' pre-understanding included extensive knowledge of the ambulance service and emergency care because the authors were nurses and researchers specialising in this context.

### 2.5. Ethical considerations

Through a post in the aforementioned Facebook group, the eligible participants received written information about the study aims, the responsible researcher, and the voluntary nature of this research. By opening the web-link to the questionnaire, the eligible participants received additional information; "By answering and sending in the questionnaire, you give your consent to participate in the study, and it will not be possible to withdraw your information after sending in the answers because your data will be anonymous". According to Swedish regulations, ethical approval was not necessary for this research since neither personal nor physical sensitive data were collected and because all participation was individual and voluntary (i.e., the participants were not representing their employers). However, our study was designed to meet the ethical principles set out by the International Council of Nurses, which states that all research needs to ensure that participants' data are treated with anonymity, integrity, and confidentiality [24].

## 3. Results

In total, 204 questionnaires were answered. Most of the participants worked in Stockholm, the capital of Sweden ( $n = 66$ ; 32%); 104 (51%) were male; and 98 (48%) female. The participants' mean age was 42.3 years, and most ( $n = 137$ ; 67%) were specialist nurses, as shown in Table 1. Moreover, 38% ( $n = 78$ ) answered that they had completed

**Table 1**  
Participants' demographic data (n = 204).

Gender	Frequency	%	Mean/median
Male	104	51	42.3/42 years
Female	98	48	
Binary	2	1	
<b>Age</b>			
25–30	22	11	
31–35	33	16	
36–40	43	21	
41–45	37	18	
46–50	31	15	
>50	39	19	
<b>Place of work</b>			
Capital of Sweden	66	32	
Central Sweden	52	25	
Northern Sweden	42	21	
Southern Sweden	44	22	
<b>Profession</b>			
EMT*	29	14	
RN**	38	19	
Specialist RN	137	67	
<b>Years of experience in the ambulance service</b>			
<1	12	6	
1–5	54	26	
6–10	41	20	
>10	97	48	
<b>Formal training in hygiene less than 3 years ago</b>			
Yes	78	38	
No	126	62	

\* Emergency medical technician.

\*\* Registered Nurse.

training in hygiene in the last three years. Those that received training stated that it had been provided by: The employer (n = 32), the university (n = 11), self-study using the web (n = 25), a combination of different training sources (n = 6). Four participants had missing data regarding this last topic.

### 3.1. Ambulance Staff's Self-Reported perceptions and compliance with HH

The self-reported median for HH compliance was 85% (interquartile range 78–98%), while the median for staff's perceptions of their peers' compliance with HH was 70% (interquartile range 50–80%). Most participants (42.6%) answered that good HH did not require an extra effort when providing patient care (Fig. 1).

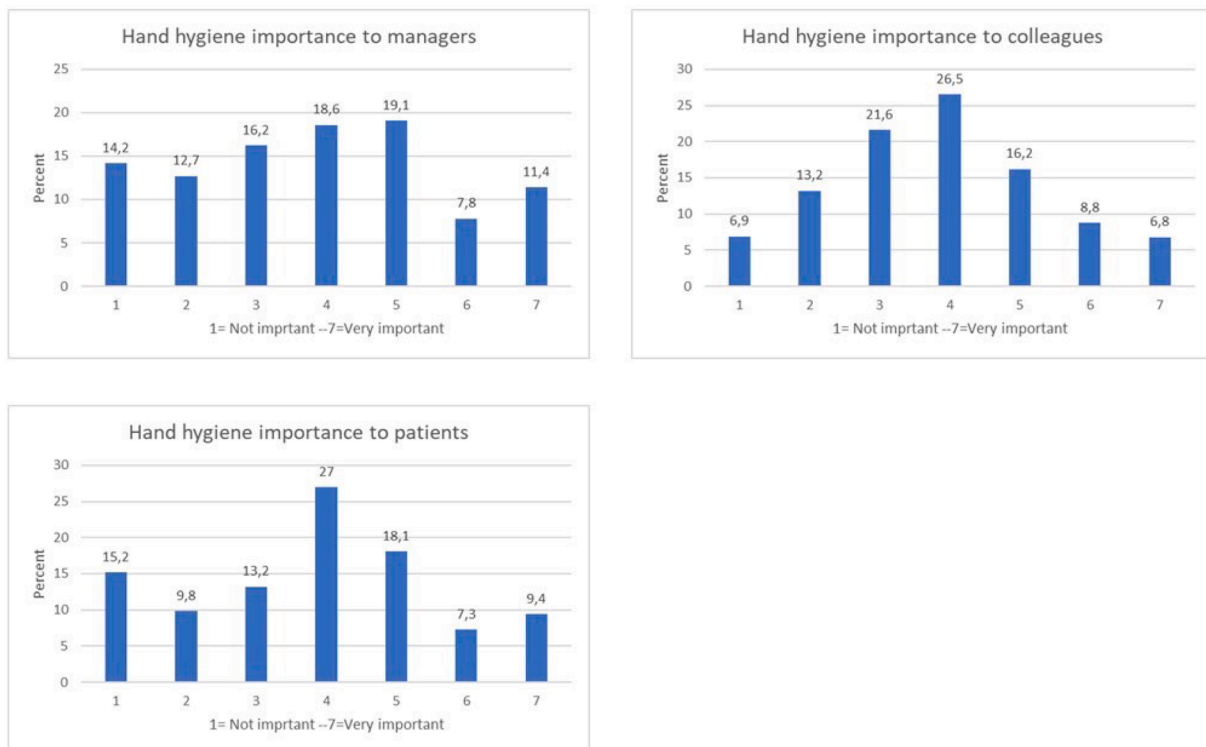
Moreover, 14% of the participants (n = 29) perceived that their managers assessed appropriate HH compliance as non-important for ambulance patient care, 5% (n = 14) perceived that their colleagues gave such an assessment, and 15% (n = 31) perceived that their patients did so (Fig. 2).

Participants estimated that 25% (median) (interquartile range: 20–40%) of the patients cared for at hospitals would suffer from an HCAI (missing data n = 4), and that the HCAI could have a serious impact on patients' outcomes. Moreover, participants perceived that HH has a very high preventive effect toward the risk for HCAI (Fig. 3).

To the question: "Which interventions could be effective at supporting and improving ambulance staff's HH compliance?" participants answered: always having access to hygiene supplies at the location where care is provided (n = 179; 87.7%); receiving feedback (n = 167; 81.9%); receiving support from the employer (n = 167; 81.8 %); receiving additional training (n = 158; 77.4%); being a role model (n = 155; 76%); having clear and simple instructions available (n = 149; 73 %); and being reminded through posters (n = 142; 69.6%; missing data n = 3).

### 3.2. The effect of the COVID-19 pandemic on ambulance staff's compliance with hygiene routines

In total, 190 (93%) participants answered the open-ended question (sentences n = 336; range 1–8; mean 1.9; median 2). Out of these, 16 (8%) stated that the COVID-19 pandemic had not changed their hygiene routines in the ambulance service "No, I always think about hygiene



**Fig. 1.** Ambulance staff's perceived efforts to comply with appropriate hand hygiene during patient care.

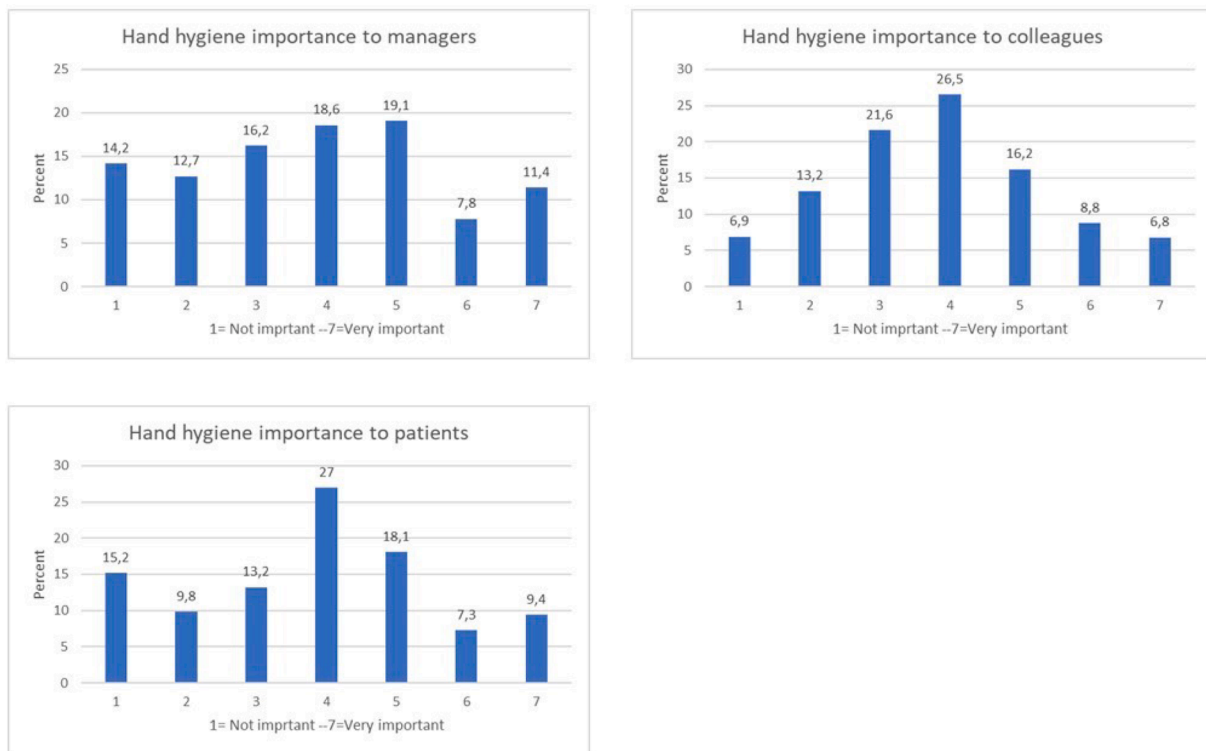


Fig. 2. Ambulance staff's perceptions about how hand hygiene is important to their managers, colleagues, and patients.

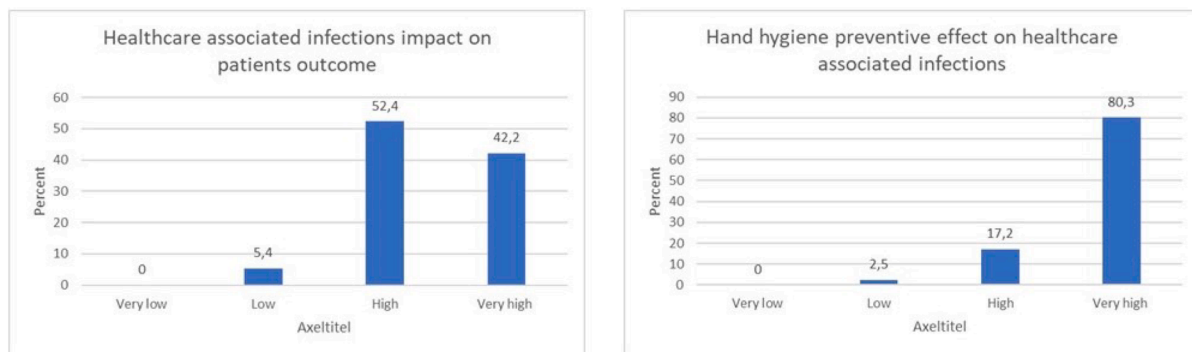


Fig. 3. Ambulance staff's perceptions about the impact of healthcare-associated infections in patient outcomes and of hand hygiene in reducing the risk of healthcare-associated infections.

*... routines when I work[...]". However, most (n = 174; 92%) answered that both their own and their peers' hygiene routine compliance had improved during the pandemic "Yes, I have improved my compliance with*

*the routines and I have also noticed that my colleagues are better at this[...]". Overall, these findings highlight that our participants improved their compliance with hygiene routines, and these findings are underpinned*

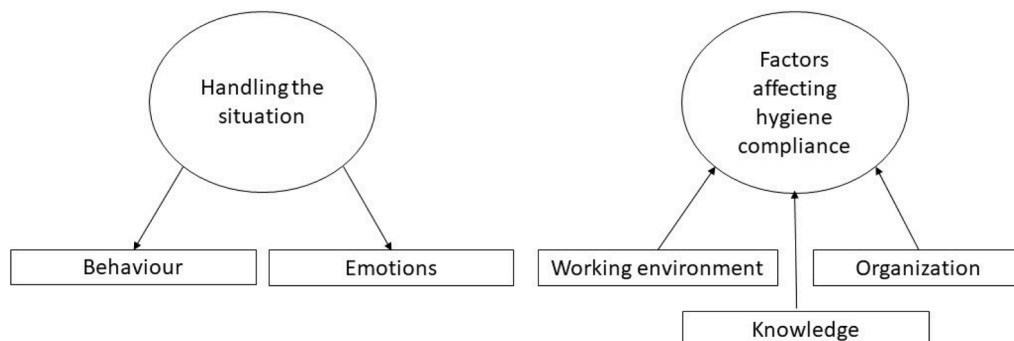


Fig. 4. Thematic map of the qualitative analysis.



by the two main themes identified during the qualitative analyses: *Handling the situation* and *Factors affecting hygiene compliance*. Fig. 4 shows a thematic map of the qualitative analysis.

### 3.3. Handling the situation

As highlighted in the previous paragraph, the conditions for working in the ambulance service have changed during the pandemic caused by COVID-19. Through our qualitative analyses, we analysed how participants described theirs and their peers' adaptation to the pandemic situation. Overall, participants described that their adaptation was driven by emotions such as fear of being sick and of infecting the family, colleagues, and friends.

"I have concerns for my own health; to be infected by this dreadful illness. I am also afraid to spread the infection to others or bring the infection home, to my family [...]."

To deal with these fears, participants reported that they endeavoured to identify their own knowledge gaps regarding hygiene and to update their knowledge prior to the work shift; this was done by reading new information concerning COVID-19, which was provided by their employers. Participants also described how the dispatch centre provided them with information on how to handle hygiene routines before arrival at the scene.

Moreover, participants compared their own previous and current (i. e., in the COVID-19 situation) hygiene compliance. During the pandemic, they: started to use gloves and other protective equipment more often; increased the use of alcohol-based liquids for hand disinfection; washed their hands with soap and water to a greater extent; and washed their uniforms after each work shift. They also described how their own colleagues had changed their work behaviours in compliance with these same hygiene routines. However, despite this reported increase in the use of protective equipment, participants also described how they tried to be more frugal with their equipment due to a perception that there was a limited supply. Moreover, some participants described frustration with some colleagues that were nonchalant and who did not protect themselves:

*"I still see colleagues with watches, rings, and loose nails [...] They [colleagues] put on the gloves when they get out of the ambulance and don't change them during the whole assignment [...] they mess around with the gloves everywhere [...]"*

Regardless of such frustration, participants noted that before the pandemic they were not used to telling their colleagues that they were not following hygiene guidelines, whereas now, *"thanks to COVID-19 [...]"*, it had become easier for them to reprimand non-compliant colleagues. Participants were also concerned about their own and their colleagues' behaviours, as they perceived that as soon as a patient was confirmed as not having COVID-19, they returned to their old habits (i. e., non-compliance with hygiene routines).

*"[...] they don't clean the ambulance/equipment if the patient is only suffering from, for example, a bone fracture".*

Participants were also concerned about hygiene compliance maintenance in the post-pandemic scenario; namely, they feared that after the pandemic they would go back to being non-compliant with the hygiene guidelines. Thus, at the same time that they perceived self-betterment, they also questioned themselves: would this improvement continue?

### 3.4. Factors affecting hygiene compliance

Participants also described how the factors influencing their compliance with hygiene routines could be, at the same time, barriers to and opportunities for enhanced - perceived - hygiene compliance. Specifically, the unpredictable work environment was described as a barrier

to hygiene routine compliance.

*"[...] Caring for patients in the forest hinders my ability to follow strict guidelines [...]"*.

Additionally, they noted that, in situations where time was critical, hygiene was not prioritised, and that the lack of a stopwatch inside the ambulance made them choose to wear a wristwatch. Moreover, although participants increased their knowledge and understanding about the impact of hygiene routine compliance and how essential it is (which motivated them to increase their compliance), they also reflected upon the risk of using new protective equipment (e.g., gas masks, which were introduced in the ambulance service during the pandemic). Reportedly, these could cause a false sense of security, which could thereby lead to them being less disciplined regarding other components of their hygiene routine compliance.

Additionally, participants described a new experience whose onset was associated with the pandemic. Suddenly, their managers and organisations became more active in their support of hygiene routine compliance. Particularly, participants highlighted the following initiatives that were brought about by the pandemic and were provided by their managers/organisations: encouragement to follow hygiene guidelines; hiring of nurses responsible for hygiene during their work; enhanced access to protective equipment; allocation of time for ambulance cleaning after each assignment; follow-up inspections to check for hygiene compliance; hiring of professional cleaners; clarification of the hygiene guidelines; and time allocation for ambulance and equipment cleaning after each patient handover at the emergency department.

## 4. Discussion

The COVID-19 pandemic promoted both fear and learning among the studied ambulance staff, and both motivated our study participants to increase their compliance (self-reported) and perceptions toward HH and hygiene routines. However, while their self-perceptions about HH compliance were 85% (median), the participants' perceptions about their peers' HH compliance were 70% (median). These findings are in line with a Danish study, but that study was not performed during a pandemic [18]. A reasonable assumption regarding these similar results may be that self-reported HH compliance was even higher during the ongoing pandemic. Thus, although our study methods did not objectively analyse if participants actually had a higher compliance with hygiene routines during the pandemic, it may be reasonable to assume that they became better at such compliance. This is because their answers to the open-ended question highlighted their personal motivations toward self-betterment in HH and hygiene routine compliance. Nevertheless, our study methods should be treated with caution because, the expressed compliance may be, to a higher extent, a sign of self-protection, rather than a sign of patient-directed protection. This phenomenon was highlighted in a previous study by Emanuelsson et al. [10].

Our results also showed that participants increased the frequency with which they cleaned their working clothes. Reportedly, the COVID-19 pandemic onset caused them to wash their clothes after every shift. This may indicate a need for employers to be responsible for the cleaning of working clothes, instead of individual employees; this is especially important because cleaning working clothes at 60 °C was shown to reduce bacteria almost to zero [25].

More than 80% of our study participants perceived that the following factors could increase their hygiene compliance: always having access to hygiene supplies; receiving feedback; and receiving support from the employer. These supportive factors were also described in their answers to the open-ended question; however, some participants reflected that, although some of these factors already existed in the ambulance service prior to the pandemic, they still perceived themselves and their colleagues as non-compliant to the hygiene routines. This may indicate that there are additional factors affecting staff's compliance with HH and

hygiene routines that were not addressed by our study. Is it possible that the life-saving expectations and behaviours among the ambulance staff [10–13,26] are a hindrance to hygiene routine compliance? This question arose from the participants' descriptions on how they used to follow hygiene routines when working in the hospitals, but when they started working in the EMS, they reportedly changed their behaviours. Thus, it may be that work culture affects professionals' sense of motivation toward compliance with HH and hygiene in the service. Regardless of the reason for the lack of compliance with HH and hygiene routines, the behaviour is a patient safety risk, and the staff can thereby cause increased suffering for the patients.

Summarising, to increase ambulance staff's HH and hygiene routine compliance, we believe that the knowledge and experience gathered by these workers during the pandemic need to be maintained by the relevant stakeholders; otherwise, ambulance staff may return to previous, non-compliant behaviours after the pandemic and the risks of patients suffering from HCAI may not decrease as wished and needed.

## 5. Strengths and limitations

First, we utilised virtual snowball sampling. It is well-known that virtual snowball sampling using social media is effective for recruiting hard-to-reach participants, and it is also regarded as a cost-effective method with minimal time constraints. However, by using social media we excluded staff that did not utilise social media. And we may assume that the use of social media for data collection provided us with the possibility to gain a higher degree of participation from persons that were personally interested in the studied topic [20,21]. Another limitation is the lack of measurement to ensure the validity and reliability of the used questionnaire, but content validity was achieved by having a group of prehospital emergency care students comment on the translated questionnaire. Another limitation, the participants' experiences may not be representative of all the personnel in the EMS since most participants were specialist nurses, which does not reflect the current distribution of employees in Swedish ambulance services. However, the specialist nurse is the one in the team with the highest medical and scientific knowledge, and it is reasonable to think that their answers also reflect the team's work. Due to the risk of selection and sampling bias in the study the generalizability of the findings is limited, but it is reasonable to think that the results may be transferable into similar contexts and situations. The answers of 93% of the participants to the open-ended question we utilised confirmed, at least to some extent, the quantitative findings we observed, while also adding new knowledge concerning the factors influencing HH and hygiene routine compliance in the EMS setting. However, there was no possibility to ask the participants clarifying questions to their answers or to ask them to verify the findings. In addition, the answers to the open-ended question varied in length (range 1–8 sentences); the short answers were condensed and the longer answers more detailed. To increase the credibility of the analysis, three out of the four authors participated in all steps of the analysis, and the fourth author who had no knowledge about the ambulance service, did member-checks during the analysis and at the end of the process to consolidate the study findings. An assumption is that the knowledge from this study can be used by the relevant stakeholders to provide quality improvements concerning hygiene in the Swedish ambulance service—and international ambulance services—whenever applicable.

## 6. Conclusions

Our results highlighted that the COVID-19 pandemic caused Swedish ambulance staff to learn more about hygiene (to better deal with the pandemic situation) and to be fearful about their infection status, both of which motivated them to increase their self-reported HH and hygiene routine compliance. However, for this increase to be sustainable, we highlight the need for interventions aimed at changing ambulance staff's perceived behaviour and at identifying their major personal motivations

that may lead to improved HH and hygiene routine compliance. Otherwise, these professionals will return to previous non-compliant behaviours after the pandemic, and the risk of patients suffering from HCAI may not decrease as wished.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

To all Swedish ambulance personnel who has cared for the patients during the pandemic and thank you all who answered the questionnaire who shared your experiences without your answers, thoughts and opinions, this study would never have been made.

## Authors' contributions

First, second and last author contributed during the planning stage and performed the data collection. All authors contributed to the data analysis and interpretation of data. All authors contributed, read, and approved the final manuscript. No funding was received for this work.

## Data Sharing/Availability

The data used and analysed during the current study are available from the corresponding author on reasonable request.

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