ORIGINAL ARTICLE

Healthcare personnel's working conditions in relation to risk behaviours for organism transmission: A mixed-methods study

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Abstract

Aims and objectives: To investigate healthcare personnel's working conditions in relation to risk behaviours for organism transmission.

Background: Healthcare personnel's behaviour is often influenced by working conditions that in turn can impact the development of healthcare-associated infections. Observational studies are scarce, and further understanding of working conditions in relation to behaviour is essential for the benefit of the healthcare personnel and the safety of the patients.

Design: A mixed-methods convergent design.

Methods: Data were collected during 104 h of observation at eight hospital units. All 79 observed healthcare personnel were interviewed. Structured interviews covering aspects of working conditions were performed with the respective first-line manager. The qualitative and quantitative data were collected concurrently and given equal priority. Data were analysed separately and then merged. The study follows the GRAMMS guidelines for reporting mixed-methods research.

Results: Regardless of measurable and perceived working conditions, risk behaviours frequently occurred especially missed hand disinfection. Healthcare personnel described staffing levels, patient-level workload, physical factors and interruptions as important conditions that influence infection prevention behaviours. The statistical analyses confirmed that interruptions increase the frequency of risk behaviours. Significantly higher frequencies of risk behaviours also occurred in activities where healthcare personnel worked together, which in the interviews was described as a consequence of caring for high-need patients.

Conclusions: These mixed-methods findings illustrate that healthcare personnel's perceptions do not always correspond to the observed results since risk behaviours frequently occurred regardless of the observed and perceived working conditions. Facilitating the possibility for healthcare personnel to work undisturbed when needed is essential for their benefit and for patient safety.

1 | INTRODUCTION

Preventing organism transmission in healthcare delivery is a major global issue for patient safety, because healthcare-associated infections (HCAI) are the most common form of healthcare injury (Haque et al., 2018; World Health Organization, 2021). Healthcare personnel's (HCP) infection prevention behaviour is described as being a key factor in the prevention of HCAI (Allegranzi & Pittet, 2009; World Health Organization, 2009). Non-compliance with hand hygiene is widely regarded as the major risk behaviour for organism transmission (Allegranzi & Pittet, 2009; Haque et al., 2018). Interventions aiming to increase hand hygiene compliance among HCP are numerous, but accompanied by various difficulties (Gould et al., 2017; Price et al., 2018; Seo et al., 2019). Results in a comprehensive literature review by Gould et al., (2017)indicated that interventions gave a slight improvement in hand hygiene compliance and a low to moderate certainty of evidence was described. Long-term follow-up is uncommon, for example only three of 24 studies included in Seo et al., (2019) had measured long-term follow-up with maintained results. A systematic review of 19 systematic reviews by Price et al., (2018) found only one study with a low risk of bias. Even though non-compliance to hand hygiene is described as the major risk, several other risk behaviours that can lead to organism transmission have been described, for example inappropriate use of gloves (Lindberg et al., 2020) or protective clothing and uncleaned medical devices (Clack et al., 2018; Livshiz-Riven et al., 2015; Loveday et al., 2014). Despite numerous interventions aiming to decrease HCP risk behaviours, HCAI are still reported as a global problem (World Health Organization, 2021).

2 | BACKGROUND

Registered nurses (RNs) worldwide describe how they are experiencing undesirable working conditions (Goodare, 2017). Working conditions are described as a factor that influences the individual, and human risk behaviours are often a causal part of a sequence of events and not the origin (Rasmussen, 2003). For HCP, several working conditions have been identified as influencing the risk for HCAI. A systematic review found that bed occupancy, staffing, workload, use of pool or agency nurses and availability of materials play key roles in infection prevention. Outcomes were measured mainly by the frequency of HCAI or compliance with hand hygiene (Zingg et al., 2015). Virtanen et al., (2009) combined a personnel survey with

What does this paper contribute to the wider global clinical community?

- Interruptions and colleagues working together during patient care activities increase risk behaviours for organism transmission.
- Infection prevention work needs to include hand disinfection along with other risk behaviours, as only half of the problem is accessed when the focus is exclusively on hand disinfection.
- That mixed-methods research can be appropriate when investigating a complex relationship as between healthcare personnel's working conditions and infection prevention behaviours.

infection prevalence and found that long work hours, low trust and poor collaboration between colleagues as well as high work stress increases HCAI (Virtanen et al., 2009). An early review investigated the relationship between RNs' working conditions and different patient outcomes, including HCAI. The results described how staffing levels have both a negative and positive impact on HCAI. Since working conditions were often measured by data from surveys and linked to quality indicators within nursing, the researcher described the results as ambiguous and suggested future research to measure observable working conditions and patient outcomes (Bae, 2011). RNs have described working conditions, for example heavy workloads, understaffing, lack of hand disinfection agents and improper placement of products or sinks to be reasons for non-compliance with hand hygiene. Other reasons not connected to working conditions, such as forgetfulness, skin irritation and difficulty putting on gloves after hand disinfection, were also described (Sadule-Rios & Aguilera, 2017).

Being interrupted is another working condition that can influence patient safety (Monteiro et al., 2015; Wagner et al., 2020). RNs are often interrupted in their work, and this phenomenon has been studied mainly in relation to medication safety (Hayes et al. 2015; Raban & Westbrook, 2014; Schroers, 2018; Thomas et al., 2017). Interruptions have been described as leading to increased cognitive loads and frustration among RNs (Thomas et al., 2017). Different sources for the interruptions besides self-interruptions are, for example, colleagues, patients, work phones and a lack of materials (Monteiro et al. 2020; Schroers, 2018). Interruptions have also been

found to influence the occurrence of HCP's risk behaviours for organism transmission (Lindberg et al., 2017, 2018). This issue would benefit from further study in regard to the sources of the interruptions and how the HCP perceive interruptions in relation to their infection prevention behaviours.

Human behaviour is influenced by the context of the work and the working conditions. Staffing, bed occupancy, workload and availability of materials have been reported as crucial factors in infection prevention. Despite this, observational studies that investigate HCP's observed and perceived working conditions in relation to HCP's observed behaviours are lacking. Studying this relationship is essential to increase the understanding of this complex subject. A mixed-methods study is one appropriate way to accomplish this. When the relationship is known, suitable improvements and measures can be implemented for the HCP that benefits them and patients safety.

3 | AIM

To investigate healthcare personnel's working conditions in relation to risk behaviours for organism transmission.

4 | METHODS

4.1 | Design

A mixed-methods convergent design where qualitative and quantitative data were collected in parallel, given equal priority, analysed separately, and then merged was used (Creswell and Plano 2017). Collecting both quantitative and qualitative data can bring greater insight into the problem than either type of data alone could. A procedural diagram of the study design is provided in Figure 1. The Good Reporting of a Mixed Methods Study (GRAMMS) was used as a framework to report the study design and findings (O'Cathain et al., 2008: See File S1).

4.2 | Setting and sample

The study was conducted at eight conveniently chosen surgical and orthopaedic units in five Swedish hospitals. Participants were RNs, assistants nurses (ANs) and the unit's first-line managers (FLMs). No inclusion criteria were defined. The sample and settings are described in Table 1.

4.3 | Data collection

Data were collected through focussed mobile positioning observations (Spradley, 1980). The observer did not participate in the patient care to prevent alterations in the working conditions. Structured interviews with FLMs and semi-structured interviews (Polit & Beck, 2021) with RNs and NAs were collected concurrently. From 28 February to 6 May 2019, the first author spent three mornings at each of the eight included units. In total, 151 h were spent at the units. The total amount of hours performing the observations was 104. The remaining time was spent on the interviews and preparing for them. Prior to the observations, the HCP were asked to provide demographics about themselves. They were also asked to provide information about their present work conditions, for example number of patients they were responsible for, staffing level, bed occupancy as well as their perceptions of the general workload and patient-level workload that is based on clinical condition and level of care needs. This information resulted in a data set of the working conditions for the participant. During each observation, 2–4 HCP were shadowed while they performed different activities. When one activity was concluded, the observer either continued to follow the same participant or observed another. Field notes comprising all observed behaviours were written by hand during the observations. The field notes were written in a different colour for each participant to facilitate the preparations for the interviews and to enable the linking of the field notes to the HCP working conditions in the analyses. Locations of the performed activities were also noted. After the observations, the in person semi-structured interviews were held with all of the observed RNs and ANs. The majority were recorded and lasted between 5 and 27 min. Questions were asked regarding their reflections on the day's working conditions (including interruptions), how they perceived the working conditions in relation to their infection prevention behaviour and reflections on risk behaviours that occurred during the observations. When an opportunity arrived during a data collection day, a structured in person interview was conducted with each respective FLM. Questions were asked concerning the length of time they were managers, their professional degree and the unit's overall working conditions, for example staffing issues, unit layout and facilities.

4.4 | Data analysis

Initially, the quantitative and qualitative data were analysed separately (Figure 1). In the first step, the transcribed field notes were divided into a total of 378 observation units, that is when one activity ended and another started. HCP's working conditions were then categorised according to description and distribution (Table 2). Additionally, data from observation units were deductively categorised by the first author and quantified into different types of risk behaviours (Table 3) as described by Lindberg et al., (2017). To assess consistency regarding the determination of risk behaviours, the first and last authors independently analysed risk behaviours from three randomly selected observation days (42 observation units = 11% of the total 378). Inter-rater reliability for the 2-category classification (identifying no risk behaviour versus risk behaviour) was analysed with Kappa statistics (K) plus Gwet's agreement coefficient (AC1) and their 95% confidence intervals (95% CIs). The AC1 statistic is

	QUAL	QUAN	QUAL	QUAN
Data collection	**Procedure** Focused observations of 79 healthcare personnel from eight units **Timing** Mornings at the units between February 28th to May 6th, 2019 **Product*** Field notes	**Procedure** Questions about background data + working conditions with the same 79 healthcare personnel **Timing** Prior to the observations **QUAN** (structured data) **Product QUAN** Background data about healthcare personnel (Table 1) **Product*** Data set of working conditions for respective healthcare personnel	**Procedure** Semi-structured interviews with the same 79 healthcare personnel **Timing** After the observations **QUAL** (semi-structured data) **Product*** Transcripts	**Procedure** Structured interviews with first-line managers from respective unit (n=8) **Timing** Sometime during the observation days **Product QUAN** Background data regarding first-line managers and units (Table 1) **Product*** Data set of each unit's overall working conditions covering aspects of staffing, physical layout and facilities

	QUAL → QUAN	QUAN	QUAL	QUAN
Data analysis	**Procedure** Dividing field notes into observation units. Categorization of observation units into: -Location of activity -Colleagues working together -Character of activity Categorization of interrupted activities into: -Interruption requires changing location -Source of interruption Categorization and quantification of: -Risk behaviours **Product QUAN** -Observation units -Description and distribution of healthcare personnel's working conditions (Table 2) and risk behaviours (Table 3) linked with each observation unit (Table 4)	**Procedure** Linking healthcare personnel's working conditions with observation units **Product QUAN** -Description and distribution of healthcare personnel's working conditions -Number of patients -Estimated overall patient-level workload -Staffing levels -Bed occupancy (Table 2) Linked with each observation unit (Table 4)	**Procedure** Qualitative content analysis of transcripts **Product QUAL** Categories describing the content areas: working conditions (including interruptions) and Healthcare personnel's reflections on risk behaviours (Table 5)	**Procedure** Two-step cluster analysis based on information from all of the units' overall working conditions **Product QUAN** Cluster solution

	Procedure Statistical analysis of quantitative products: Pearsons's chi-squared x^2, Kruskal-Wallis H, Mann-Whitney U **Product QUAN** Comparisons between working conditions and total respective risk behaviour category (Table 6) Comparisons between clusters and total respective risk behaviour category (Table 7)			
Results	**Merging of QUAL and QUAN results** **Mixed methods Product** Integrated interpretation of healthcare personnel's working conditions and their relationship to risk behaviours for organism transmission			

†: Products marked with * are used in additional analysis. When grey background, products are presented as results.

FIGURE 1 Procedural diagram of the convergent mixed-methods study design, with qualitative (QUAL) and quantitative (QUAN) data. †: Products marked with * are used in additional analysis. When grey background, products are presented as results

more robust than K statistics and has therefore been recommended as an alternative or complement to K (Wongpakaran et al. 2013). Additionally, since K statistics can sometimes be low despite high levels of agreement, we also calculated the prevalence-adjusted bias-adjusted kappa (PABAK) (Sim & Wright, 2005). The data set of working conditions for the respective HCP was linked to the observation

SETTING	n = 8	SAMPLE	
Hospital units		**Healthcare Personnel**	**n = 79**
Community hospital units	3	**Education**	
District hospital units	3	RN, number	37
Regional/university hospital units	2	AN, number	42
Unit specialty		**Sex**	
Surgical	4	Women, number	70
Orthopaedic	4	Men, number	9
Units' physical layout		**Age, years** mean (SD)	39.6 (12.8)
Square form	1	**Working experience, years** mean (SD)	11.6 (13.3)
Two parallel corridors	3	**Years at present unit,** mean (SD)	6.4 (8.4)
Long corridor	2		
T-formed	2	**First-line Managers**	**n = 8**
Number of patient beds		**Number of subordinates**	
10–19	3	30–39	1
20–30	5	40–49	4
Work structure		50–59	2
Pair = RN & AN work together	2	60–69	1
Team = RN +2 or more ANs	3	**Professional degree**	
Mixed = pair/team	3	Registered nurse, number	8
Entire unit open		**Sex**	
Yes	4	Women, number	8
No (due to lack of personnel)	4	**Years as FLM,** mean (SD)	4.1 (7.7)
Type of patient rooms			
Only single patient rooms	2		
Single and double rooms	3		
Single/double/four beds per room	2		
Single/double/four/six beds per room	1		

Abbreviations: AN: Assistant nurse; FLM: First-line manager; RN: Registered nurse; SD: Standard deviation.

units and added to Table 2. An example of the field note analysis and linkages to HCP's working conditions is illustrated in Table 4.

In the second step, transcriptions from the semi-structured interviews were analysed using qualitative content analysis (Graneheim & Lundman, 2004). The interviews were read through repeatedly to get an overall understanding and then read closely to deductively divide the text into the content areas: working conditions (including interruptions) and reflections on risk behaviours. The text within the content areas was thereafter inductively divided into meaning units, and when needed condensed before being labelled with a code. The codes were compared based on their differences and similarities and sorted into categories and subcategories, which the qualitative results are based on. For the content area regarding reflections on risk behaviours, the text was deductively divided into risk behaviours that formed the categories. Presented in Table 5 are the content areas with their categories and subcategories that describe the HCP's perceptions of working conditions in relation to risk

behaviours for organism transmission. The first author conducted the analysis and discussed it with the other authors until consensus was reached. Results from the semi-structured interviews generated questions that were clarified by statistical analyses.

Cluster analysis is a method that can be used to determine which objects are similar to each other in a given set and to group similar objects into clusters (Romesburg, 2004). The third step in this study's data analysis was to classify the units based on similarities and dissimilarities, and create clusters with units having similar working conditions. The data set of each unit's overall working conditions was used, and a two-step cluster analysis with distance measure log-likelihood was performed (Romesburg, 2004). Based on visual inspection of Akaike's information criterion (AIC), both three and four clusters were considered as appropriate since they had good cluster quality measured by the Silhouette index (SI). Final determination based on clinical relevance revealed three clusters. The stability and reliability of the cluster analysis was confirmed by

TABLE 2 Description and distribution of healthcare personnel's observed and perceived working conditions

Working conditions	Frequencies (%)
Location of activity, based on observation units (*n* = 378)	
Single patient room	187 (49.5)
Double room	86 (23)
Four-bed room	23 (6)
Six-bed room	25 (6.5)
Other location	57 (15)
Healthcare personnel (HCP) working together, based on observation units (*n* = 378)	
Yes (Two or more colleagues working together)	98 (26)
No (The HCP perform the care activity independently)	280 (74)
Character of activity, based on observation units (*n* = 378)	
Single (Containing one single activity)	77 (20.5)
Combined (Containing several subsequent activities)	142 (37.5)
Interrupted (The HCP was interrupted during the task)	159 (42)
Interruption requires change of location, based on interrupted activities (*n* = 159)	
Yes (The HCP has to change locations due to the interruption)	91 (57)
No (The HCP does not change location due to the interruption)	68 (43)
Source of interruption, based on interrupted activities (*n* = 159)	
Colleague (Including interruptions from other healthcare professionals/colleagues or work phone)	65 (41)
Patient (Including interruptions from patients, relatives and nurse call button)	72 (45)
Self-interruption (e.g. forgetting or misplacing equipment/supplies)	22 (14)
Number of patients, based on observation units (*n* = 378)	
Caring for 2–4 patients	231 (61)
Caring for 5–7 patients	120 (32)
Caring for 8–10 patients	27 (7)
Estimated overall patient-level workload, based on observation units (*n* = 378)	
Low-need (The HCP estimated overall patient-level workload to be low based on clinical condition of patients and level of care needs)	58 (16)
Medium-need (The HCP estimated overall patient-level workload to be medium based on clinical condition of patients and level of care needs)	183 (48)
High-need (The HCP estimated overall patient-level workload to be high based on clinical condition of patients and level of care needs)	137 (36)

(Continues)

TABLE 2 (Continued)

Working conditions	Frequencies (%)
Staffing levels, based on observation units (*n* = 378)	
Understaffed	96 (25.5)
Fully staffed	44 (11.5)
Overstaffed	238 (63)
Bed occupancy, based on observation units (*n* = 378)	
Patient beds available	200 (53)
At full capacity	146 (38.5)
Over full	32 (8.5)

repeating the clustering procedure, which resulted in the same cluster grouping and quality.

In the fourth step, the descriptive statistics regarding risk behaviours and working conditions were analysed. Due to the non-normal distributed data, Kruskal–Wallis H and Mann–Whitney U non-parametric tests were used to compare risk behaviours in relation to working conditions. Pearson's chi-squared test was used to compare the sources of the interruptions incurred by the RNs and ANs. Significance was set as $p \leq .05$. Statistical analyses were calculated in IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp. Armonk, NY, USA). WINPEPI Program Version 11.65 was used to calculate inter-rater reliability.

Finally, the qualitative and quantitative findings were merged and presented together in the results to achieve an integrated interpretation of HCP's working conditions in relation to risk behaviours for organism transmission.

4.5 | Ethical considerations

The Swedish ethical review authority approved the study protocol (reg. no. 2019-00530). Before data collection, information about the aim, methods and their right to withdraw at any time was given and written informed consent was obtained from all participants. All patients involved were asked for verbal approval of the observer's presence.

5 | RESULTS

The results start with descriptive statistics, and then, the integrated findings are illustrated. The integrated findings begin with descriptions from the qualitative material, including quotations, followed by the quantitative statistical analyses. A complete description of categories and subcategories generated from the content analysis is described in Table 5, and all of the statistical analyses are presented in Table 6. Finally, the healthcare personnel's reflections on observed risk behaviours are illustrated.

TABLE 3 Description and distribution of observed risk behaviours

Risk behaviour	Description	Frequencies (%)
Hand disinfection	Does not disinfect hands	721 (56.5)
Placement of materials	Inappropriate placement of contaminated material, returns dispensed material	184 (14.5)
Work-clothes	Contaminates clothing, inappropriate use of protective clothing, does not use apron, does not change apron	135 (10.5)
Glove usage	Does not use gloves, does not change gloves	113 (8.9)
Cleaning	Does not clean objects, does not clean with appropriate agent	76 (5.9)
Aseptic	Inappropriate aseptic technique	40 (3.2)
Contaminated water	Uses water that should be changed	4 (0.3)
Hand wash	Does not wash hands with soap and water when caring for patients experiencing vomiting or diarrhoea	2 (0.2)
		1275 (100%)

5.1 | Descriptive statistics of healthcare personnel's working conditions and risk behaviours for organism transmission

Almost half of the observed activities were conducted in single patient rooms, and in over 40% of the observed activities, the HCP were interrupted. The majority of units were overstaffed and had available patient beds. Descriptions and distribution of the HCP's observed and perceived working conditions are presented in Table 2. In total, 1275 risk behaviours for organism transmission were observed, which calculates to approximately one risk behaviour every five minutes. The most frequent risk behaviours were related to missed hand disinfection, inappropriate placement of contaminated materials and inappropriate use of protective clothing. Descriptions and distribution of observed risk behaviours are presented in Table 3. A substantial inter-rater reliability for the categorisation of risk behaviour was demonstrated since the Cohens kappa was 0.74, (SE = 0.051; 95% CI: 0.67–0.81), the adjusted kappa PABAK 0.75, and Gwet's AC1-statistic was 0.76 (SE = 0.033; 95% CI: 0.69–0.82).

5.2 | Working conditions in relation to risk behaviours for organism transmission

Staffing levels were described by the HCP in the interviews as being a crucial working condition when it comes to influencing their infection prevention behaviour. Some HCP discussed how overstaffing could make the work unstructured and create difficulties in knowing who does what, while most HCP described how being fully staffed made it easier to care for all of the patients and their needs. *When it is this well staffed, it is easier to have time for things and do them well and all the hygiene steps, but otherwise it gets a little trickier (RN).* Other members of the healthcare team, who are not assigned to a particular patient or patients and could help as an extra resource,

were described as beneficial. Ancillary/auxiliary staff such as coordinators, receptionists, pharmacists and kitchen staff were highly appreciated and were described as facilitators that helped them follow hygiene guidelines. Less discussed were bed occupancy and number of patients. However, there were no significant differences when comparing the number of risk behaviours between staffing levels, bed occupancy or number of patients in the statistical analyses, see Table 6.

In the interviews, the HCP associated physical factors such as confined work areas, wheelchairs and other equipment that stood in the way and hindered the work flow with potential risk factors. Patients sharing rooms, toilets or equipment were also described as potential risks for organism transmission. Crucial working conditions described as influencing their infection prevention behaviour were the availability and placement of disinfection agents and protective equipment. When equipment and hand or surface disinfection agents were missing or poorly placed, for example it was not where it was supposed to be and the HCP had to look for it in another area, the HCP told how that could lead to decreased usage. There was an expressed disagreement between the HCP regarding an increased likelihood of risk behaviours in rooms with more than one patient, although the majority had the opinion that there was an increased risk. *When you're in a single patient room, the conditions are a little better. When you are in a large room with many patients, it's easy to be careless and go between patients. When you close the door and go in to a new patient, you think more about hygiene (RN).* In the comparative statistical analyses from the observations, there were significantly more risk behaviours involving work-clothes in a six-bed room compared to a single, double and four bed room. No additional significant differences were identified in the remaining risk behaviour categories when comparing patient rooms, Table 6.

Patient-level workload based on the clinical condition and level of care needs of the patients was frequently discussed during the interviews and was associated with workload. Caring for patients with low-need levels was associated with good working conditions and adequate

TABLE 4 Example from analysis of field notes

Observation unit	Identified risk behaviour	Healthcare personnel (HCP) working conditions	Interruption in activity (written in italics)
Assistant nurse (AN) walks into the patient's room with a trolley for blood testing. Puts the trolley beside the bed. Opens[1] the trolley and gathers up a needle, a test tube, and some alcohol swabs. Gathers an alcohol swab and from a sealed box on the trolley some tape. Takes the tourniquet from the trolley and fastens it on the patient's arm. Leans[2] against the bed, looks and feels[3] for veins. Disinfects the patient's skin with the alcohol swab. Feels the vein once again. Takes[4] the needle and sticks[5] the patient. No blood returns. Loosens the tourniquet. Removes the needle, applies the needle safety shield and tapes a dry swab over the puncture site. Puts the needle in the patient's bed[6]. Opens[7] the trolley and gathers a new needle. *A colleague comes in and talks to the AN.* AN tightens the tourniquet again. Feels[8] another vein. Disinfects the skin. Sticks[9] the patient, fills up the test tube and puts it on the trolley. Releases the tourniquet. Removes the needle, applies the needle safety shield and tapes a new dry swab over the puncture site. Discards both needles in the needle safety box on the trolley. Verifies the patient's identity and marks the test tube. Hangs the tourniquet on the side of the trolley[10]. Discards the waste materials and disinfects hands. Takes the trolley and leaves it at its assigned place in the corridor[11]. Walks to the nurse's office and writes a nursing documentation[12].	Hand disinfection Work-clothes Hand disinfection Glove usage Aseptic Placement of material Hand disinfection Hand disinfection Glove usage Cleaning Cleaning Hand disinfection Numbers of risk behaviours: 12	Location of activity: Four-bed room HCP work in pairs: No Character of activity: Interrupted Numbers of patients AN responsible for: 8	Estimated patient-level workload: Low-need Unit's staffing levels: Fully staffed Unit's bed occupancy: Patient beds available	Interruption requires changing locations: No Source of interruption: Colleague
AN walks into patient's room with a bladder scanner. Puts on gloves[1]. Applies gel on patient's abdomen over bladder. Takes the probe and scans the bladder. Disinfects the probe with an alcohol swab. Discards the swab. Wipes patient's skin. Removes and throws gloves away[3]. Walks out and places the bladder scan[4] in the corridor.	Hand disinfection Work-clothes Hand disinfection Cleaning Numbers of risk behaviours: 4	Location of activity: Six-bed room HCP work in pairs: No Character of activity: Single Numbers of patients AN responsible for: 7	Estimated patient-level workload: Medium-need Unit's staffing levels: Overstaffed Unit's bed occupancy: Patient beds available	-

TABLE 5 Content areas, categories and subcategories describing healthcare personnel's perceptions of working conditions in relation to risk behaviours for organism transmission

Content area: Working conditions (including interruptions)		
Staffing levels	Advantages with sufficient staffing levels	Sufficient staffing levels facilitate compliance with hygiene guidelines
		With good resources healthcare personnel can ask for help
		Extra staff resources and ancillary/auxiliary staff are facilitators that help healthcare personnel follow hygiene guidelines
	Difficulties due to overstaffing	Work can be unstructured
		Difficulties knowing who does what
Physical factors	Design of the premises	Small or crowed premises are difficult to work in and increase the risk for organism transmission
		Spacious premises facilitate work
	Access to and placement of disinfection agents and protective equipment affects healthcare personnel compliance with hygiene guidelines	Absence of protective equipment complicates compliance
		Having to go far or look for materials decreases compliance with hygiene guidelines
		Adequate availability of protective supplies/equipment facilitates compliance
		Convenient and easy access to hand and surface disinfection agents increases compliance
	Potential risks for organism transmission when patients sharing premises or equipment	Patients sharing room or toilet are risks for organism transmission
		No difficulties with hygiene guidelines despite patients sharing room
		Patients sharing aids or equipment are risks for organism transmission
Patient-level workload and workload	Factors contributing to adequate workload	Caring for low-need patients
		Adequate tempo with no stress facilitates work
	Factors contributing to heavy workload	High-need patients needing extensive care
		Sudden events
		Patients whose condition has declined
		Discharges
Psychosocial working environment	Interaction with colleagues important for work environment	Good cooperation between colleagues facilitates work
		Cooperation- and communication shortcomings complicates work
	Workplace culture and engagement influences infection prevention behaviour	The managers involvement in infection prevention affects the workplace culture
		Being each other's role model improves infection prevention practices
Interruptions	Experienced sources of interruptions	Colleagues
		Work phone
		Doctors' rounds
		Self-interruptions
		Patients
		Patients' relatives
	Interruptions as potential risk behaviours involving subcategories	Hand hygiene
		Work-clothes
		Glove usage
		Placement of materials
		Cleaning
		Aseptic technique
	Healthcare personnel who did not experience being interrupted/ interruptions	Being able to focus on the work task
		Being able to complete work tasks
		Working in peace and quiet

(Continues)

TABLE 5 (Continued)

Content area: Working conditions (including interruptions)	
Content area: Reflections on risk behaviours	
Risk behaviours	Reflections regarding hand disinfection
	Reflections regarding work-clothes
	Reflections regarding glove usage
	Reflections regarding placement of materials
	Reflections regarding cleaning
	Reflections regarding aseptic technique

tempo. In contrast, high-need patients requiring extensive care were said to increase workload and stress, which they associated with an increased risk for organism transmission. *Today it is rather extreme since none of the eight take care of themselves, not even those on the waiting list...//... that can affect hygiene (RN).* Unexpected events, patient's whose conditions had declined and discharges were also associated with a heavy workload. Since patient-level workload was emphasised in the qualitative data, a variable based on the overall clinical condition and level of care needs was developed. In the comparative statistical analyses, no significant differences could be seen in the number of risk behaviours when examining the low-, medium- and high-need patients (Table 6). A consequence of high-need patients according to the HCP was the need to work together when giving the care. Some described how this increased their workload further and negatively influenced infection prevention behaviours. In the statistical analysis, when comparing situations where the HCP worked together during patient care activities to situations where the HCP worked independently, this finding was confirmed in all of the risk behaviour categories except for risk behaviours involving glove usage (Table 6).

During the interviews, the HCP expressed how the psychosocial working environment played a crucial role in both the working conditions and their infection prevention behaviour. They emphasised that their colleagues and managers' involvement was crucial for the workplace culture regarding infection prevention and discussed how involvement, attitudes and behaviours are influenced by others. *Everyone is very careful and we remind each other 'you forgot your apron', sometimes you can do it without saying anything by taking an extra apron and giving it to the other person (AN).* Good cooperation and trust between colleagues were said to positively influence the work environment and benefit hygiene practices, while communication shortcomings were described to do the opposite. *It has been, what should I say, a crazy day with very little communication ...//... it gets cramped, not literally, there are a lot of people talking, but there is no unity. A lot can fall between the cracks on a day like this (AN).*

The cluster analysis based on all of the units' overall working conditions resulted in three cluster groups with the following characteristics:

Cluster 1 = Lacking kitchen staff and a room for overflow of patients (2 units).

Cluster 2 = High-need patients throughout plus high staff turnover (4 units).

Cluster 3 = Only single patient rooms with accompanying disinfection room and linen cupboard for each room (2 units).

When comparing risk behaviours in relation to clusters, there were significantly more risk behaviours regarding work-clothes in cluster 1 and 2 compared to cluster 3. The remaining risk behaviours showed no significant differences (Table 7).

5.2.1 | Interruptions in relation to risk behaviours

The HCP told how interruptions were common and emphasised how interruptions negatively influenced their working conditions and infection prevention behaviour. This was confirmed in the statistical analyses where all of the risk behaviour categories had significantly higher numbers during interrupted activities compared to risk behaviours during single and combined activities. During those occasions when HCP had to change locations due to the interruption, the number of total risk behaviours and risk behaviours concerning hand hygiene was significantly higher than interrupted activities that did not require the HCP to go to a different location. The RNs frequently discussed how the majority of the interruptions were derived from colleagues and the work phone. In contrast, the ANs described how interruptions from patients, including nurse call button, were the major source of interruptions. *Especially evenings, weekends and when doctors are on-call you have more patients and you get disturbed by others, you have to check the calls ...//... you can't really relax because you might have to go to the next one (AN).* The different sources of the interruptions described by the RNs and ANs were investigated and confirmed in the statistical analyses (Table 6). The HCP also discussed self-interruptions, for example forgotten supplies/equipment or a lack of concentration. Having sufficient time to think and prepare before different procedures was described as essential to avoid self-interruptions.

5.3 | Healthcare personnel's reflections on risk behaviours from the observations

During the interviews, the HCP were often, from the start, unaware of the risk situations they had participated in, this despite the fact that all of the participants performed risk behaviours at some time during the time they were being observed. However, as the

TABLE 6 Comparisons between working conditions, the total risk behaviours and each respective risk behaviour

	Total risk behaviours	Risk behaviours regarding hand disinfection	Risk behaviours regarding placement of materials	Risk behaviours regarding work-clothes	Risk behaviours regarding glove usage	Risk behaviours regarding cleaning	Risk behaviours regarding aseptic technique
Location of activity							
Single patient room mean (SD) IQR	4.1 (3.8) 3	2.0 (1.8) 2	0.6 (1.2) 1	0.4 (0.6) 1	0.4 (0.7) 1	0.3 (0.6) 0	0.1 (0.4) 0
Double room mean (SD) IQR	3.9 (3.0) 3	2.2 (1.8) 2	0.5 (0.8) 1	0.3 (0.6) 1	0.2 (0.6) 0	0.2 (0.4) 0	0.1 (0.4) 0
Four-bed room mean (SD) IQR	3.5 (3.0) 4	1.6 (1.7) 1	0.5 (0.7) 1	0.3 (0.5) 1	0.4 (0.8) 1	0.3 (0.5) 0	0.09 (0.3) 0
Six-bed room mean (SD) IQR	4.4 (3.0) 4	1.6 (1.1) 1	0.5 (0.9) 1	1.0 (1.0) 2	0.3 (0.8) 0	0.3 (0.5) 1	0.04 (0.2) 0
Test statistics H (df)	1.377 (3)	5.091 (3)	0.442 (3)	12.256 (3)	4.673 (3)	1.555 (3)	
p-Value	.711	.165	.931	**.007**	.197	.670	
Bonferroni Post hoc test				1–2 0.696 1–3 0.803 1–4 **0.001** 2–3 0.985 2–4 **0.001** 3–4 **0.009**			
Healthcare personnel work in pairs							
Yes mean (SD) IQR	4.4 (4.1) 3	2.4 (2.2) 2	0.8 (1.4) 1	0.3 (0.6) 0	0.4 (0.7) 1	0.3 (0.5) 1	0.2 (0.5) 0
No mean (SD) IQR	3.0 (2.6) 3	1.7 (1.4) 1	0.4 (0.8) 1	0.4 (0.6) 1	0.3 (0.6) 0	0.2 (0.5) 0	0.1 (0.3) 0
Test statistics U	16241.5	15943	15858	11974	14857	15289	14799
p-Value	**.006**	**.014**	**.004**	**.019**	.093	**.010**	**.018**
Character of activity							
Single mean (SD) IQR	1.4 (1.1) 1	0.9 (0.6) 1	0.1 (0.3) 0	0.3 (0.5) 0	0.1 (0.3) 0	0.03 (0.2) 0	0.03 (0.2) 0
Combined mean (SD) IQR	2.5 (1.8) 2	1.6 (1.1) 1	0.3 (0.6) 0	0.3 (0.5) 1	0.2 (0.4) 0	0.1 (0.4) 0	0.04 (0.2) 0
Interrupted mean (SD) IQR	5.1 (3.7) 5	2.7 (2.1) 3	0.9 (1.4) 1	0.5 (0.7) 1	0.5 (0.8) 1	0.4 (0.6) 1	0.2 (0.5) 0
Test statistics H (df)	1114.606 (2)	76.476 (2)	44.142 (2)	9.399 (2)	28.774 (2)	26.680 (2)	17.385 (2)
p-value	**<.001**	**<.001**	**<.001**	**.009**	**<.001**	**<.001**	**<.001**
Bonferroni Post hoc test	1–2 **<0.001** 1–3 **<0.001** 2–3 **<0.001**	1–2 **<0.001** 1–3 **<0.001** 2–3 **<0.001**	1–2 **0.017** 1–3 **<0.001** 2–3 **<0.001**	1–2 0.565 1–3 **0.008** 2–3 **0.014**	1–2 0.455 1–3 **<0.001** 2–3 **<0.001**	1–2 0.062 1–3 **<0.001** 2–3 **0.001**	1–2 0.690 1–3 **0.001** 2–3 **<0.001**
Interruption requires a change of location							
Yes	5.6 (3.8) 5	3.1 (2.3) 3	0.9 (1.4) 2	0.5 (0.8) 1	0.5 (0.7) 1	0.3 (0.6) 1	0.3 (0.5) 0

(Continues)

TABLE 6 (Continued)

	Total risk behaviours	Risk behaviours regarding hand disinfection	Risk behaviours regarding placement of materials	Risk behaviours regarding work-clothes	Risk behaviours regarding glove usage	Risk behaviours regarding cleaning	Risk behaviours regarding aseptic technique
No	4.6 (3.5) 4	2.2 (1.5) 2	0.7 (1.3) 1	0.4 (0.6) 1	0.5 (0.9) 1	0.4 (0.7) 1	0.1 (0.4) 0
Test statistics U	3804	3823	3362	3178	3235	3053	3429
p-Value	.03	.024	.476	.986	.806	.597	.173
Number of patients healthcare personnel are responsible for							
2–4 mean (SD) IQR	3.5 (3.5) 4	2.0 (1.9) 2	0.6 (1.2) 1	0.3 (0.6) 1	0.3 (0.7) 0	0.2 (0.5) 0	0.1 (0.4) 0
5–7 mean (SD) IQR	3.2 (2.4) 4	1.8 (1.3) 1	0.4 (0.8) 1	0.4 (0.6) 1	0.3 (0.6) 0	0.2 (0.6) 0	0.09 (0.3) 0
8–10 mean (SD) IQR	2.8 (1.9) 3	1.9 (1.4) 2	0.3 (0.4) 1	0.4 (0.5) 1	0.3 (0.5) 1	0.04 (0.2) 0	0.04 (0.2) 0
Test statistics H (df)	0.320 (2)	0.168 (2)	1.414 (2)	2.322 (2)	0.374 (2)	4.721 (2)	0.890 (2)
p-Value	.852	.920	.493	.313	.829	.094	.641
Patient-level workload							
Low-need mean (SD) IQR	3.0 (2.4) 2	1.7 (1.4) 1	0.3 (0.6) 0	0.3 (0.5) 1	0.3 (0.6) 0	0.2 (0.4) 0	0.09 (0.3) 0
Medium-need mean (SD) IQR	3.2 (2.5) 4	1.8 (1.4) 1	0.5 (0.9) 1	0.3 (0.6) 1	0.3 (0.6) 0	0.2 (0.6) 0	0.1 (0.3) 0
High-need mean (SD) IQR	3.8 (3.9) 4	2.2 (2.0) 2	0.6 (1.3) 1	0.4 (0.7) 1	0.3 (0.7) 1	0.2 (0.4) 0	0.1 (0.4) 0
Test statistics H (df)	0.734 (2)	1.933 (2)	3.939 (2)	0.762 (2)	0.664 (2)	0.522 (2)	0.193 (2)
p-Value	.693	.380	.140	.683	.717	.770	.908
Staffing levels							
Understaffed mean (SD) IQR	2.8 (2.1) 3	1.7 (1.3) 1	0.4 (0.9) 0	0.2 (0.5) 0	0.2 (0.5) 0	0.2 (0.4) 0	0.06 (0.3) 0
Fully staffed mean (SD) IQR	3.5 (3.2) 4	2.1 (2.1) 2	0.6 (1.0) 1	0.4 (0.5) 1	0.3 (0.5) 0	0.1 (0.4) 0	0.07 (0.3) 0
Overstaffed mean (SD) IQR	3.6 (3.4) 4	1.9 (1.8) 2	0.5 (1.0) 1	0.4 (0.7) 1	0.4 (0.7) 1	0.2 (0.6) 0	0.13 (0.4) 0
Test statistics H (df)	3.103 (2)	0.216 (2)	5.100 (2)	5.517 (2)	3.992 (2)	1.695 (2)	2.709 (2)
p-Value	.212	.898	.078	.063	.136	.429	.258
Bed occupancy							
Beds available mean (SD) IQR	3.4 (3.1) 4	2.0 (1.7) 2	0.5 (1.0) 1	0.4 (0.7) 1	0.2 (0.6) 0	0.2 (0.4) 0	0.1 (0.4) 0
At full capacity mean (SD) IQR	3.3 (3.0) 4	1.7 (1.5) 1	0.5 (1.0) 1	0.3 (0.5) 1	0.4 (0.7) 1	0.3 (0.6) 0	0.09 (0.3) 0
Over full mean (SD) IQR	3.5 (3.6) 4	2.1 (2.1) 2	0.4 (0.7) 1	0.2 (0.4) 0	0.4 (0.7) 1	0.2 (0.5) 0	0.2 (0.5) 0

(Continues)

TABLE 6 (Continued)

	Total risk behaviours	Risk behaviours regarding hand disinfection	Risk behaviours regarding placement of materials	Risk behaviours regarding work-clothes	Risk behaviours regarding glove usage	Risk behaviours regarding cleaning	Risk behaviours regarding aseptic technique
Test statistics H (df)	0.048 (2)	1.772 (2)	0.227 (2)	2.830 (2)	4.982 (2)	1.052 (2)	0.127 (2)
p-Value	.976	.412	.893	.243	.083	.591	.938

Source of the interruption	Registered nurses %	Assistant nurses %
Colleague	58.5	27
Patient	23.5	55
Self-interruption	18.0	18
Test statistics χ^2 *p*-value	**<.001**	

Abbreviations SD, Standard deviation; IQR, Interquartile range; df, Degrees of Freedom. H, Kruskal–Wallis; U, Mann–Whitney; x^2: Pearsons's chi-squared. Significant values in bold.

†Risk behaviours regarding contaminated water and hand washing were not analysed because too few observations occurred to be included in the analysis.

TABLE 7 Comparisons between clusters, the total risk behaviours and each respective risk behaviour

Risk behaviour	Cluster 1 (n = 2)			Cluster 2 (n = 4)			Cluster 3 (n = 2)			Test statistics Kruskal–Wallis H	df	*p*-value	Bonferroni post hoc test *p*-value
	Mean	SD	IQR	Mean	SD	IQR	Mean	SD	IQR				
Total risk behaviours†	3.6	3.2	4	3.3	3.1	3	2.9	2.6	4	3.217	2	.2	
Hand disinfection	2.0	1.6	2	1.9	1.9	12	1.7	1.5	2	1.721	2	.423	
Placement of materials	0.5	1.1	1	0.6	1.0	1	0.4	0.7	1	1.437	2	.487	
Work-clothes	0.5	0.7	1	0.3	0.5	1	0.1	0.3	0	15.184	2	**.001**	1–2 0.197 1–3 <**0.001** 2–3 **0.009**
Glove usage	0.3	0.6	0	0.4	0.7	1	0.3	0.6	0	3.368	2	.186	
Cleaning	0.2	0.6	0	0.2	0.4	0	0.2	0.5	0	0.516	2	.773	
Aseptic technique	0.1	0.4	0	0.1	0.3	0	0.1	0.4	0	0.789	2	.674	

Abbreviations SD, Standard deviation; IQR, Interquartile range. Significant values in bold.

†Risk behaviours regarding contaminated water and hand washing were not analysed because too few observations occurred to be included in the analysis.

interviews progressed and they discussed situations that had occurred during the day, the HCP often became aware of situations. The most frequently occurring risk behaviours were discussed in the interviews, which often occurred in relation to their working conditions. The HCP mentioned stress and interruptions as reasons for missed hand disinfection. They were aware that hand disinfection sometimes was neglected before putting on and after removing gloves. Some expressed uncertainty on when to wear gloves. The majority of the HCP were aware they sometimes used gloves inappropriately, for example did not change gloves between moments or that they were overusing gloves more for self-protection rather than hygiene. Not wearing an apron was considered to be a risk for organism transmission, and several participants were aware that they had sometimes missed wearing an apron during the observations. Most often when aprons were missed, the HCP described how the original intention was not to have close patient contact, for example only dispense medication. Other reasons discussed by the HCP for not wearing an apron were that it was time-consuming and plastic was bad for the environment. *I had just entered the room when I realized I had forgotten something. I put the apron in my pocket because I hadn't used it yet. Then, when I came back, I took it out and used it. I think of it as recycling (AN).* When the disinfectant to clean surfaces and equipment was missing or hard to reach, it was considered less important and not used to save time. However, the HCP described missed disinfection or inadequate placement of materials or equipment as being risks for organism transmission. Another situation mentioned as a risk was the lack of aseptic technique during intravenous medication administration. The major reasons for this according to the RNs were stress and forgotten materials. Risks for organism transmission were often associated with caring for patients that had diarrhoea, vomiting or multidrug-resistant bacteria. Some HCP had not perceived that they had been at risk for organism transmission that particular day because they had not cared for patients with any of those conditions.

6 | DISCUSSION

Regardless of the HCP's observed and perceived working conditions, risk behaviours for organism transmission frequently occurred during care activities. In our mixed-methods study, HCP described several working conditions such as staffing levels, patient-level workload, physical factors and interruptions as important aspects that influenced their infection prevention behaviour. However, in the comparative statistical analysis from the observation data, the risk behaviours were mostly related to situations where the HCP worked together during patient care activities and interrupted activities. Interruptions had a significant association with several risk behaviour categories that have also been described in previously published studies on HCP's risk behaviours for organism transmission (Lindberg et al., 2017, 2018).

In the qualitative part of our study, the HCP did emphasise how interruptions influenced their working conditions and their infection prevention behaviour. However, half of the interruptions were made by colleagues. This is in line with several previous studies that found the majority of interruptions to be made by colleagues (Monteiro et al. 2020; Schroers, 2018; Wagner et al., 2020). Interruptions are well researched in relation to medication safety. In a mixed-method before and after study, significant reductions in both interruptions and medication errors occurred when RNs used do-not-disturb vests while preparing and administering medications. However, the RNs raised some concerns about this approach. Since the RNs perceived the interruptions as mainly coming from other colleagues, they felt the vests would attract attention. There was also the issue of hygiene because several colleagues shared the same vest (Verweij et al., 2014). Our study's results revealed that the RNs were interrupted by colleagues significantly more than the ANs were. The ANs were interrupted primarily by the patients. Interruptions are described to be part of health care and something that cannot be completely avoided (Hopkinson & Wiegand, 2017), but reducing interruptions would benefit the HCP's working conditions as well as patient safety (Monteiro et al., 2015). Hopkinson and Wiegand (2017) concluded that RNs would benefit from education to increase further understanding and awareness of their contribution to interruptions and how they interact in a complex system. However, based on our study's results, we can conclude that it can be more challenging to decrease interruptions among ANs than RNs. This is valuable knowledge when designing future interventions aiming to reduce interruptions in order to prevent risk behaviours for organism transmission. Future interventions could benefit from strategies designed collectively with RNs, ANs and FLMs together to reduce unnecessary interruptions from colleagues and patients. In a newly published observational study, the RNs were found to continue with the primary task they had started half the time and did not change to a secondary task caused by the interruption (Wagner et al., 2020). In our study, 43% of the interruptions led to the HCP having to go to a different location, and among these there were significantly more risk behaviours regarding hand hygiene. These results also emphasise the importance of preventing interruptions. An observational study found interruptions to be most frequent during the mornings between the hours of 7 and 11 (Yen et al., 2018). In our study, data were collected during the mornings, and interruptions occurred frequently. ANs described the patients' use of the nurse call button to be a common source of interruptions. In a qualitative study, some patients told how they were willing to receive attention from different RNs and thought it was more important to receive attention quickly. In contrast, some patients expressed difficulties in having to relate to different personnel (Klemets & Evjemo, 2014). However, it is not the patients' use of call buttons per se that is the issue, but how they are handled by the HCP. Klemets and Evjemo (2014) discussed technical aids that could be used by the HCP to change and review each other's availability status and prevent unwanted interruptions.

An interesting result in our study was the increased frequency of risk behaviours when the HCP worked together during patient care activities. Reasons for these results are yet to be answered. It may have links to interruptions and difficulties foreseeing the colleague's

next move. A consequence of personal chemistry or communication shortcomings are also possibilities. Information is lacking regarding any differences between the different constellations of HCP. When studying human behaviours, social interactions must be considered since the context influences the individual (Rasmussen, 2003). Earlier research has described communication and teamwork failures as contributing factors to adverse events. Two newly published systematic reviews found that team training could improve teamwork skills such as situational awareness, communication and safety attitudes (Costar & Hall, 2020; Wu et al., 2020). Some studies in a review by Costar and Hall (2020) also measured patient outcomes. A reduction of HCAI were obtained in intervention studies that used team training, such as role-play and simulation exercises (Costar & Hall, 2020). This phenomenon needs to be studied in more detail to investigate possible reasons for the increased frequencies of risk behaviours when HCP work together.

In our study's results, ~50% of the total risk behaviours comprised missed hand hygiene, which has long been known as the major risk for organism transmission in health care (Allegranzi & Pittet, 2009). Additionally, the majority of interventions aiming to reduce the risks for HCAI have concentrated on hand hygiene (Price et al., 2018). However, we cannot access all risk behaviours for organism transmission by focussing exclusively on hand disinfection. Our results from the statistical analyses pointed out risk behaviours involving protective work-clothes to be related to the HCP's working conditions. This was evident in the cluster comparisons and patient rooms, where there were significantly more risks observed in the six-bed patient rooms. These results are congruent since the cluster group with the fewest risk behaviours involving work-clothes was characterised by their single bed occupancy. In the qualitative results, the HCP were partly aware of these risks and they discussed the inadequate usages of protective work-clothes as being risk filled and that such risks can occur when patients share a room, which is common in health care.

Even though working conditions considered to be acceptable existed, for example fully staffed and a sufficient availability of patient beds was common, risk behaviours for organism transmission occurred frequently anyway. In our study, it is difficult to explain if overstaffing was a coincidence or it was possibly due to a heavy workload. This question is something that can be taken into account when designing future studies. HCP risk behaviours can be influenced by several aspects and must be taken into account as potential confounders in this study. Knowledge, motivation, responsibility, attitudes and resources are all described as being able to influence HCP's infection prevention behaviours (Seo et al., 2019; Smiddy et al., 2015). Social influence and organisational culture have also been described as essential in infection prevention (Zingg et al., 2015). In our study's qualitative results, the HCP described how the psychosocial working environment influenced their behaviour, but no quantitative data were collected making statistical analyses impossible, which is another factor to consider when planning further studies.

6.1 | Strengths and limitations

The mixed-methods design of this study has contributed to a multifaceted understanding of this complex subject. The possibility of moving back and forth in the data enabled a great number of findings to emerge and has contributed to nuanced results. Direct observations are acknowledged as the 'gold standard' when measuring hand hygiene compliance (Haas & Larson, 2007). However, observations are allied with difficulties. An extensive systematic review by Jeanes et al., (2019) concerning the validity of hand hygiene compliance measured by observations described information bias, selection bias and confounding bias as potential threats to validity (Jeanes et al., 2019). The Hawthorne effect involves individuals modifying behaviours when they are aware of being observed (Purssell et al., 2020). No attempts to control the Hawthorne effect were assessed in this study, but despite the potential risk for information bias related to the Hawthorne effect, risk behaviours frequently occurred during the observations. Absence of inter-rater reliability is a common critique in observational studies (Jeanes et al., 2019). The performed inter-rater reliability is a strength in this study, and the substantial agreement (Landis & Koch, 1977) strengthens the results additionally. The first and last authors, who conducted the analysis of risk behaviours, have extensive experience in infection prevention and control and are trained in observation techniques and the analysation of these types of data. It was considered appropriate to conduct the observations in the mornings, which are often the busiest time for patient-related activities. Working conditions can differ between the day, evening and night shifts, which can be a potential selection bias (Jeanes et al., 2019). Spradley (1980) described how focussed observations are to observe carefully selected events based on the study's aim, which facilitates the observer's ability to stay focussed during the observations. Mobile positioning that follows one participant throughout the activity (Spradley, 1980) was considered appropriate since it enables the observer to see the relationship between the HCP's working conditions and risk behaviours. Data were collected in surgical and orthopaedic units with rich setting and sample variations, for example age and working experiences that increase the generalisability of this study results. The interviews were conducted not long after the observations, and the majority were audio recorded. An interview guide was used to ensure that the main topics were covered, but at the same time, the interviews were adapted to the situations that occurred during the observations. Quotations from all categories are presented in the results to facilitate transferability (Graneheim & Lundman, 2004).

7 | CONCLUSION

These mixed-methods findings illustrate that HCP's perceptions do not always correspond to the observed results since the risk behaviours occurred frequently regardless of the observed and perceived working conditions. Interruptions and working together during

patient care activities were shown to be highly associated with risk behaviours, and from this, we can assume HCP's infection prevention behaviours are more closely associated with what is happening in the moment than to their overall working conditions. Facilitating the possibility for healthcare personnel to work undisturbed when needed is essential for their benefit and patient safety.

8 | RELEVANCE FOR CLINICAL PRACTICE

The relationship between interruptions and infection prevention behaviour is important knowledge for both HCP and FLMs. Highlighting and preventing interruptions can improve working conditions. Interventions aimed at reducing interruptions could benefit from strategies designed collectively by the HCP and FLMs together. By reducing interruptions, working conditions can be improved and risk behaviours for organism transmission reduced.

The increased frequency of risk behaviours when the HCP worked together during patient care activities has not been described previously. These findings need to be made known in healthcare settings and considered in regard to infection prevention. Further research is needed in this area.

Furthermore, infection prevention work needs to include both hand disinfection along with other risk behaviours, as only half of the problem is accessed if the focus is directed exclusively on hand disinfection.

CONFLICT OF INTERESTS
The authors declare they have no conflict of interests.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.