Safety Performance of Healthcare Professionals

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List of Abbreviations

HCP	Healthcare professionals
SJT	Situational judgement test
SPOHC	Safety performance of healthcare professionals
WHASI	Workplace health and safety instrument
WHASI-G	German version of the workplace health and safety instrument
WHO	World Health Organization
OSH	Occupational safety and health

1. Abstract

Patient safety was recently declared as a global priority by the World Health Organization and the evaluation of the performance of health care systems, organizations and their actors remains a main area of challenge for research and policy, as well as for organization and management. This dissertation aimed to address three objectives to get a deeper and more complex understanding of safety performance and the behavior of healthcare professionals working in acute care in Germany to improve patient safety by 1) validation of an instrument to measure the constructs safety performance, safety knowledge and safety motivation; 2) developing and testing a new possibility to measure safety performance as actual behavior within clinical safety scenarios; 3) exploring the perspectives of healthcare professionals regarding their experiences and views on safety performance. The three publications were based on data of the project “safety performance of healthcare professionals - SPOHC”, which was carried out between 2018 and 2020. (1) and (2) were based on data of a cross sectional survey with 168 healthcare professionals. The following methods were used in the three publications: (1) evaluation of the internal consistency and construct validity, using exploratory and confirmatory factor analysis to test how the data fit with the original model. (2) A situational judgment test with seven items covering seven different safety scenarios was developed and tested through internal consistency and construct validity. (3) 23 healthcare professionals were interviewed using semi-structured interviews. The categories were developed deductively based on the human factors model of patient safety. Main results show that (1) Cronbach’s alpha for all four dimensions was >0.7. All items were loaded on factors according to the original theoretical model. (2) The items of the SJT demonstrated Cronbach's alpha of 0.57. Moderate positive correlations were found among the seven variables in the study. (3) Results highlight the importance of safety performance as a construct of occupational health rather than of patient safety, the role of the organization and the self-responsibility of healthcare professionals. All presented data are part of an explorative study and thus are limited in terms of their generalizability. Furthermore, future research should focus on longitudinal designs to study time effects, it remains outstanding which role the organizational, sociodemographic or person- and situation-related aspects have and how they may predict and influence the safety performance of HCP.

2. Introduction and Aims

The World Health Organization (WHO) has defined patient safety as “a framework of organized activities that creates cultures, processes, procedures, behaviors, technologies and environments in health care that consistently and sustainably lower risks, reduce the occurrence of avoidable harm, make error less likely and reduce impact of harm when it does occur” (World Health Organization 2021). Patient safety was recently declared as a global priority, as an essential foundational step in building, designing, operating and evaluating the performance of all health care systems and their actors (World Health Organization 2021).

The relevance of patient safety is moreover demonstrated by the estimation that one in every ten patients is harmed while receiving acute medical care in hospitals (Slawomirski et al. 2017). The harm can be caused by adverse events which are, on the one hand, preventable in 50% of the cases (Vries et al. 2008), and on the other hand, are a leading cause of death and disability in the world (Kohn et al. 2000). In European countries, adverse events have an occurrence between 08-12% in all hospitalizations (Vries et al. 2008). The most frequent adverse events were identified as operation related (39.6%); drug related (15.1%); system related (8.1%); medical procedures (7.8%) and diagnostic (7.5 %) (Vries et al. 2008).

Consequently, safe care is directly influenced by organizational, technical, team and individual aspects, as described within the WHO definition of patient safety and taken up in different approaches, such as the human factors approach (World Health Organization 2021). This approach aims to improve patient safety by questioning and exploring how (health care) systems work and how the complexity of these systems affects patient safety (Carayon et al. 2014). It refers to environmental, organizational, job factors, and human and individual characteristics that influence behavior at work (Health and Safety Executive 1999). Griffin and Neal (2000) focus especially on the human and individual factors and proposed the model of workplace safety with the constructs safety compliance and safety participation which define the concept of safety performance. Both of these dimensions are referring to the actual behavior of healthcare professionals and how they perform at

work. The term safety compliance is used to describe the core activities that HCP need to carry out to maintain workplace safety (Griffin und Neal 2000; Christian et al. 2009). These behaviors include adhering to standard work procedures and wearing personal protective equipment (Griffin und Neal 2000; Christian et al. 2009). The term safety participation is used to describe behaviors that do not directly contribute to an individual's personal safety but rather help in developing an environment that supports safety (Christian et al. 2009; Griffin und Neal 2000).

Closely connected to patient safety and the construct safety performance is occupational safety and health (OSH) of healthcare professionals. OSH is generally defined as "the science of anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment" (Alli 2008). In Germany, 22.8% of all occupational accidents were among HCP, working in the public sector in 2019 (German Social Accident Insurance 2020). Consequently, preventing occupational accidents and injuries and improving OSH is crucial for healthcare systems, HCP as well as patients and their families.

2.1 Theoretical Background

The integrative model of workplace safety, published in 2009 by Christian and colleagues, integrates the aspects of patient safety, occupational safety and safety performance in a theoretical model, which reflects on the relations and associations between distal situation- and person-related factors, proximal person-related factors, safety performance and safety outcomes (Christian et al. 2009) (Figure 1). This model builds upon the model of workplace safety by Neal and Griffin while describing the influence of distal situation-related and person-related factors on the motivation and knowledge of the HCP (as proximal person-related factors) and thus on safety performance in the form of compliance and participation (Griffin and Neal 2000; Christian et al. 2009; Neal and Griffin 2004).

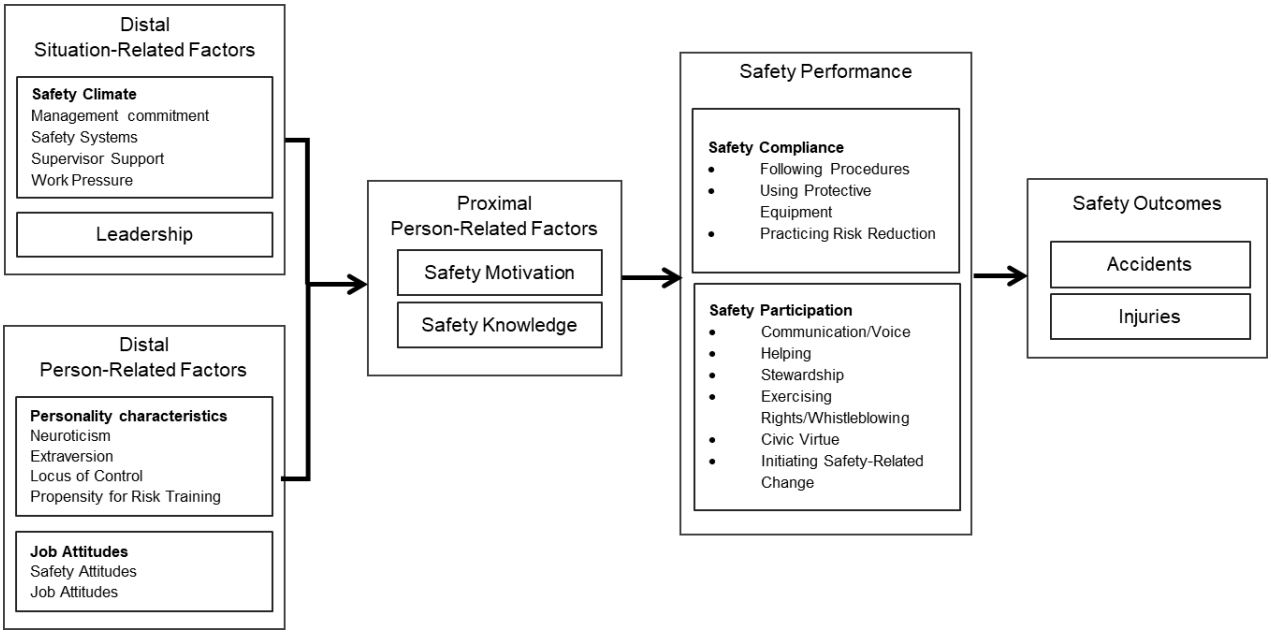

Figure 1: Integrative Model of Workplace Safety by Christian et al. 2009, p. 1105

In this cumulative dissertation, an adapted form of the integrative model of workplace safety was used for the theoretical background in this study. Table 1 below gives a brief overview of the used constructs and dimensions and their definitions.

Table 1: Overview of constructs and dimensions

Construct/Dimension	**Definition**
Safety performance	Construct, which consists of safety compliance and safety participation and describes safety behavior (Christian et al. 2009).
Safety compliance	Core safety activities that need to be carried out to maintain workplace safety (Griffin und Neal 2000).
Safety participation	Behaviors, which help to develop an environment that supports workplace safety (Griffin und Neal 2000).
Proximal person-related factors	Safety knowledge and safety motivation as proximal antecedents to safety performance behaviors (Christian et al. 2009).
Safety knowledge	A direct determinant of performance behaviors, knowing how to perform safely (Christian et al. 2009).
Safety motivation	Tends to reflect the willingness of healthcare professionals to seek safety-related behaviors and the value associated with those behaviors (Neal und Griffin 2006).

2.2 Empirical Background

In recent years, the link between safety performance, safety climate and influencing factors has received increasing interest in occupational as well as patient safety research. Several meta-analyses, systematic and narrative reviews, longitudinal and case-control studies have been published and focused on determinants of the integrative model of workplace safety, performance at the workplace, role of psychological, organizational and patient safety climate along with other aspects, which could mediate the role of safety, attitudes and individual aspects (Uzuntarla et al. 2020; Aghaei et al. 2020; Toppazzini and Wiener 2017; Toderi et al. 2015; Neal and Griffin 2006; Clarke 2010; Clarke 2006; Manapragada et al. 2019; Christian et al. 2009). In a meta analysis by Clarke, safety climate – as a distal situation-related factor – was found to have a partial mediation role in the relationship between psychological climate and safety performance (Clarke 2006). Another meta-analysis by Christian et al. demonstrated that safety climate was positively related to safety knowledge and safety motivation and that these dimensions were positively related with safety performance (Christian et al. 2009). Followingly, other research examined a positive relationship between safety awareness and safety performance (Uzuntarla et al. 2020), or between occupational safety climate, patient safety climate and safety performance (Aghaei et al. 2020). Recently, Toppazzini and Wiener published their work about the influence of organizational climate and individual differences on safety performance and focused on the impact of the individual characteristics neuroticism and conscientiousness (Toppazzini and Wiener 2017).

The aims of the presented research were and are still striving to understand what exactly influences safety performance, more specifically safety behavior at the workplace to identify constructs and dimensions, factors and perceptions, which may lead to negative safety outcomes such as unsafe care, workplace accidents or injuries. As a result, the question has emerged as to how, in addition to influencing factors on safety performance, HCP behaviors can be measured and assessed in clinical situations/scenarios. Besides distal situation- and person-related factors influencing safety performance, especially the proximal person-related factors affecting performance of HCP and the performance itself, still need to be examined.

2.3 Objectives and Aims

To summarize, the research focus was specifically on the individual level of HCP safety performance and how proximal person-related factors affect the safety behavior at the workplace. This cumulative dissertation aims to close the gap of measuring safety performance and proximal person-related factors of German HCP and develop new possibilities to measure safety performance. This work contributes to the emerging body of evidence in safety research regarding safety performance by addressing three objectives:

1) The first objective of this dissertation was to translate, test and validate an instrument to measure the constructs safety performance and proximal person-related factors of HCP working in German hospitals.
2) Second, this dissertation aimed to develop and test a new possibility to measure safety performance of HCP with a situational judgement test (SJT) to measure the actual behavior within clinical safety scenarios.
3) The third objective was to explore the perspective of HCP about their experiences and views on safety performance in their daily working routine.

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3. Publications

This cumulative dissertation comprises three original articles published in international peer-reviewed journals indexed in Web of Science. Each publication is based on data from the SPOHC study, which was conducted at the Institute for Patient Safety of the University Hospital Bonn (IfPS) between 2018 and 2020.

Publication 1 and 2 were designed to contribute to the understanding of the measurement of safety performance through the adaptation of an existing instrument and the development of novel measurement approach. Study 3 was designed to gain an understanding of antecedents of safety performance of HCP.

More specific:
1) The first publication aimed to prepare and validate a German version of the workplace health and safety instrument (WHASI-G), which measures the constructs safety performance (consisting of the dimension's safety compliance and safety participation) and proximal person-related factors (consisting of the dimension's safety knowledge and safety motivation).
2) The goal of the second publication was to develop, test and validate seven SJT items which cover seven different clinical safety scenarios to measure the safety performance of HCP working in clinical settings.
3) The third publication aimed on exploring the perspectives of HCP on their daily safety performance at the workplace, influencing factors, barriers and facilitators.

3.1 Publication 1: Safety Performance of Healthcare Professionals: Validation and Use of the Adapted Workplace Health and Safety Instrument

Heier, L.; Gambashidze, N.; Hammerschmidt, J.; Riouchi, D.; Weigl, M.; Neal, A.; Icks, A.; Brossart, P.; Geiser, F.; Ernstmann, N. (2021a): Safety Performance of Healthcare Professionals: Validation and Use of the Adapted Workplace Health and Safety Instrument. *Int. J. Environ. Res. Public Health*, *18*, doi:10.3390/ijerph18157816. Impact Factor: 3.390

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Safety Performance of Healthcare Professionals: Validation and Use of the Adapted Workplace Health and Safety Instrument

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Abstract: Improving patient safety and reducing occupational accidents are two of the main challenges in healthcare. Instruments to measure safety performance and occupational safety are rare. This study aimed to prepare and validate a German version of the adapted workplace health and safety instrument to assess the safety performance of healthcare professionals. Overall, 168 healthcare professionals participated in this explorative cross-sectional study. The instrument consists of 16 items related to safety performance in four dimensions. We calculated mean values and standard deviations for each individual item and those of the four dimensions of the instrument. We evaluated internal consistency and construct validity, explored the dimensionality of the instrument through exploratory factor analysis, and tested how our data fit with the original model with confirmatory factor analysis. Among the participants, 73.8% were nurses and nurses in training, with the majority of the sample being female (71.9%) and younger than 30 (52.5%). Cronbach's alpha for all four dimensions was >0.7. All items were loaded on factors according to the original theoretical model. Confirmatory factor analysis showed good model fit (normed $\chi^2/df = 1.43$ ($\leq$2.5), root mean square error of approximation = 0.06 ($\leq$0.07), goodness of fit index = 0.90 (>0.90), comparative fit index = 0.95 ($\geq$0.90), and Tucker–Lewis index = 0.93 (>0.90). The German version of the instrument demonstrated acceptable properties and was a good fit to the original theoretical model, allowing measurement of healthcare professionals' safety knowledge, motivation, compliance, and participation.

Keywords: patient safety; occupational safety; safety performance; healthcare professionals; acute care

1. Introduction

Thousands of deaths and disabilities occur because of occupational accidents each year worldwide; approximately 318,000 of these deaths are due to accidents and two million are due to work-related diseases [1–3]. In Germany, 22.8% of all occupational accidents in 2019 were among healthcare professionals working in the public sector [4]. One in every ten patients is harmed while receiving acute care in hospitals [5]. Improving patient safety and reducing occupational accidents are two of the main challenges in healthcare

worldwide [6]. A growing body of literature focusing on the impact of an organizational or safety climate, safety performance, and occupational safety, as well as occupational safety climate in healthcare, has emerged [7–16]. Studies explicitly focusing on safety performance in acute care hospitals are rare, although healthcare professionals play a leading role in improving and maintaining patient safety. Healthcare providers' own behaviors, together with workplace safety, affect occupational and patient safety [17,18] with strong links to nontechnical skills including error awareness, teamwork, and decision-making [19,20].

According to Griffin and Neal, safety performance consists of safety compliance and safety participation [21]. The term safety compliance is used to describe the core activities that individuals need to carry out to maintain workplace safety. These behaviors include adhering to standard work procedures and wearing personal protective equipment. The term safety participation is used to describe behaviors that do not directly contribute to an individual's personal safety but help develop an environment that supports safety [21,22]. With regard to the integrative model of workplace safety, safety performance is directly influenced by the proximal person-related factors of safety motivation and safety knowledge [23] (Figure 1). Safety motivation and safety knowledge are supposed to be influenced by safety climate, leadership, personality characteristics, and job attitudes [13,23]. Knowledge is a precondition for enacting safe behaviors (the know-how to perform safely), and motivation reflects a willingness to attempt to use safety behaviors [23,24]. The model of workplace safety of Griffin and Neal has been widely used and successfully implemented within occupational safety across different organizational contexts [23]. Kaleth and colleagues tested a Persian safety performance scale among Iranian employees of a petrochemical complex and reported a high internal consistency [25]. Similar results were reported by Braunger and colleagues, who tested the instrument as well as the model in Austria [26]. Gracia and colleagues underline their findings for the Spanish setting [27]. Toderi and colleagues studied the individual safety performance in Italy and their findings confirmed the adequacy of the original items, and they reported a satisfactory reliability as well as validity [28]. Scales that measure the constructs of safety knowledge, safety motivation, safety compliance, and safety participation were presented in the original study of Neal et al. [22]. This model and the workplace health and safety instrument used by Neal et al. are widely used and proven to be stable, with good psychometric properties and excellent internal consistency [22,23]. However, to our knowledge, it has not yet been used in healthcare settings in German-speaking countries.

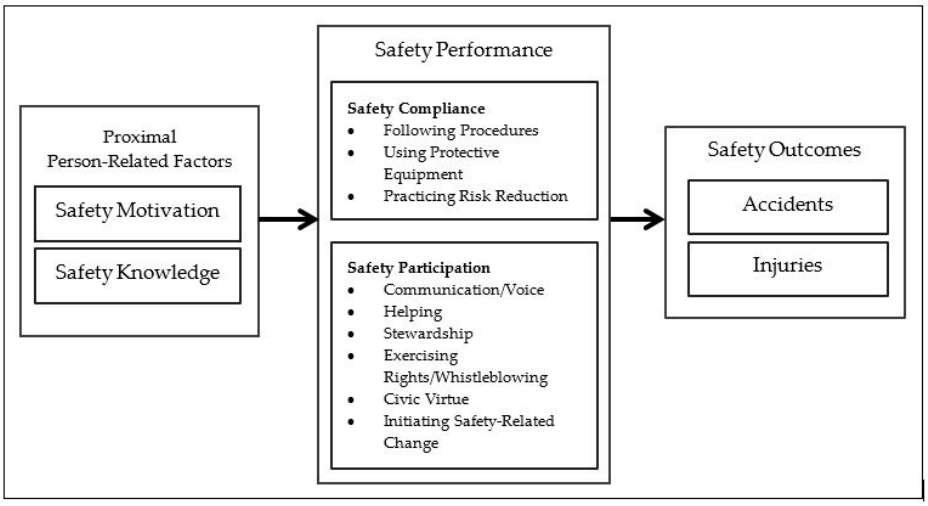

Figure 1. Adapted integrative model of workplace safety [23]. Adapted with permission Christian, M.S.; Bradley, J.C.; Wallace, J.C.; Burke, M.J. (2009). 2021 Michael Christian.

This study aimed to prepare and validate a German version of the adapted workplace health and safety instrument to assess the safety performance of healthcare professionals in German hospitals.

2. Materials and Methods

2.1. Design

A stepwise procedure was established with translation, application, and testing for psychometric and factorial validity. The data for this study was collected as part of the research project "Safety Performance of Healthcare Professionals" (SPOHC), conducted in 2018–2020. The ethics committee of the University Hospital Bonn approved the study methodology (number: 075/19).

2.2. Study Instrument

The original English version of the workplace health and safety instrument (WHASI) published by Neal et al. was translated into German [22]. In this study, we followed the technique recommended by van de Vijver, Banville et al., and Vallerand [29–31]. A double translation/back-translation was conducted by three different professional translators. The translated items were then discussed and evaluated by three researchers in cooperation with one of the developers of the original scales to ensure that the meanings of the original items were retained. The German version of WHASI (WHASI-G), which is similar to the original instrument, consists of 16 items related to the safety behaviors of clinical personnel. Consistent with the English version, items can be grouped into four scales: Safety Motivation, Safety Knowledge, Safety Compliance, and Safety Participation. Participants' agreement is measured using a five-point Likert scale (from 1 (strongly disagree) to 5 (strongly agree)). The German version was cognitively pretested with nursing staff from a long-term care facility in Germany (n = 12) [32]. This method aimed to identify the causes of errors in surveys [32]. Additional items captured the demographic characteristics of the study participants.

2.3. Setting, Procedure, and Sample

Using the WHASI-G, the data was collected in three hospitals and two nursing schools. First, the organizations' top management was informed about the goals and methods of the study via email. Next, a member of the study team met the decision-makers to present the study and clarify the questions. After the top management agreed to participate, they suggested clinics and their teams. These units and teams were informed about the study by the study team via email. If the heads of the units/teams were interested in participating, they were asked for an appointment to present the objectives, data protection, contact persons, and next steps. After all the questions have been answered, all healthcare professionals of these teams were invited to participate in the study. We invited them via email and personal contact in team meetings. Reminders were sent out to facilitate engagement after two and four weeks. The questionnaire was preceded by an informed consent form that provided participants with detailed information about the study. Participation was completely voluntary and anonymous.

2.4. Analysis

We calculated the mean values and standard deviations for each individual item, as well as those of the four dimensions of the instrument [33]. The dimension scores were calculated by averaging corresponding items. The number (percentage) of missing answers for individual items was evaluated as an indication of acceptability. The floor and ceiling effects, measured as the proportion of the lowest and highest answer choices, respectively, were evaluated to check the instrument's performance on the low and high construct levels.

To evaluate the psychometric properties of the WHASI-G, we analyzed internal consistency, construct, and factorial validity. The internal consistency of each dimension was evaluated using Cronbach's alpha, with an expected alpha of >0.7. To evaluate con-

struct validity, we studied Spearman's correlations and expected low to moderate positive correlations between the four safety performance dimensions. We evaluated convergent validity by calculating the average variance extracted (AVE) for each dimension (AVE > 0.5). We estimated divergent validity using the Fornell-Larcker criterion. We calculated the square root of AVE ($\sqrt{}$AVE) and expected it to be larger compared to correlations between dimensions [34].

To evaluate if the data were suitable for factor analysis, we first calculated the Kaiser–Meyer–Olkin (KMO) and measure of sampling adequacy (MSA) (for both >0.7 desired and >0.9 perfect). Additionally, the significant *p*-value (<0.05) of Bartlett's test of sampling adequacy would indicate that it is possible to extract more than one factor. Most of these analyses used the list-wise exclusion of missing cases; therefore, only complete cases were used for the analysis. To explore the factor structure based on our data, we conducted exploratory factor analysis (EFA) with maximum likelihood estimation. A scree plot and Eigenvalues of >1 guided the factor extraction. To aid in the interpretation of factors, we used varimax orthogonal pre-rotation followed by promax oblique rotation. Factor loadings of >0.35 were considered significant, and cross-loadings of <0.35 were considered acceptable [33].

CFA tests the fit of empirical data with the originally proposed model (i.e., four-factor structure). We used the following fit indices with corresponding benchmarks: normed χ^2 ($\chi^2/df \leq 2.5$), root mean square error of approximation (RMSEA ≤ 0.07), the goodness of fit index (GFI > 0.90), comparative fit index (CFI $\geq$ 0.90), and Tucker–Lewis index (TLI > 0.90) [35]. We conducted CFA using the four-factor model proposed by Neal et al. and compared fit indices with the results of a one-factor solution [22].

3. Results

3.1. Study Sample and Descriptive Statistics

Thirteen departments from three hospitals and two nursing schools were included in the study. A total of 430 HCPs were invited to participate. The response rate was 39.1% (n = 168). After inspection, 8 cases were removed because all of the 16 WHASI-G items were missing. The remaining 160 cases were available for further analysis. Demographic characteristics of the study sample are provided in Table 1. Nurses and nurses in training comprised 73.8% of the participants, with the majority of the sample being female (71.9%) and without leadership functions (82.5%). About half of the participants were younger than 30 (52.5%).

All items had missing answers of <5%, ranging from 0% to 3.8%. Item 13 ("I promote the safety program within the organization") demonstrated a floor effect (lowest score of >15%); all other items and all four dimensions demonstrated a ceiling effect (highest score of >15%). The mean scores for the four dimensions ranged from 3.5 for Safety Participation, to 4.83 for Safety Motivation. Descriptive statistics are presented in Table 2.

3.2. Analysis of Internal Consistency, Construct, and Factorial Validity

Of the 160 overall cases, 141 complete cases (88.1%) were available for further analysis. Table 3 shows the internal consistencies of the WHASI-G tool and the correlations between scales. The Cronbach's alpha for all four dimensions was >0.7. Further analyses revealed that, if item 5 ("I believe that workplace health and safety is an important issue") were removed, Cronbach's alpha would increase from 0.72 to 0.78. The correlations between the WHASI-G's four dimensions were all positive and in the small to moderate range, with all but one being significant at $p < 0.01$. The dimension Safety Compliance demonstrated adequate convergent validity (AVE = 0.54), while the other three dimensions had AVE < 0.5. All four dimensions demonstrated discriminant validity as $\sqrt{}$AVE of all dimensions were higher than correlations with other dimensions.

Table 1. Characteristics of the study sample.

	n	%
Total sample	160	100%
Profession		
Physician	23	14.40%
Nurse	62	38.80%
Nurse in training	56	35.00%
Other	18	11.30%
Missing	1	0.60%
Gender		
Female	115	71.90%
Male	45	28.10%
Leadership functions		
Yes	24	15.00%
No	132	82.50%
Missing	4	2.50%
Tenure in the profession		
<3 months	2	1.30%
3–12 months	1	0.60%
1–5 years	76	47.50%
>5 years	79	49.40%
Missing	2	1.30%
Tenure in clinic		
<3 months	4	2.50%
3–12 months	6	3.80%
1–5 years	87	54.40%
>5 years	62	38.80%
Missing	1	0.60%
Age		
<30	84	52.50%
31–40	29	18.10%
41–50	23	14.40%
>50	23	14.40%
Missing	1	0.60%

Note: Demografic variables are presented in bold.

The KMO for the sample of 141 complete cases was 0.79, and the MSA for individual items were all >0.7, except for items 5 (0.54) and 8 (0.63), which are both from the scale Safety Motivation. Bartlett's test of sampling adequacy was significant ($p < 0.001$), indicating that more than one factor could be extracted.

Based on Keiser's criterion (Eigenvalues > 1) and the evaluation of the scree plot, four factors were extracted in EFA. Table 4 presents the final, rotated solution and the items' factor loadings. All WHASI-G items were loaded on factors according to the original theoretical model. None of the items had significant cross-loading. The item with the lowest factor loading was item 5 from the scale Safety Motivation (see Table 4).

Table 2. Descriptive statistics of the WHASI-G items and scales.

Dimensions/Items	Missing	Floor Effect	Ceiling Effect	Mean Score	SD
Safety Knowledge	**0.0%**	**0.0%**	**42.5%**	**4.19**	**0.63**
1. I know how to perform my job in a safe manner.	0.0%	0.0%	45.0%	4.35	0.68
2. I know how to use safety equipment and standard work procedures.	1.9%	0.6%	41.9%	4.15	0.89
3. I know how to maintain or improve workplace health and safety.	3.1%	0.0%	31.9%	4.08	0.80
4. I know how to reduce the risk of accidents and incidents in the workplace.	2.5%	0.0%	36.3%	4.19	0.77
Safety Motivation	**0.0%**	**0.0%**	**91.3%**	**4.83**	**0.30**
5. I believe that workplace health and safety is an important issue.	0.0%	0.0%	93.1%	4.90	0.42
6. I feel that it is worthwhile to put in the effort to maintain or improve my personal safety.	1.9%	0.0%	78.1%	4.77	0.49
7. I feel that it is important to maintain safety at all times.	0.6%	0.0%	78.8%	4.77	0.46
8. I believe that it is important to reduce the risk of accidents and incidents in the workplace.	0.6%	0.0%	88.8%	4.89	0.34
Safety Compliance	**1.3%**	**0.0%**	**38.8%**	**4.18**	**0.64**
9. I carry out my work in a safe manner.	1.3%	0.0%	36.9%	4.22	0.74
10. I use all the necessary safety equipment to do my job.	3.1%	1.3%	44.4%	4.21	0.90
11. I use the correct safety procedures for carrying out my job.	2.5%	0.6%	33.1%	4.21	0.72
12. I ensure the highest levels of safety when I carry out my job.	2.5%	0.6%	29.4%	4.10	0.76
Safety Participation	**0.6%**	**1.3%**	**17.5%**	**3.50**	**0.87**
13. I promote the safety program within the organization.	3.8%	18.8%	8.1%	2.78	1.24
14. I put in extra effort to improve the safety of the workplace.	1.3%	3.1%	19.4%	3.53	1.04
15. I help my coworkers when they are working under risky or hazardous conditions.	1.3%	1.3%	52.5%	4.41	0.77
16. I voluntarily carry out tasks or activities that help to improve workplace safety.	2.5%	11.3%	18.1%	3.28	1.26

Note: Mean scores represent low (1) to high (5) agreement. SD: standard deviation. Dimensions, presented in bold, according to the original instrument of Neal et al. [22].

Table 3. Internal consistency (Cronbach's alpha), convergent and discriminant validity, and construct validity (Spearman's rho).

	α	AVE	$\sqrt{AVE}$	Spearman's Correlation		
				SK	SM	SC
SK—Safety Knowledge	0.80	0.46	0.68			
SM—Safety Motivation	0.72	0.45	0.67	0.24 *		
SC—Safety Compliance	0.84	0.54	0.73	0.54 *	0.31 *	
SP—Safety Participation	0.76	0.44	0.66	0.33 *	0.14 +	0.43 *

Note: α—Standardized alpha; AVE—average variance extracted; $\sqrt{AVE}$—square root of average variance extracted; * $p < 0.01$; + $p = 0.09$; SK—Safety Knowledge, SM—Safety Motivation, SC—Safety Compliance.

Table 4. Results of exploratory factor analyses for the WHASI-G (rotated solution).

Items		Factor 1	Factor 2	Factor 3	Factor 4
Safety Knowledge					
1.	I know how to perform my job in a safe manner.	**0.569**	−0.016	0.190	0.062
2.	I know how to use safety equipment and standard work procedures.	**0.576**	−0.001	0.044	0.148
3.	I know how to maintain or improve workplace health and safety.	**0.805**	0.090	−0.042	−0.078
4.	I know how to reduce the risk of accidents and incidents in the workplace.	**0.744**	0.059	−0.043	−0.013
Safety Motivation					
5.	I believe that workplace health and safety is an important issue.	0.121	**0.370**	−0.051	−0.026
6.	I feel that it is worthwhile to put in the effort to maintain or improve my personal safety.	0.007	**0.630**	0.118	−0.066
7.	I feel that it is important to maintain safety at all times.	0.136	**0.567**	0.064	−0.067
8.	I believe that it is important to reduce the risk of accidents and incidents in the workplace.	−0.069	**0.968**	−0.054	0.077
Safety Compliance					
9.	I carry out my work in a safe manner.	0.128	0.065	**0.635**	0.034
10.	I use all the necessary safety equipment to do my job.	−0.063	0.062	**0.599**	0.090
11.	I use the correct safety procedures for carrying out my job.	0.035	−0.112	**0.978**	−0.099
12.	I ensure the highest levels of safety when I carry out my job.	−0.009	0.101	**0.660**	0.113
Safety Participation					
13.	I promote the safety program within the organization.	0.057	−0.036	0.082	**0.696**
14.	I put in extra effort to improve the safety of the workplace.	0.076	−0.027	−0.054	**0.709**
15.	I help my coworkers when they are working under risky or hazardous conditions.	−0.155	0.130	0.131	**0.545**
16.	I voluntarily carry out tasks or activities that help to improve workplace safety.	0.056	−0.100	−0.029	**0.677**

Note: In bold are loadings > 0.35. Dimensions, presented in bold, according to the original instrument of Neal et al. [22].

The sample size did not allow for split-half cross-validation, conducting EFA and CFA in separate halves. Consequently, we aimed to use CFA to test the fit of the originally proposed model (i.e., four-factor model) with the data. CFA showed a good fit of the original four-factor model to our empirical data: normed $\chi^2/df = 1.43$ ($\leq$2.5), RMSEA = 0.06 ($\leq$0.07), GFI = 0.90 (>0.90), CFI = 0.95 ($\geq$0.90), and TLI = 0.93 (>0.90). In comparison, all of the fit indices of the one-factor solution were below the set criteria: $\chi^2/df = 4.1$ ($\leq$2.5), RMSEA = 0.15 ($\leq$0.07), GFI = 0.71 (>0.90), CFI = 0.59 ($\geq$0.90), and TLI = 0.53 (>0.90).

4. Discussion

In this study, we aimed to prepare the German version of WHASI and evaluate its psychometric properties. We used data from three German hospitals to validate the WHASI-G for use in German-speaking healthcare facilities.

In our study, the WHASI-G demonstrated acceptable properties in most of the analyses and was a good fit for the original theoretical model. Furthermore, there were very few missing answers, indicating that participants were able to respond to all questionnaire items. Only one item demonstrated floor effect, and all the other items had a significant ceiling effect, meaning that the instrument may not be able to detect differences on the high end of the measurement scale. Item 5 of the scale Safety Motivation ("I believe that workplace health and safety is an important issue") seemed uncontroversial, and consequently, most of the study participants completely agreed with it (93.1%). The highly

limited variance of this item was reflected in a lower correlation with the other items and poorer performance. Still, it demonstrated an acceptable fit with the general model; therefore, we would not recommend removing this item but instead using the instrument in the original form. The three out of four dimensions of the instrument demonstrated limited convergent validity. At the same time, all four dimensions had adequate discriminant validity indicating, that they measure distinctly different constructs.

The results of the German scales support the adequacy of the original version as well as those found in previous studies examining the adapted version of the WHSI. The four-factor model proposed by Neal et al. can be suggested to properly measure determinants and components of safety performance [22]. The correlations between the WHASI-G's four dimensions were all positive, with all but one being significant at $p < 0.01$, which is similar to the findings of Toderi and colleagues, who tested the four-factor model in the Italian context [28]. In the present study, the Cronbach's alpha for all four dimensions was >0.7, which is similar to the findings of Kwon and Kim as well as the original study of Neal et al. [22,36]. The Spanish version reported a Cronbach's α value of 0.88 and 0.86 of safety compliance and safety participation, which also underlines the good psychometric properties with a high internal consistency [37]. CFA produced an excellent fit for the 4-factors model, e.g., with a RMSEA = 0.06 ($\leq$0.07), and CFI = 0.95 ($\geq$0.90). In comparison, the Italian version showed an RMSEA = 0.04 and CFI = 0.99 [28].The adapted integrative model of workplace safety is based on Griffin and Neal's model of safety performance, which itself is built upon the theory of performance [21]. In summary, the adapted model is characterized by two main concepts: on the one hand, the distinction between safety compliance and safety participation as part of the construct of safety performance and, on the other, the distinction of proximal person-related factors of safety knowledge and safety motivation [23]. Concerning the descriptive results among German healthcare professionals working in acute care, our data showed lower safety participation scores compared with the safety compliance scores. These results are similar to other studies that have used the same instrument [26,28]. The original instrument developed and published by Neal et al. distinguished between safety activities that are part of the job (safety compliance) and activities that support the broader environmental context (safety participation) [22]. A meta-analysis conducted by Christian et al. showed that safety participation and safety compliance may be influenced by aspects of safety climate, such as workers' attitudes and beliefs regarding safety [23]. Similarly, longitudinal studies by Neal and Griffin suggested that an employee's safety motivation and safety participation can improve if they believe in the importance of safety [24,38]. Manapragda et al. also found that, when nurses believe that management is committed to safety, promotes open communication, and supports safety systems, they are more likely to stick to safety practices and promote the safety agenda of their workplace [39]. In our study, no safety climate aspects were collected. There is a need for further research to investigate the extent to which the aspects of safety climate may explain the difference between safety participation and safety compliance scores.

4.1. Limitations

The results of this investigation should be interpreted in light of several limitations. The main limitation of our study is the convenience of our sampling approach and the proportions of the surveyed professions. We used a systematic, stepwise approach to explore the applicability of the newly developed WHASI-G. Yet, we acknowledge that our sample size was limited and that its composition may limit the external validity of our results; i.e., the majority of the participants were registered nurses and nurses in training. It must also be noted, that the topic of safety performance in acute care can be strongly influenced by social desirability bias. In addition, there is a potential risk of selection bias due to the recruitment strategy of this study. Not all clinics and teams of the participating hospitals were contacted by the study team, but only those suggested by management. It remains unclear whether management has followed certain characteristics of the proposed

units and teams. Future studies should thus test the WHASI-G among larger, more professionally diverse samples to evaluate its applicability in multi-professional teams across different care domains, e.g., acute vs. non-acute and inpatient vs. outpatient care facilities. Due to the sensitive nature of safety performance, participation was completely anonymous, and consequently evaluating test-retest validity was not part of the study. The results were obtained from professionals working in hospitals in Germany and thus may reflect safety measures and standards specifically for this national healthcare system. Future investigations into the content and criterial validity of the WHASI-G should be undertaken, such as the concurrent measurement of safety performance with an alternative tool or the incorporation of measures of the workplace and patient safety. In our study, we used an adapted model that did not include measuring other determinants that influence safety, such as safety climate or leadership aspects. Future studies should further examine the association between these constructs and their effect on external measurements, such as patient-related outcomes.

4.2. Practical Implications

The WHASI-G, tested and validated in this study, provided a way to measure registered nurses', nursing students', and physicians' safety performance, safety knowledge, and safety motivation in a clinical setting. This 16 items instrument is easy to use and can be implemented to identify gaps in these particular dimensions. With regard to the recently published World Health Organization (WHO) global patient safety action plan, which provides concrete actions to be taken by health care facilities [6], hospitals and their clinical teams can use WHASI-G to measure their safety performance, to develop interventions to improve patient safety and/or occupational safety.

In academia, the instrument enables researchers to study the role of safety performance, safety knowledge, and safety motivation in high-reliability organizations. It remains outstanding, which role sociodemographic and/or organizational aspects have and how these factors (e.g., profession, gender) predict the safety performance of healthcare professionals. These aspects should be addressed in further studies to get a more comprehensive understanding of safety performance and its related factors.

5. Conclusions

Drawing upon a stepwise procedure, we successfully adapted and tested the German version of the workplace health and safety instrument (WHASI-G). It can be used for the evaluation of the safety performance of clinical teams in German hospitals. The WHASI-G demonstrated good psychometric properties and showed good factorial validity consistent with the original version proposed by Neal et al. [22]. The WHASI-G is a reliable, easy-to-use instrument for measuring and monitoring the safety-related knowledge, motivation, compliance, and participation of healthcare professionals in clinical care environments. In the future, it can be applied by management, administrative, or clinical personnel to develop and evaluate training or safety-related interventions in healthcare. This work makes an important practical contribution, as the availability of a validated instrument for German-speaking countries to measure safety performance supports both the development of safety research and clinical risk management strategies.

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3.2 Publication 2: Development and testing of the situational judgement test to measure safety performance of healthcare professionals: An explorative cross-sectional study

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RESEARCH ARTICLE

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Development and testing of the situational judgement test to measure safety performance of healthcare professionals: An explorative cross-sectional study

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Abstract

Aim: To measure safety performance, situational judgement test, which is a method composed of job-related situations, can be used. This study aimed to develop and test its psychometric properties by measuring the safety performance of healthcare professionals in German hospitals.

Design: An explorative cross-sectional study.

Methods: A team of researchers, nurses and physicians developed seven items, which focus on different safety areas. Descriptive statistics were calculated for each item. Cronbach's alpha was calculated as an indication of internal consistency. Spearman's correlation between the items was evaluated as analysis of construct validity. A cross-sectional survey with healthcare professionals in three German hospitals was conducted to test the developed instrument.

Results: A total of 168 healthcare professionals participated (response rate: 39.1%). 70.2% were women, and 38.7%, 33.9%, 15.5% and 11.3% were registered nurses, nurses in training, physicians and other healthcare professionals respectively. The situational judgement test demonstrated an acceptable psychometric performance.

KEYWORDS

acute care, healthcare professionals, patient safety, safety performance, situational judgement test

1 | INTRODUCTION

Adverse events, with an 8%–12% occurrence in all hospitalizations in European countries, have a huge impact on patient mortality and morbidity (Vries et al., 2008). In recent decades, especially since the publishing of the report "To err is human: building a safer health system" in 1998 (Kohn et al., 2000), the importance of safety skills, safety performance and safety culture have become clear and more evident (Brasaitė et al., 2016; Christian et al., 2009; Kiesewetter et al., 2018; Okuyama et al., 2014; Waterson et al., 2019). The World Health Organization (WHO) has recently published a global action plan, which provides a direction for concrete actions to be taken by healthcare facilities, countries and WHO itself to implement World Health Assembly resolution WHA72.6 (World Health Organization, 2021). This resolution gives priority to patient safety as an important step in designing, operating and evaluating the performance of all

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healthcare systems (World Health Organization, 2021). Several strategies provide detailed steps, addressing safety culture and patient safety strategies in all clinical programmes (e.g., infection prevention, medication safety, safety and medical devices among other safety topics; World Health Organization, 2021). A number of survey instruments have been developed and used to measure safety culture, and a link between safety culture and safety performance in health care is emerging (Okuyama et al., 2018; Pronovost et al., 2003; Scott et al., 2003; Waterson et al., 2019). Hospitals, along other health institutions, are implementing measures of patient safety and improving strategies for patient safety culture, which reflects the individual and group values, attitudes, behaviour patterns, competencies and perceptions (Brier et al., 2015; Granel et al., 2020; Okuyama et al., 2018).

2 | BACKGROUND

Registered nurses, nursing students and physicians are actively involved in improving this multidisciplinary and multi-professional approach of safety performance. Along other skills and competencies, they need safety skills to recognize patient safety incidents (e.g. syringe labelling), work in a team, learn from errors and use problem-solving techniques and practice development skills (Brasaitė et al., 2016; Kwiecień-Jaguś et al., 2018; Lavoie et al., 2020; Tower et al., 2019; Willman et al., 2020). Nurses, as the largest healthcare professional group, have an extraordinary impact on patient safety and their safety performance influences quality of care, well-being and health outcomes of their patients. They are a constant presence for the patient, interact with other HCP on a regular basis and are responsible for monitoring patients' condition, understanding and communicating care processes and changes in patient condition (Peck Malliaris et al., 2021). Furthermore, healthcare professionals (HCPs) can become causes of near misses, adverse events and errors (Alsharari et al., 2021; Kiesewetter et al., 2018; Veloski et al., 2005). Research with focus on individual level and its impact on patient safety is rare, although these gaps in knowledge are currently being addressed by using alternative research designs; therefore, an increasing number of qualitative studies are being published (Granel et al., 2020; Manapragada et al., 2019; McNab et al., 2016). Another option to measure the safety performance on the individual level and its impact on patient safety is a situational judgement test (SJT). It is a method composed of challenging work-related situations and different courses of action (Lievens & Motowidlo, 2016; Muck, 2013; Oostrom et al., 2015; Patterson et al., 2016b). Situations may be presented in verbal, video-based or written formats and contain different options (answer possibilities) from which the study participant chooses the most appropriate response (Christian et al., 2010). They have a long history of use for employee or student selection, and scenarios, which typically describe a dilemma or problem requiring knowledge, skills and abilities, are being used (Christian et al., 2010). SJT provides a reliable and cost-effective method for measuring non-academic attributes that are significant for clinicians and other HCPs (Cousans et al., 2017; Patterson, Knight, et al., 2016; Patterson, Zibarras, et al., 2016). Validated and reliable SJTs are available for nursing and medical school assessment, recruitment and hiring and for job performance evaluation in general practice (Bledow & Frese, 2009; Cousans et al., 2017; Crook et al., 2011; McDaniel et al., 2001; Neal et al., 2018; Patterson et al., 2017; Patterson, Zibarras, et al., 2016). However, to the best of our knowledge, no validated SJT measuring the safety performance of HCPs exists.

2.1 | Research question

The first objective of this study was to develop items describing safety-relevant situations in routine health care and corresponding answer categories with possible courses of action. The second objective was to test the set of items in a sample of HCP to evaluate its validity and reliability.

3 | THE STUDY

3.1 | Design

An exploratory cross-sectional study of HCPs working in German hospitals between July 2019 and March 2020 (Safety Performance of HCP project) was conducted, to pilot the newly developed SJT. The Safety Performance of HCP project is built upon the integrative model of workplace safety and focuses on safety performance as a construct of safety compliance and safety participation (Christian et al., 2009; Neal & Griffin, 2002). The study population consists of registered nurses, nursing students (last year of training) and physicians from three acute hospitals and two nursing schools in Germany. Risk managers, medical directors and nursing managers and headmasters of nursing schools were informed about the study via email and/or personal contact at the ward. Each participant received a questionnaire using an online survey system or a paper–pencil format. Data collection in each organization lasted for approximately 6 weeks, and participants were reminded every other week.

3.2 | Methods

3.2.1 | SJT development

To ensure content validity and internal consistency, the development of SJT items in this study followed the recommendation for SJT development in the medical training of Patterson and Zibarras, et al., 2016). Item development follows a process consisting of six sequential steps (Patterson, Zibarras, et al., 2016). In the first step of SJT development in the present study, a team of researchers, academic nurses (registered nurses who are working in academics) and physicians, all working in the field of patient safety, started with a safety performance role analysis of physicians, registered

nurses and nursing students in acute medical care. Key attributes and competencies of different healthcare professions regarding safety compliance, safety participation and safety knowledge were gathered and analysed (Patterson, Zibarras, et al., 2016). This ensures that the content and situations of the items reflect everyday working scenarios (Patterson, Zibarras, et al., 2016). The results were seven different safety situations, which reflect everyday working areas (hygiene, workplace safety, patient identification, patient involvement, prophylaxis, infection prevention and communication).

During the second step, the test construction was specified: all SJT items were knowledge based, with a multiple-choice answer possibility (three answers per item), provided in a pencil–paper format and an online survey system. The SJT items were introduced with a brief, two-to-three-sentence situation description, followed by an instruction to choose the three out of 10 actions that best reflect the participant's behaviour in real life.

Step 3 is the actual item development and first reviews, to make sure the scenarios and responses are realistic, appropriate and plausible (Patterson, Zibarras, et al., 2016). On the basis of the seven safety situations, which were gathered in step 1, seven items with 10 response options each were developed, representing different safety topics (hygiene, workplace safety, patient identification, patient involvement, prophylaxis, infection prevention and communication). The seven different situations and answer options depict daily working situation in acute care and should be equally relevant for all HCPs. An example item is presented in Table 1.

To develop the scoring system (the fourth step in the SJT development), an expert group of HCPs was asked to choose the three most appropriate actions in terms of safety performance for each of the situations (Bergmann et al., 2006). The expert group consisted of physicians (n = 4), nurses (n = 8), nursing students (n = 10) and researchers (with a background in patient safety and health services research; n = 6). The answers provided by the expert group were analysed, and a safety performance score (SPS) was developed. The answer options, which were chosen by >40% of the experts, were assigned 2-point, followed by 1-point (15%–40%) and 0-point (<15%) answers. On the basis of the instruction to choose three options, it is possible to achieve a score between 0 and 6 points. SPS was calculated as the average of available seven items, also ranging between 0 and 6 points. SPS scores ≤2.5, between 2.5–4.5 and between 4.5–6.0 were considered basic, advanced and expert safety performance respectively.

The SJT was piloted with a survey among HCPs in step 5 (please see section study design and setting).

3.2.2 | Analysis

In the sixth and last step, the development of an SJT to measure the safety performance of HCP was finalized with a psychometric analysis (Patterson, Zibarras, et al., 2016). Descriptive statistics were calculated for each SJT item (frequencies, means, standard deviations and minimum and maximum scores). Cronbach's alpha, as an indication of internal consistency of the instrument, was calculated (Field, 2018; Hair, 2010). Spearman's correlation between the SJT items was evaluated as an analysis of construct validity. Low-to-moderate positive correlations were expected because all items were considered to be measuring constructs related to safety performance.

TABLE 1 Example of a SJT item: patient identification

Situation	A patient (65 years old, open fracture after a bicycle fall) comes to the emergency centre and receives acute medical care. When transferring to the radiology, it is noticeable that the patient chart has a different name than the patient
Filling instructions	What corresponds most closely to your reaction? Please bear in mind how you would really react in your daily work. It is not a question of knowledge; it is an assessment of your actual behaviour Choose three most appropriate actions you would take in this situation
Answer options	• Actively ask the patient for his full name and date of birth • Search the emergency centre for the right patient chart • Inform colleagues in radiology about the lack of patient identification • Ask the patient about his previous treatment • Explain the situation in the team and address the relevance of patient identification • Make sure patient is wearing patient bracelet and this is the right one • Contact the responsible physician to see if he has performed a patient identification • Write a CIRS message • Inform and calm the patient • Don't tell the patient so he won't be worried

Note: CIRS – Critical Incidence Reporting System, a reporting system to systematically collect the hospital-wide information about patient safety relevant incidents for organizational learning and continuous improvement.

3.3 | Ethics

The study followed the ethical principals in accordance with the Declaration of Helsinki. The participants received written information about the study and an informed consent form together with privacy policy documents were attached to the questionnaire. The study was given ethical approval by a local ethical review board (number: 075/19).

Due to the sensitive topic of measuring safety performance, all professions were precisely informed about the protection of their person and data as well as the publication of the results. It was ensured that participation is completely anonymous and that no conclusions can be drawn about individuals or teams. Nurses were informed about the study in team meetings, physicians with an information letter and students with an introductory session on patient safety. In this way, all uncertainties and questions could be asked and clarified promptly. In addition, members of the project team visited the clinics every 14 days to answer any questions or concerns about patient safety or safety performance.

4 | RESULTS

4.1 | Study sample

Thirteen departments from three hospitals and two nursing schools were included in the study. A total of 430 HCPs were invited to participate. The response rate was 39.1% ($N = 168$). Of the participants, 70.2% were women, and 53.0% were <31 years old. In addition, 38.7%, 33.9%, 15.5% and 11.3% were registered nurses, nurses in training, physicians and other HCPs respectively. Furthermore, of the participants, 14.9% reported of having leadership roles. Details of the study sample are presented in Table 2.

4.2 | Data processing

The study participants have not frequently chosen exactly three answers; in individual cases, up to seven answers were selected. To maintain consistency of scoring, the cases with >3 selected answers were considered invalid and were treated as missing in the analysis. Detailed numbers of missing and invalid cases are presented in Table 3.

4.3 | SJT

The overall mean of all items was 4.38 (standard deviation, 0.75; range, 1.86–5.57). Item 03 (Patient Identification) and item 01 (Infection Prevention) had the highest numbers of invalid cases (21 and 17 cases respectively), which means that 21 and 17 participants selected four or more answer possibilities, instead of three. Moreover, item 01 (Infection Prevention) had the highest mean score of 5.09. Item 04 (Patient Involvement) had the lowest mean score of 3.93. All other items resulted in mean scores >4.0 (Expert Safety Performance). The results of the descriptive analysis are detailed in Table 3.

4.4 | Internal consistency and construct validity

We included complete cases for analyses of internal consistency and construct validity ($N = 111$). The items of the SJT demonstrated Cronbach's alpha of 0.57. Moderate positive correlations were found among the seven variables in the study. Item 01 (Infection Prevention) showed significant correlation with item 02 (Communication) and item 06 (Workplace Safety). Item 02 (Communication) correlated significantly with item 06 (Workplace Safety) as well as item 07 (Hygiene) and item 03 (Patient Identification). Item 04 (Patient Involvement) correlated with item 06 (Workplace Safety). Item 05 (Prophylaxis) also correlated with item 06 (Workplace Safety). The least correlated items were item 04 (Patient Identification) and item 05 (Prophylaxis). No items were redundant, and there was no excessive correlation between the items (Spearman's rho > 0.85). All correlations are presented in Table 4.

4.5 | SPS

On the overall SPS, 56.8% of study participants reached scores ≥4.5, indicating an expert safety performance. 40.5% got an advanced SPS (2.5–4.5) and 2.7% a basic SPS (<2.5). On the single item level, 81.1% got an expert SPS on item 01 (Infection Prevention). More than half of participants got an expert SPS on item 02 (Communication) with 58.3%, item 05 (Prophylaxis) with 56.3% and item 07 (Hygiene) with 51.7%. Less than half of participants got expert SPS on item 03 (Patient Identification), item 04 (Patient Involvement) and item 06 (Workplace Safety).

Four items got a basic SPS ≥ 10%: item 06 (Workplace Safety) got the highest percentage of a basic SPS with 18.8%, followed by item 02 (Communication) with 16.0%, item 04 (Patient Involvement) with 14.3% and item 05 (Prophylaxis) with 10.6%. We report the distribution of the basic, advanced and expert SPS detailed in Figure 1.

5 | DISCUSSION

This study demonstrated the development and testing of SJT for measuring the safety performance of HCPs working in acute care in Germany. To improve transparency, content validity and reliability in item development, the development of SJT items followed the recommendation of Patterson and colleagues (2016).

In this study, the newly developed instrument demonstrated an acceptable psychometric performance. The items included in the SJT were developed to cover a wide range of situations focusing on safety performance and relevant for most HCPs working in

clinical settings. Majority of the participants were able to provide valid answers to all items. The situations were designed not to repeat, although designed to complement, each other and build a more comprehensive picture of safety performance at the frontline. This was reflected in positive but low correlations, with no significant negative correlations between items. In a meta-analysis, the internal consistency coefficient of SJT items ranged from 0.43 to 0.94 (McDaniel et al., 2007). On the basis of this range, our instrument had acceptable internal consistency measured using Cronbach's alpha (0.57) for newly developed SJT with a diverse set of items (Catano et al., 2012). To further evaluate the reliability of the instrument, future studies should seek to establish test–retest reliability (Catano et al., 2012; Lievens et al., 2008; McDaniel et al., 2007).

Assessments of SPSs in different domains and subgroups have to be subjected to future studies. However, the findings of this study suggest an expert and advanced safety performance among frontline HCPs. Expert safety performance was pronounced for infection prevention, communication and prophylaxis. Basic safety performance was found for workplace safety and communication. Whether HCPs do not safely perform in certain areas (e.g. communication) or whether the items do not capture safety performance well will have to be clarified in future validation studies.

In a previous research, SJTs were used to measure several performance outcomes, for example, job performance (Chan & Schmitt, 2002; Lievens et al., 2008; McDaniel et al., 2001), personal initiative (Bledow & Frese, 2009) or job knowledge (Crook et al., 2011). With respect to job performance, research shows that SJTs seem to be a good predictor and should be as valid as those frequently used interviews and biographical measures (Chan & Schmitt, 2002; McDaniel et al., 2001). In this study, the newly developed SJT demonstrated an acceptable psychometric performance. However, whether the SJT developed and tested in this study is also a good predictor for safety performance remains an outstanding question and should be considered in future research.

5.1 | Limitations

There are several methodological limitations to our research that should be considered when interpreting the results. Because of the exploratory character of this study, the results should be considered indicatory.

With regard to the development of the items, it should be noted that the development workshop was largely conducted by professionals with a nursing background, which may influence the item content and specific situations. For the expert scoring, not only experts in patient safety were selected but also other HCPs, who have no additional training in safety performance. If more experts had been

TABLE 2 Sociodemographic data of the sample ($N = 168$)

	n	%
Gender		
Female	118	70.2
Male	50	29.8
Age (year)		
<30	89	53.0
31–40	31	18.5
41–50	24	14.3
>50	23	13.7
Profession		
Physician	26	15.5
Nurse	65	38.7
Nursing student	57	33.9
Others	19	11.3
Leadership role		
Yes	25	14.9
No	139	82.7
Work experience		
<3 months	2	1.2
>3 months <1 year	1	0.6
1 to 5 years	81	48.2
>5 years	82	48.8
Period of employment		
<3 months	4	2.4
>3 months <1 year	6	3.6
1 to 5 years	92	54.8
>5 years	65	38.7

TABLE 3 Descriptive statistics of seven test items and of overall Safety Performance Score (SPS)

	Missing cases	Invalid cases (>3 answers)	Used cases	Mean score	Standard deviation	Min	Max
SPS			148	4.43	0.72	1.86	5.57
Item 01 (Infection Prevention)	10	15	143	5.10	1.19	1.00	6.00
Item 02 (Communication)	10	2	156	4.37	1.33	1.00	6.00
Item 03 (Patient Identification)	14	21	133	4.39	1.06	0.00	6.00
Item 04 (Patient Involvement)	20	8	140	4.01	1.38	0.00	6.00
Item 05 (Prophylaxis)	19	7	142	4.47	1.27	1.00	6.00
Item 06 (Workplace Safety)	20	4	144	4.12	1.45	0.00	6.00
Item 07 (Hygiene)	20	5	143	4.73	1.27	0.00	6.00

TABLE 4 Spearman's correlations between items

	SPS	01	02	03	04	05	06	07
Item 01 (Infection Prevention)	0.49**	1.00	0.23*	0.18+	0.13	0.08	0.28*	0.07
Item 02 (Communication)	0.56**		1.00	0.20*	−0.04	0.10	0.28*	0.19*
Item 03 (Patient Identification)	0.32**			1.00	0.00	−0.07	0.09	−0.01
Item 04 (Patient Involvement)	0.40**				1.00	0.08	0.20*	−0.03
Item 05 (Prophylaxis)	0.38**					1.00	0.19*	0.14
Item 06 (Workplace Safety)	0.63**						1.00	0.04
Item 07 (Hygiene)	0.42*							1.00

Note: SPS: Safety Performance Score; Analysis with complete cases only ($N = 111$); Cronbach's alpha = 0.57.
*p <.05; **p <.001; +p =.06.

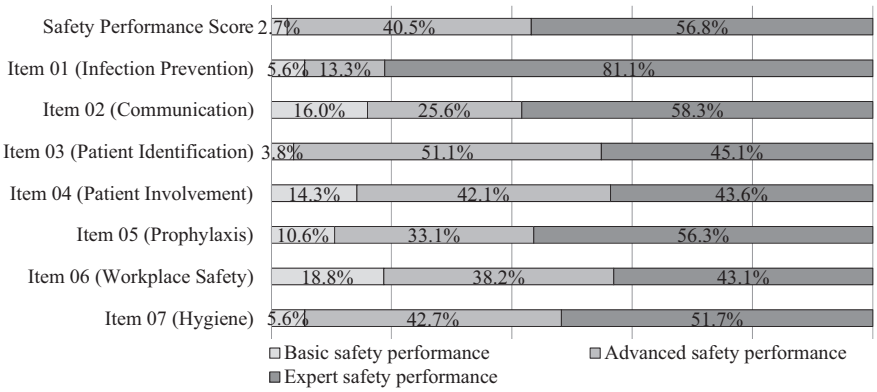

FIGURE 1 Basic, advanced and expert safety performance score on single item level as well as an overall safety performance score

involved in the scoring, the scoring system might have been chosen differently and consequently in different outcomes. Summarized, we cannot exclude possible limitations in the methodology, such as biases in rating and variations in how the study population understood the situations. The items with a high percentage of missing or excluded cases may indicate a higher item difficulty. Furthermore, order effects of SJT items are well known and should be considered while interpreting the results (Marentette et al., 2012).

It must also be noted that the topic of safety performance in acute care can be strongly influenced by social desirability and framing effects. Moreover, 14.9% of participants hold a leadership position that may influence SJT results. Supervisors can have a strong influence on patient safety as well as the safety performance of employees, what needs to be addressed when interpreting the results (Cavazotte et al., 2013; Ring & Fairchild, 2013). Future studies should take a closer look at the effect and differences of leadership positions and HCP as well as other hierarchical levels on the topic of safety performance and patient safety. In addition, responses may not reflect impacts of stress in patient safety-related scenarios, which HCPs may experience at the frontline and influence their performance.

Furthermore, we acknowledge that our sample size was limited and that its composition can limit the external validity of our results. A modest response rate of 39.01% and 168 HCP in our study is a result of the convenience of our sampling approach and the proportions of the surveyed professions, which could cause selection bias. Similar study population sizes have been reported for SJT to measure hygiene competencies of HCP, among others (Heininger et al., 2021). In patient safety research, response rates of HCP under 50% are not uncommon (Robertson et al., 2015). No information was available for non-respondents, which is a further limitation and should be taken into account while interpreting the trustworthiness of our study.

6 | CONCLUSION

The explorative study presents the development and testing of SJT to measure the safety performance of HCPs working in acute care. The SJT demonstrated an acceptable psychometric performance and can be used to measure safety performance of HCPs in certain areas, such as hygiene, patient identification and infection prevention. Having only detailed knowledge is insufficient in order to work safe, the knowledge needs to be applied correctly across a multitude of situations (Heininger et al., 2021). Therefore, the SJT helps to identify specific safety gaps at the individual level of nurses, nurses in training and physicians, which thereby can be addressed for further interventions to improve patient safety.

Further research is needed to answer questions about time effects in longitudinal research studies, construct validity, in particular, in comparison with other measurements, such as non-participating observations.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

AUTHOR CONTRIBUTIONS

All authors conceived and designed the study. Recruitment, data collection and data management with the assistance of DR, JH, FG and NE; data analysis with the assistance of NG and NE and manuscript draft, including tables and figures: LH. All authors reviewed the manuscript, provided comments and approved the final version.

ETHICAL APPROVAL

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the Medical Faculty of the University of Bonn, Germany (Number: 075/19, 30 April 2019).

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available from the corresponding author upon reasonable request.

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3.3 Publication 3: Safety Performance in Acute Medical Care: A Qualitative, Explorative Study on the Perspectives of Healthcare Professionals

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Safety Performance in Acute Medical Care: A Qualitative, Explorative Study on the Perspectives of Healthcare Professionals

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Abstract: Healthcare professionals need specific safety performance skills in order to maintain and improve patient safety. The purpose of this study is to get a deeper understanding of healthcare professionals' perspective in acute care on the topic of safety performance. This study was conducted using a qualitative approach. Healthcare professionals working in nursing were interviewed using semi-structured interviews. Using content analyzing, categories were identified which present aspects of safety performance; subcategories were developed deductively. A total of 23 healthcare professionals were interviewed, of which 15 were registered nurses, five were nursing students and three were pedagogical personnel. Nine (39.1%) were <30 years old, 17 (73.9%) were female, and 9 (39.1%) had a leadership function. Results highlight the importance of safety performance as a construct of occupational health rather than of patient safety, and the role of the organization, as well as the self-responsibility of healthcare professionals. Healthcare professionals should be more conscious of their role, have a deeper understanding of the interaction of individual, team, patient, organization and work environment factors.

Keywords: patient safety; occupational safety; safety performance; healthcare professionals; nursing; acute care; qualitative research

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1. Introduction

With an occurrence of 8 to 12% of all hospitalizations in European countries, adverse events have a significant impact on patient outcomes [1]. Hospitalized patient outcomes, such as mortality, hospital-acquired pneumonia, catheter-associated urinary tract infection and pressure sores, are directly associated with nurse-to-patient ratio, training and staffing, and work experience, among other factors [2–4]. Patient safety and health do, therefore, directly depend on healthcare professionals (HCP), especially nurses skills, knowledge and well-being [5–7]. The nurses' safety, well-being and safe care of patients are related to nurses' working environment [2,3,5,7–11]. The National Academy of Science identified in nurses' work and work environments several aspects which are evolving over time and influencing patient safety in a clinical setting: more complex, multimorbid clinical conditions of patients, shorter hospital stays, redesigned work, changes in the deployment of nursing personnel, frequent patient turnover, high staff turnover, long work hours, a rapid increase in new knowledge and technology and increased interruptions and demands [9].

These factors indicate that organizational and technical aspects, along with team and individual elements, affect patient safety. The human factors approach aims to improve patient safety by questioning and establishing how systems work and how this complexity

affects patient safety [12,13]. Human factors and ergonomics are scientific disciplines that aim to produce knowledge to redesign and improve processes [12–14]. Human factors refer to environmental, organizational and job factors, and human and individual characteristics that influence behavior at work [15]. It follows that organizational factors will affect patient safety, but the team and individual aspects will equally influence the behavior of nurses and other HCPs concerning safe patient care [12,13,16].

As a construct consisting of safety participation and safety compliance, HCPs' safety performance plays a key role in providing safe care, consequently maintaining and improving patient safety [17]. The term safety compliance is used to describe the core activities that need to be carried out by individuals to maintain workplace safety [17]. These behaviors include adhering to standard work procedures and wearing personal protective equipment. The term safety participation is used to describe behaviors that do not directly contribute to individual safety but help develop an environment that supports safety [17,18].

The association of HCP behavior and patient safety has been thoroughly studied, using a quantitative or mixed-method approach [2,4,19–27]. HCPs who work in nursing, and their unique views on safety performance regarding Griffin and Neals conceptualization [18], their role, and expectations for their work environment in acute medical care in Germany are rare. This study aims to explore HCP perspectives on the topic of safety performance with a qualitative approach.

2. Materials and Methods

2.1. Study Design

This qualitative interview study is part of the explorative mixed-methods SPOHC study (Safety Performance of Healthcare Professionals), conducted in 2018–2020. The study received ethical approval from a local ethics committee in Germany (number 075/19). SPOHC is built upon the integrative workplace safety model and focuses on safety performance as a construct of safety compliance and safety participation [28,29]. The SPOHC data collection methods comprised qualitative interviews and a cross-sectional written survey with healthcare professionals. The SPOHC survey results focus on the testing and validation of two instruments (a workplace health and safety instrument and situational judgement test) to measure the safety performance of HCP in Germany. Both instruments show acceptable psychometric properties, allowing new possibilities to measure the construct of safety performance [24,30].

2.2. Sample and Study Setting

The sample was based on convenience sampling and consisted of registered nurses, nursing students (last year of training) and pedagogical personnel working in nursing in one university hospital, two university teaching hospitals and two nursing schools. Registered nurses in Germany generally undergo a three-year training program integrated into nursing schools with a state examination. University qualifications in nursing, which are standard internationally, have only a short tradition in Germany and, so far, account for only a small proportion of about one to two percent of the nursing teams in hospitals [31]. Nursing schools are traditionally part of hospitals; consequently, nursing students work on the frontline from the beginning of the training program, attended by their supervisors. The focus of their work is to assist patients with physical care, assist team members, provide guidance and supervision to patients and their families. In some long-term psychiatric departments, staff with a pedagogical education are also part of the multiprofessional nursing team. They take on nursing-therapeutic tasks, especially in areas of child and adolescent psychiatry, and care for patients in these contexts. Nursing-therapeutic tasks can be e.g., developing the structure of the day or monitoring of the patient in working groups. The multi-professional nursing team can therefore consist of registered nurses, nursing students and pedagogical personnel to ensure high quality care on several levels. Nurses who have completed a one or two-year training program to be a nursing assistant were excluded from the study.

Nursing managers and headmasters of nursing schools were informed about the study via email and personal contact. The SPOHC project was presented during regular team meetings by a researcher with a clinical and nursing science background, and questions regarding goals, data protection, process, and effort could be answered directly. All HCPs were precisely informed about the protection of their person and data as well as the publication of the results. It was ensured that participation was completely anonymous and that no conclusions could be drawn about individuals or teams. If the HCP expressed interest in participating, they were subsequently contacted by email, with data protection documents and consent forms. Subsequently, with the HCP's consent, an appointment was made for the interview.

2.3. Data Collection

Two female researchers with a nursing science background, and a female student assistant with a psychology background, conducted semi-structured, face to face interviews with HCPs who were working in nursing between July 2019 and March 2020. Both researchers and the student assistant are trained in qualitative data collection and data analysis topics.

The semi-structured interview content was developed with the CRSS method to develop interview guidelines: C = collect, R = review, S = sorting, S = summarize [32]. The first step was a brainstorming process to collect questions, followed by a review step to sort out all closed, evaluative, and suggestive questions [32]. In the next step, questions were sorted by content and in the last step, summarized [32]. The brainstorming process and first collection of questions in step one was influenced by own prior clinical experience, publications on safety performance, and the theoretical model (the integrative workplace safety model) on which the overall SPOHC study is based [28,29].

The guidelines consisted of four key questions regarding aspects and barriers of safety performance, the own role and enhancements for work on the frontline (detailed information about the key questions is presented in Figure 1). The key questions were designed to achieve descriptions of specific situations and procedures at the frontline to explore realistic situations and let the participant reflect on their performance and role as a HCP. The semi-structured interview was pre-tested with a study nurse working in health services research and with clinical experience.

Key questions:

1. Tell me, what do you generally understand by safety performance.
2. Please describe situations in which you have behaved safely.
3. Please describe situations in which unsafe behavior was observed.
4. If you think about your role, how would you assess your safety performance?
5. What do you actively do to ensure that your colleagues behave safely?
6. What would have to be different in everyday life for you to behave as safely as possible?

Figure 1. Key questions of the semi-structured interviews.

All interviews were conducted at the workplace in separate rooms without any interruptions. At the beginning of the interview, the researcher introduced herself and explained their clinical background to establish a trustworthy situation. HCPs were informed about voluntary participation, data protection, the possibility of termination at any time, and the study's aim. Sociodemographic information was collected at the end of the interviews.

2.4. Data Analysis

Each interview was audio-recorded, fully transcribed, pseudonymized and coded using content analysis. Categories were developed deductively, main categories were identified from the guideline, subcategories were based on the human factors model of patient safety [12]. The four main categories which have been identified as the most relevant for patient safety were (1) Organizational/Managerial; (2) Workgroup/Team; (3) Individual Worker; (4) Work environment [12]. We used these categories and an additional category (5) Patient/Caregiver as the subcategories in the performed content analysis. One female researcher with a background in nursing science and clinical nursing, and a female student assistant with a psychology background, who both were responsible for the data collection coded the interview transcripts independently and discussed all text segments and codes using the software MAXQDA (version 18/20, VERBI GmbH, Berlin, Germany). Afterwards, the text segments were paraphrased, generalized, and reduced, based on the content analysis recommendation form of content structuring of Mayring [33]. All anchor quotes were translated into English by a translation agency. All findings were discussed by a multidisciplinary team of researchers working in patient safety with a background in health services research, nursing science, and psychology. The transcripts or results of data analysis were not discussed with the interview partners themselves.

2.5. Trustworthiness of the Study

To ensure credibility, transferability, dependability and confirmability, our study is built upon the framework presented by Korstjens and Moser [34]. To ensure credibility, investigator triangulation was used, and two researchers coded, analyzed and interpreted the data. To ensure transferability, we sought to provide thick descriptions of context, as well as behavior and experiences. To ensure dependability and confirmability, we endeavored to report the different qualitative research steps we conducted in a transparent manner.

3. Results

3.1. Sample Characteristics

Fifteen registered nurses, five nursing students and three pedagogical personnel, all working in nursing, were interviewed. From these 23 interview partners, nine (39.1%) were <30 years old, 17 (73.9%) were female, and nine (39.1%) had a leadership function. A total of 15 (65.2%) had worked longer than five years in nursing, and 13 (56.5%) had worked longer than five years in the same department.

3.2. Aspects of Safety Performance

In general, the interviewed HCP understood the general aspects of safety performance to mean everyday behavior related to the safety of patients, their family members and hospital staff. The focus was mainly on reducing risk factors and observing occupational health and safety, observing protective measures and theories on the occurrence of errors, which are typical, practical examples of accident prevention.

> *Well, no idea, that there are no power cables on the floor that you can trip over. (IP01)*
>
> *Well, for example, that you, when you've moved a patient from one room to another, that you then lower the bed again, that you, I don't know, also explain to the patient how the nurse call button works, adjust the lights, that, if it's dark, you might also turn on the light and explain to the patient how to turn on the light. (IP05)*
>
> *It's also about sharps disposal, correct waste disposal, avoiding situations that are potentially dangerous for patients, right? (IP08)*
>
> *Well, let's start with patient safety; so, there, I would say that, for example, when the floor is mopped, that some sign is placed stating that like/that the floor is wet. (IP14)*

> *We had a construction site here a little while ago. So we had to be careful, too; there was scaffolding here on the patio, so we locked the patio door to make sure that patients do not go there and possibly climb up. (IP19)*

3.3. Aspects of Safety Performance—Organizational/Managerial

In the interviews, concerning aspects of safety performance that address the organizational level, establishing rules and checking them was a particular focus. It was reported that management specifications, assessments, standards, and guidelines influence HCP safety performance. This also includes the mandatory use of Critical Incident Reporting Systems, checklists, patient wristbands and other instruments to increase patient safety. It should be emphasized that the organization's rules should be reviewed by management to ensure consistent compliance.

> *I believe at our facility, it's that our director and deputy director are both people who pay very close attention to that. And if any mistakes are made, they communicate that. And they have very high quality standards for our team. And that as a result, I believe, a lot is actually achieved/that, well, people do act properly because we know that this is kind of demanded and required from us. (IP10)*

In the interviews, HCPs emphasized that the organization offers regular training programs and that all HCPs (e.g., physicians) are required to attend the training courses.

> *I believe, that is really because the people all receive really good initial training, a good briefing, and continued education. So, it's not like someone just says: "Come on, let me show you the emergency kit really quickly", but there is an actual continued education event where you sit down for two hours and where each drug is discussed, too, what its indication is and when to use it. (IP07)*

From the interviewees' point of view, the organization's responsibility to provide a safe workplace is important. This includes good personnel key, personnel with sufficient language skills and the establishment of appropriate structures and processes, like emergency call systems, occupational safety committees, mandatory meetings after adverse events, monitoring of patient data protection, etc.

3.4. Aspects of Safety Performance—Team

Based on the interviews, HCPs emphasized the importance of sharing knowledge about patient safety within the team. The knowledge from training programs should be passed on in teams, managers must pass on their knowledge to their employees about safety issues and current measures; there should be regular team-internal meetings focusing on patient safety.

> *That is, you then also have to take a second step and not only inform people but to somehow also enable them to act accordingly. And typically, this is best done by, well, by showing them how to do it. (IP11)*

The interviewed HCPs reported that teamwork in the inter-professional and nursing team is characterized by responsibility, openness towards mistakes, and safety. It is about agreements, open communication, trust and the perception of problems and uncertainties of colleagues. The cooperation between different professions should be reflected upon, and ambiguities should be addressed and solved through supervision. From the HCPs' point of view, teamwork described as good and relaxed promotes patient safety and safety culture within the team.

> *That is, if we had a reanimation here last time, then the medical team was brought in, then I asked that we reflect again on what we did, how we did it, how everyone experienced it, how everyone felt in the process, and we try to reflect on that again on the larger scale and simply do better in the future to simply ensure patient safety that way as well. (IP06)*

According to the participants, a team assumes a control function to detect errors early, familiarize new colleagues, and enable trustful teamwork.

> *And we actually train our physicians a little bit in this way because: "Well, do this, do that", no physician order. Now, we don't do anything without a physician order. And sometimes, many physicians actually then try to verbally delegate things somehow, but we just don't do it. And then they got used to it. (IP03)*

3.5. Aspects of Safety Performance—Individual Worker

On an individual level, adherence to safety-related rules played a major role for the interviewed HCPs. The correct wearing of protective and work clothing was mentioned here; being informed about current safety-relevant standard operating procedures and measures, carrying out room checks, protecting patients from falling, observing hygiene rules and confidentiality, and working in a de-escalating manner.

> *And most of it, well, it's very important that personal protection, that it is always paramount. Because, if I'm down sick, I can no longer help others. That's why I always start with myself. (IP17)*

Based on the interviews, HCPs should be aware of their function, have a role model status, be responsible for transferring knowledge, seek inter-professional help in case of uncertainties, and admit mistakes. It involves keeping agreements, making routine situations safe, developing an awareness of dangerous situations.

> *And especially the last case, it just showed me that even I, with twenty years of job experience, still need to always reflect. Work on myself. And that gave me a little more security, to still feel that. If I had gone in there indifferently and came out indifferently, I would have been rather worried, or actually, probably not. (IP17)*

HCPs should be responsible for participating in further training programs, continually expanding their knowledge, and passing it on.

> *And that you, as I said, participate in continued education, if you learn something from the continued education, that you just pass that on in the team, too. (IP15)*

3.6. Aspects of Safety Performance—Work Environment

On the work environment level, structural measures such as clearly arranged departments, escape routes, emergency doors, fire alarms, alarm systems, and safe windows and doors have been mentioned as aspects that influence safety performance. Medical products such as bed rails, alarm mattresses and protective equipment for nursing professionals, as well as training courses on technical aspects of everyday work (digitalization in nursing), were mentioned by the HCP here.

> *An example is, well, if a patient is infectious and isolated, you have to put on specific protective clothing if you perform activities near the patient so that you then leave the microbes in the room when you take off the protective clothing. (IP11)*

The correct handling of medication by HCP was also mentioned. Here, hygienic aspects played a role as well as control mechanisms, storage systems and the placing and administration of these.

> *Another topic is the administration of medications; for example, infusions, when I administer them. Or injections that I administer. There as well, it's important that I make sure, for instance, to disinfect the puncture site, or disinfect the connectors to which the infusion is hooked up to ensure that I do not expose the patient to microbes through the injections or infusions. (IP11)*

3.7. Aspects of Safety Performance—Patient

At the patient level, the aim is to avert dangerous situations and adverse events. Measures to protect patients must be initiated at an early stage; patients must be closely monitored to be protected immediately in case of risks—for example, the WHO checklist for avoiding adverse events during surgical procedures.

For instance, storage, repositioning, patient admission, to ensure that data are appropriately collected, documented, and that this is a continuous cycle. The patient, for example, which side is operated on, is it the right patient, is the name correct, the information, etc.? Is the patient placed on the correct table? Have we brought up the correct X-rays? It runs through all of that. Well, those are the patient-relevant data that, I think, do play a major role. Because mix-ups have been described over and over. And of course, they should be avoided if at all possible. (IP22)

So, of course, as I already mentioned, with regard to hazardous objects, escape routes, that patients have been informed, too, for instance, what to do in case of fire. Because something like that can happen at any time even without external influences. (IP13)

HCPs act as patient advocates; they are mainly responsible for patient safety. This includes providing support when uncertainties arise, providing information and assistance in decision-making, and communicating patience and time so that the patient feels supported, understood, and safe.

My staff knows exactly, if I'm not well, that I simply know I can always address that. And to give the patient this psychological, well, safety; I do think that is part of patient safety as well. (IP06)

4. Discussion

Our qualitative study aimed to explore the perspectives of HCPs who are working in nursing in acute medical care on the topic of safety performance. Categories were developed deductively based on the human factors model of patient safety, and represent aspects of safety performance experienced by HCPs at the frontline [12,13]. Results highlight the importance of safety performance as a construct of occupational health rather than of patient safety and the role of the organization. The interviewed HCPs struggled to describe what safety performance means individually, and situations related to safety performance or general safety issues. The focus of interview participants was more on occupational safety aspects (for example, handling injection needles or technical handling of medication) or organizational or management aspects, than patient- or team-related aspects of safety. Safety performance was described as a functional construct of occupational health, e.g., to ensure that patients do not fall, the work environment is secured, or work clothes are worn. It involves factual information about aspects of occupational health and safety. The interview partners were asked to describe their experience with safe situations. The HCPs stated that, beyond the functional safety performance, factors regarding teamwork, communicational skills and responsibility aspects can also be classified as a level of interactive safety performance. Their roles and responsibilities regarding patient safety became clearer and structured while talking about their perspective on safe and unsafe situations.

However, it became apparent that one's safety performance and role as a HCP in the hospital system were only superficially reflected upon, and the organization and management were described as playing a more important role. The organization should establish rules for constant compliance with high safety standards (e.g., using critical incident reporting systems, standardized handovers, safety rounds and speak up initiatives [35,36]) and checking them was a particular focus for the HCPs who work in nursing. Rules, checklists, and standards for nursing and physicians must be more strictly observed and verified by the management to improve safety performance. This is contrary to a previous study which found that nurses with higher autonomy by the organization also made fewer medication errors, and that this aspect was the only structural aspect related to patient safety [37]. The authors of this study attribute this effect to nurses' higher education. The higher the qualification, the higher the autonomy, and the rarer the patient safety errors [37]. Other studies underline the correlation between safety performance and job autonomy as well [38–40]. Registered nurses in Germany are typically trained for three years, but not on university/college level, which is the international standard for becoming a registered nurse [31]. A 2015 survey found that 1% of all nurses in Germany who work in direct

patient care have a college degree [31]. Future studies should clarify whether curricula differences in terms of safety performance between college and vocational training might contribute to the need for more monitoring management. One aspect of safety performance in all subcategories is the implementation and participation of training and qualification programs that address patient safety topics in education, training, continuing education, or degree programs for HCPs. The organizational offer of regular training programs and the self-responsibility to get regularly trained are important to provide safe and evidence-based care for patients. HCPs, as well as nursing students, in Germany are not explicitly required to attend special patient safety compliance and improvement trainings on a regular basis. Consequently, it is not ensured that HCPs are trained in topics such as speaking up, using critical incident reporting systems, standardized handovers in all clinical areas and can work safely. This aspect is the subject of numerous health policy debates to improve education and training in nursing and medical fields [41,42]. This underlines the importance of a safety culture and safety performance in acute care once more. Empowerment training for nurses that aimed to improve safety culture was found to significantly impact the clinical practice [43,44]. It focused especially on communication domains like openness, speaking up and error communication [43], aspects which were mentioned as important but also inadequate at the frontline in this study.

Limitations

There are several limitations to our research that should be considered when interpreting the results of our study. Social desirability bias may have affected our results. The topic of safety performance in acute care can be particularly influenced by social desirability, and consequently the interviewees may not have spoken openly about sensitive events, such as errors in acute care settings. The study results' generalization could be limited by the self-selection bias, as the volunteer participants may not be representative of the entire healthcare professionals. And a self-serving bias could also have influenced the response behavior and limited the interviewees' ability to reflect on their performance and role as HCPs. Furthermore, our sample consists of registered nurses, nursing students and pedagogical personnel, so the interviews primarily reflect the perspectives of these professions. The special training as a registered nurse in Germany, the involvement of students from the start of training, and the involvement of pedagogical personnel in nursing teams must be taken into account while interpreting the results. Future studies should be based on heterogeneous samples so that the average of HCPs in Germany is represented. Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

5. Conclusions

This study aimed to examine HCPs' perceptions about safety performance with a qualitative approach. Results indicate on the one hand that HCPs fail to have a more comprehensive and complex picture of safety performance at the frontline and, on the other hand, that organizational aspects have a huge impact on safety performance, and compliance to rules and standards. HCPs need regular trainings in safety performance and patient safety, provided by their organization. Based on these findings, HCPs working in nursing should be more aware of safety performance and patient safety to be more conscious of their role and have a deeper understanding of the interactions between individual, team, patient, organization, and the work environment. The necessary basic qualification of nurses should also be critically examined for Germany against the background of the international standard of higher education qualifications in nursing.

Further studies should focus on interventions to socialize nurses for patient safety and safety performance from the beginning of their education and explore inter-professional teams' experiences to get a deeper understanding of safety performance at the frontline.

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4. Discussion

This dissertation aimed to address three objectives in order to get a deeper and more complex understanding on the safety performance and the behavior of HCP working in acute care in Germany. This was carried out through

1) translating, testing and validating an instrument to measure the constructs safety performance and proximal person-related factors of HCP working in German hospitals;
2) developing and testing a new possibility to measure safety performance of HCP with a situational judgement test to measure the actual behavior within clinical safety scenarios;
3) exploring the perspectives of HCP about their experiences and views on safety performance in their daily working routine.

The study was based on the integrative model of workplace safety (Christian et al. 2009), which provides a theoretical foundation and evidence on influencing factors on safety performance and safety outcomes of HCP working in acute care and connects the three objectives and publications in this dissertation. The German version of WHASI measures the constructs and dimensions of safety performance and proximal person-related factors as described in the integrative model of workplace safety (Heier et al. 2021a). With its results, publication 1 contributes significantly to the fact that the important construct of safety performance, as well as the construct of proximal person-related factors, can now be measured in the German-speaking context by a validated instrument. One aspect that was not addressed in the integrative model of workplace safety and also represents a research gap in current patient safety research, is the possibility of measuring and assessing safety performance on the basis of specific safety scenarios. With publication 2, a novel approach to measure safety performance by a behavioral instrument was developed and the integrative model of workplace safety could be supplemented (Heier et al. 2022). The role of the organization, leadership aspects and job attitudes, which are represented as distal situation-related and distal person-related factors within the integrative model of workplace safety, were addressed in the third publication and allowed a different perspective of the constructs through the experiences of HCP themselves (Heier et al. 2021b). Publication 3 examined factors influencing safety performance and

perspectives of HCP who are working in acute care. The result that the organization should establish more specific rules to improve the safety performance, on the one hand, underlines the relevance of these constructs for patient safety and safety performance, and on the other hand, differs from the findings of Hung et al. (2013), Ko et al. (2018) and Weston (2008), who underline the correlation between safety performance and job autonomy of HCP working in acute care (Heier et al. 2021b).

4.1 Limitations and Strengths

There are several limitations to the cumulative dissertation and the SPOHC study that should be considered while interpreting the results. All presented data are part of an explorative study and are therefore limited in terms of their generalizability. Regarding the whole SPOHC study, one main limitation is the convenience of the sampling approach and the proportions of the surveyed professions. It must also be noted that the topic of safety performance in acute care can be strongly influenced by social desirability bias. In addition, there is a potential risk of selection bias due to the recruitment strategy of this study.

With regard to the second publication, the testing of newly developed SJT items, it should be pointed out that the development and expert scoring of the seven items was mainly conducted by HCP with a background in nursing and not all experts who scored the items had additional training in patient safety (Heier et al. 2022). Moreover, we cannot exclude possible methodological limitations, such as bias in rating, order effects or item difficulty (Bergmann et al. 2006; Catano et al. 2012; Christian et al. 2010; Marentette et al. 2013).

With reference to the third publication, the qualitative study about the perspectives of HCP on safety performance, the results could be limited by the self-selection bias (Heier et al. 2021b). Furthermore, the sample consists of registered nurses, nursing students and pedagogical personnel, which is almost a unique composition of nursing teams in Germany in comparison to other countries (Heier et al. 2021b).

The explorative character of SPOHC can also be seen as the main strength of this cumulative dissertation. We were able to include various teams and professional

specializations in the study and include the perspectives and experiences of nursing students in their third year to connect a multi-professional sample who work in acute care. The translation, testing and validation of a German version of WHASI represents another strength of the dissertation. Methodologically, the German version shows on the one hand a good model fit with the original instrument as well as acceptable properties, and on the other hand, the instrument offers a new and easy to use possibility to measure the safety performance and the factors knowledge and motivation of HCP in acute care in Germany (Heier et al. 2021a). The opportunity to develop an entirely new instrument and test it with an initial sample to make behavior and performance more quantifiable is another strength of this dissertation and opens up the possibility of measuring safety performance with a novel approach to testing and evaluating (Heier et al. 2022). The inclusion of the perspectives of HCP regarding safety performance with the human factors approach to discuss the results remains a following strength of this dissertation. The results were put in the light of organizational, technical, team, patient and individual aspects and could be discussed along a theoretical approach (Heier et al. 2021b).

4.2 Implication for Practice & Research

The WHASI-G provides for hospitals, management and their clinical teams a possibility to measure the safety performance of their teams and based on the results, develop interventions to improve patient and occupational safety (Heier et al. 2021a). The dimensions safety knowledge, safety motivation, safety compliance and safety participation can thus be looked at more closely and can be directly adapted and implemented for interventions, such as promoting the development of interpersonal skills, leadership or teamwork (Leape 2021). The SJT can additionally measure the safety performance of HCP in specific clinical situations and provide a more detailed insight of safety related behavior (Heier et al. 2022). The SJT helps to identify gaps at the individual level of HCP, which can be addressed in patient safety trainings. Moreover, the findings of the qualitative study suggest that the own role as a HCP and the own safety performance were only superficially reflected upon, which lead to the view that the organization and management play a more important role in improving and maintaining safe care than the HCP him- or herself (Heier et al. 2021b). Hence, the management can support the safety performance by establishing mandatory trainings to use critical incident

reporting systems, standardized handovers or speak up initiatives (Ferorelli et al. 2017; Ferorelli et al. 2020).

In academia, the WHASI-G and SJT enables researchers to study the construct safety performance and proximal person-related factors in German high-reliability organizations in more detail. Regarding the WHASI-G, it remains outstanding which role organizational, sociodemographic or distal person- and situation-related aspects have and how they may predict and influence the safety performance of HCP. With reference to the SJT measuring safety performance, further research is needed to study time effects in longitudinal studies, construct validity in comparison with other possibilities to measure behavior, such as non-participating observations. In addition to the further research implications based on the findings of the publications of this dissertation, it still remains unclear whether and where the SJT is to be integrated into the integrative model of workplace safety and how the different constructs may influence the SJT dimensions. Moreover, the qualitative findings suggest that HCP should be more aware of their own role and their safety performance, which can also be addressed within the development, implementing and evaluation of inter-professional workshops and lectures, possibly starting in nursing and medical school to support inter-professional learning and working. To address this implication, a project was developed at the Center for Health Communication and Health Services Research (CHSR), clinic and policlinic for psychosomatic medicine and psychotherapy at the University Hospital Bonn, to enhance inter-professional collaboration among nursing and medical students in the area of error communication.

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