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Patient safety culture improvements depend on basic healthcare education: a longitudinal simulation-based intervention study at two Danish hospitals

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ABSTRACT

Background A growing body of evidence supports the existence of an association between patient safety culture (PSC) and patient outcomes. PSC refers to shared perceptions and attitudes towards norms, policies and procedures related to patient safety. Existing literature shows that PSC varies among health professionals depending on their specific profession and specialty. However, these studies did not investigate whether PSC can be improved. This study investigates whether length of education is associated with improvements in PCS following a simulation intervention.

Methods From April 2017 to November 2018, a cross-sectional intervention study was conducted at two regional hospitals in Denmark. Two groups with altogether 1230 health professionals were invited to participate. One group included nurses, midwives and radiographers; the other group included doctors. A train-the-trainer intervention approach was applied consisting of a 4-day simulation instructor course that emphasised team training, communication and leadership. Fifty-three healthcare professionals were trained as instructors. After the course, instructors performed in situ simulation in their own hospital environment.

Outcomes The Safety Attitude Questionnaire (SAQ), which has 6 dimensions and 32 items, was used to collect main outcome variables. All employees from both groups were surveyed before the intervention and again four and nine months after the intervention.

Results Mean baseline scores were higher among doctors than among nurses, midwives and radiographers for all SAQ dimensions. At the second follow-up, four of six dimensions improved significantly ($p \leq 0.05$) among nurses, midwives and radiographers, whereas no dimensions improved significantly among doctors.

Conclusion Over time, nurses, midwives and radiographers improved more in PSC attitudes than doctors did.

Key messages

What is already known on this topic?

► Simulation is an important strategy to identify and overcome latent safety threats. Existing literature investigating the association of in situ simulation and patient safety culture, depending on length of participants' education, is sparse.

What this study adds?

► Nurses, midwives and radiographers seemed to benefit the greatest from the intervention.

How this study might affect research, practice or policy?

► Future research should investigate if simulation should be structured depending on length of participants' education.

INTRODUCTION

WHO states that one in every 10 patients in high-income countries suffers iatrogenic harm while receiving hospital care. This harm can be caused by adverse events of which about 50% are considered preventable.[1] Thus, improving patient safety is considered one of the most important challenges in healthcare today.[2 3]

When a healthcare team faces a critical situation, teamwork and communication are critical determinants for patients' safety, well-being and survival.[4 5] Studies have documented an association between patient safety culture (PSC) and patient outcomes, such as medication errors, length of hospital stay and readmissions.[6 7] Therefore, creating the best possible PSC among health professionals is considered key to delivering effective and safe patient care.[3 8 9]

PSC refers to shared perceptions and attitudes towards norms, policies and procedures related to patient safety in a team or an organisation.[10 11] This means that individual perceptions and attitudes are aggregated at group level, for example, in clinical settings, providing a snapshot of the safety climate at a particular point in time.[12] Thus, to enable

analysis of improvements, subjective cultural standards are quantified and measured.[10] A commonly used questionnaire measuring PSC within hospitals is the Safety Attitudes Questionnaire (SAQ).[13 14] Surveyed PSC dimensions are teamwork climate, safety climate, job satisfaction, stress recognition, perception of management and working conditions.[12]

Existing literature is not one pointed, and it lacks methodological strength. The literature shows that PSC varies among health professions and specialties, but no current evidence has established an association between length of education and receptiveness to costly interventions and perceptions of PSC. A Norwegian study documented that PSC scores varied considerably across hospital departments.[15] Two studies investigated PSC across the Danish healthcare system; one reported a significant difference in positive attitudes among doctors, nurses and nursing assistants; however, no consistent pattern was found across PSC dimensions.[16 17] Another study indicated that nurses are more positive than doctors, though no statistical significance was found, leading to a recommendation of further investigation.[18]

Two reviews published in 2013 concluded that intervention studies documenting differences in perceptions of PSC over time were characterised by poor implementation and limited support from management.[10 11] Furthermore, most studies had single-group pre–post intervention designs with relatively small to moderate sample sizes. However, both reviews indicated that PSC improved when interventions were multifaceted, supported by management and aimed at enhancing communication, coordination and teamwork in safe clinical practices.[10 11] In addition, studies did not examine potential variation in perceptions of safety culture by care provider type.[10] A Danish study evaluated safety attitudes before and after an in situ simulation program and found improvement in PSC.[19] However, the study was limited by only 39 participants and no follow-up measurement, leading the authors to suggest future research focusing on repeated simulation sessions and longer follow-up periods.[19] This argument is supported by another Danish simulation-based intervention study, which found no changes in PSC over time.[20] Likewise, authors suggested future research including repeated simulation sessions and a longer follow-up period. Finally, another two more recent Danish studies investigated PSC, in which one used in situ simulation as a tool to train teamwork, leadership and communication.[16 21] Results showed that in situ simulation can be used as a tool to improve PSC over time, particularly in an acute setting.[16]

Simulation can be used to imitate a real-life scenario from a clinical setting in which a scene of clinical conditions is created to mirror authentic situations.[22 23] Simulation allows interprofessional teams to review and strengthen their skills and to solve problems in a simulated clinical setting, that is, in situ. At its core, in situ simulation is an approach with which to support and improve skills within teamwork, leadership and communication.[5 23] It is hypothesised that simulation can be used as an instrument to improve PSC, since both teamwork, safety climate and working conditions are relevant factors within both simulation and PSC.[5 12 22 23] This statement has been supported in previous studies.[16 19 20] Additionally, in situ simulation has been described as an important strategy to identify and overcome latent safety threats.[7 11]

To our knowledge, no studies conducted in developed countries published within the last 10 years has investigated the association of in situ simulation and PSC, depending on length of participants' education. This study investigates the association of changes in PSC with influence of length of education before and after an in situ simulation intervention.

METHODS

Setting

A longitudinal intervention study was conducted from 2017 to 2018 at two Danish general hospital sites. Hospital 1 had a capacity of 333 beds; hospital 2, a capacity of 220 beds. Staff members from hospital 1 included 19 groups mainly handling emergency functions. Staff members from hospital 2 included 16 groups in which mainly elective functions were carried out (online supplemental appendix 1). In situ simulation was not facilitated systematically in either of the hospitals prior to the study.

Intervention

We used a train-the-trainer approach. This made it possible to train a limited number of instructors who subsequently performed in situ simulation with a large group of employees.

Before the intervention, 53 health professionals, including doctors, nurses, midwives and radiographs, were trained as simulation instructors. Three instructor teams were created consisting of 20 instructors within team 1, 18 instructors within team 2 and 15 instructors within team 3 (online supplemental appendix 1). The hospital management appointed instructors with no selection criteria, besides from the employees' motivation. At least one employee from each of the groups listed in online supplemental appendix 1 was trained as a simulation instructor.

To become a certified simulation instructor, healthcare professionals participated in a 3-day course, including a fourth day follow-up session after 6 weeks. Course contents were imparted during the 6-week training period. The course focused on team-based skills including team training, communication and leadership. In practice, the course included both theory sessions and practical sessions, which is illustrated in the instructor course curriculum (online supplemental appendix 2). During the 6-week training period, participants were able to apply and test acquired skills as a simulator instructor in their own clinical environment. Experienced simulation instructors and experts in simulation were responsible for providing the course in which the main priority was

to create a safe learning environment. Practical sessions were structured so that participants conducted simulation sessions and debriefing of their peers, after which they received feedback by an experienced instructor. During the course the instructor trainees were closely mentored by a faculty of experienced instructors giving feedback on every briefing, simulation, debriefing cycle. This was to ensure that each trainee was able to understand the curriculum and conduct simulation with structured briefing, and debriefing by TeamGAINS.[24] At the fourth day follow-up session, participants received additional feedback on the simulation they had performed during the 6-week training period. After the fourth day follow-up session, every participant received a diploma, indicating a completion of the course. The debriefing was an essential part of the course. By using the TeamGAINS debriefing tool, we supported the instructor and ensured that important teamwork elements from the simulation session were evaluated.[24]

After completing the instructor course, the simulation instructors returned to their hospital department in which they were responsible for conducting simulation with staff in their own department. Every simulation session was initiated, planned, led and documented in log notes by the simulation instructors. Instructors started to facilitate simulation in their own departments after the fourth day follow-up session. During working hours, instructors were responsible for appointing employees participating in simulation sessions. Every instructor was then equipped to create a safe learning environment among colleagues.

Data collection

Perceptions of PSC were measured once before the intervention and twice after the intervention; at four and 9 months (table 1). PSC measurements were conducted from April 2017 to December 2018. Inclusion criteria for the first assessment of the PSC were full- or part-time clinical staff with patient contact. Nurses, doctors, midwives and radiographers were invited to participate. Employees were divided into staff with a medium-cycle higher education and staff with a long-cycle higher education. A medium-cycle higher education included a 3.5-year bachelor as a nurse, a midwife or a radiographer. A long-cycle higher education included a 6-year bachelor and master's degree as a doctor.

Staff members assigned after baseline measurement were not invited to participate in the second and the third data collection of SAQ-Danish version of The (DK). The reason was a main interest in the group of staff, which participated throughout the study period. Each invitee was assigned a unique personal identifier that remained across the three data collection periods. Data were collected across three teams. Team 1 consisted of health professionals employed at hospital 1, team 2 consisted of health professionals employed at hospital 2 and Team 3 consisted of a mixed team of health professionals from both hospital 1 and Hospital 2. In total, 1230 employees (team 1: n=490, team 2: n=432 and team 3: n=308) qualified for inclusion (online supplemental appendix 1). The total number of participants was determined as the 1230 healthcare professionals, since they were employed in a department in which there was a trained certified simulation instructor. No priori power analysis was conducted. However, previous studies that investigated PSC and/or simulation interventions included a similar or smaller number of participants, and found significant changes.[16–21]

To measure participants' perceptions of PSC, we used a validated SAQ-DK including; profession, gender, age group, organisational role, affiliation and work experience.[12 17] Research variables did not differ between the hospitals.

As illustrated in table 1, data were collected over three periods; before the intervention (baseline) and after approximately 4 months (first follow-up) and 9 months (second follow-up). Previous studies found that team-based skills have shown to deteriorate after 6 months.[25 26] To measure potential changes in PSC, the SAQ-DK was therefore collected both four and 9 months after intervention.

The SAQ-DK was distributed electronically via the survey system SurveyXact using individual links in emails to all included staff. Only the person in charge of

Table 1 Data collection periods at baseline, first follow-up and second follow-up

	2017		2018		
Timeline	**April**	**August**	**January**	**May**	**November**
Team 1 (hospital 1)					
SAQ-DK collection period	25 Apr - 19 May 2017	23 Aug - 14 Sep 2017	10 Jan- 05 Feb 2018		
Team 2 (hospital 2)					
SAQ-DK collection period		23 Aug - 14 Sep 2017	10 Jan - 05 Feb 2018	08 May - 12 Jun 2018	
Team 3 (mix)					
SAQ-DK collection period			10 Jan- 05 Feb 2018	08 May- 12 Jun 2018	01 Nov- 27 Nov 2018

SAQ-DK, Danish version of The Safety Attitude Questionnaire.

distribution of questionnaires had access to the individual responses. After 2 weeks, one reminder was emailed to all invitees who had not yet responded. The research group frequently visited the participating departments to increase the response rates. Furthermore, management and key persons received weekly emails displaying current response rates. Finally, a sentiment of collective motivation was nurtured at morning conferences. To account for vacation periods and public holidays, some data collection periods were slightly longer than others (table 1).

The psychometric properties of SAQ-DK were tested in a previous cross-sectional study showing good construct validity and reliability.[12 17] SAQ-DK comprises 32 items covering six dimensions of PSC, namely, teamwork climate, safety climate, job satisfaction, stress recognition, perception of management and working conditions.[12 17]

Data analysis

Data were analysed separately for all participants and participants replying to all three SAQ-DK surveys, characterised as the 'stable group'.

Data were processed in two analyses. First, analyses included the proportion of participants with a positive attitude (% positive, defined by one participant's mean scale score ≥75). Second, analyses included mean scale scores and SD. Both analysis scales ranged between 0 and 100. A change in mean scores indicated the perceived level of PSC among surveyed staff. Percent positive illustrated a potential improvement within PSC attitudes over time. Earlier studies state that an improvement of more than 5% over time may be identified as clinically relevant.[21 27 28]

To calculate PSC outcomes, every SAQ-DK item score was converted to a 0–100 points scale in which 1=0, 2=25, 3=50, 4=75 and 5=100. To match positively worded questions, items number 2 and 11 were scored in reverse. Mean scale scores were calculated using the average score of the scaled items.[21]

The proportion of participants with a positive attitude was analysed and compared across measurements and subgroups (depending on length of education) for all three data collection periods. To compare differences in mean scale scores at baseline measurement and second follow-up measurement, depending on length of education, paired sample t-tests were applied in the stable groups. All analyses were performed using STATA 17.

Patient and public involvement

No patient or public involvement.

RESULTS

Invitees and participants

A total number of 1230 employees were invited to participate in this study. The response rate was 65.8% at baseline, 66.8% at first follow-up and 66.8% at second follow-up. A total of 404 employees responded to all three surveys and were referred to as the stable group. Table 2 shows that length of education appeared similar across collection periods and within age groups. However, the proportion of females differed significantly in the two groups with 97% of participants with a medium-cycle higher education compared with 54% of participants with a long-cycle higher education ($p<0.05$). Furthermore, participants in the medium-cycle higher education group clearly outnumbered employees (n=633 at baseline) in the long-cycle higher education group (n=176 at baseline). Lastly, healthcare professionals employed in the departments for more than 5 years mainly consisted of the medium-cycle higher education group (56 %) vs 44% among the long-cycle higher education group.

In situ simulations performed

During the intervention period, the number of performed simulation sessions was logged. Between baseline and first follow-up, 123 simulation sessions were performed among the invited employees (online supplemental appendix 1). Another 87 sessions were performed between the first and second follow-up, which yields a total number of 210 performed simulation sessions during the data collection period. An average of 6.2 healthcare professionals participated in each simulation session. Learning objectives during the simulation sessions were interdisciplinary and divided into team-based objectives and technical objectives. Main focus was on team-based objectives, primarily including ISBAR communication (identity, situation, background, assessment and recommendation), closed loops, communication and leadership. Technical objectives were a natural part of the interdisciplinary simulation sessions and included cardiac arrest, intubation, triage, anaphylaxis, bleeding, respiratory insufficiency, airway, breathing, circulation, disability and exposure and difficult airway handling.

Change in PSC over time

Tables 3 and 4 illustrate the change in PSC over time. Both tables provide an insight into PSC both at baseline, first follow-up and second follow-up. Table 3 shows the proportions of staff with positive attitudes towards PSC over time. Among employees with a medium-cycle higher education, all PSC dimensions but stress recognition improved. Improvements ranged from 3.3% for teamwork climate to 10.9% for safety climate. Three dimensions improved more than 5%, including; safety climate (10.9%) perception of management (8.0%) and working conditions (8.8%). Employees with a long-cycle higher education improved in only two PSC dimensions with improvements ranging from 1.3% for stress recognition to 4.5% for teamwork climate. Employees with long-cycle higher education showed no improvements exceeding 5%. Similar results were observed in the stable group. Among employees with a medium-cycle higher education, the stable group improved by more than 5% in the dimensions; teamwork climate (5.3%), safety climate (5.6%) and working conditions (8.3%). In comparison, the stable group of employees with a long-cycle higher

Table 2 Baseline characteristics of participants

Participated at	Medium-cycle higher education n (%)	Long-cycle higher education n (%)	Total n (%)
Baseline	633 (78)	176 (22)	809* (66)†
First follow-up	553 (76)	171 (24)	724‡ (67)†
Second follow-up	472 (80)	117 (20)	589§ (67)†
Stable¶	329 (81)	75 (19)	404
Age (n=809)			
<26	13 (2)	0 (0)	13 (1.6)
26–36	178 (28)	36 (21)	214 (27)
36–46	205 (32)	72 (41)	277 (34)
46–56	145 (23)	37 (21)	182 (23)
>56	92 (15)	31 (18)	123 (15)
Sex (n=809)			
Female	614 (97)	95 (54)	709 (88)
Male	19 (3)	81 (46)	100 (12)
Profession (n=809)			
Nurses	559 (88)	0 (0)	559 (69)
Midwives	47 (7)	0 (0)	47 (6)
Radiographers	27 (4)	0 (0)	27 (3)
Doctor	0 (0)	176 (100)	176 (22)
Time employed in department (n=809)			
<5 years	278 (44)	106 (60)	384 (47)
>5 years	355 (56)	70 (40)	425 (53)

*A total of 1230 employees were invited to participate at baseline.
†Response rate.
‡A total of 1084 employees were invited to participate at the first follow-up.
§A total of 882 employees were invited to participate at the second follow-up.
¶Respondents who replied to all three questionnaires.

education did not improve by more than 5% in any dimension. However, an aggravation, by −6.7%, was observed in working conditions.

Table 4 shows that participants with a medium-cycle higher education improved their mean scores in five of six SAQ dimensions with the exception of stress recognition. Likewise, all but perception of management improved among participants with a long-cycle higher education, whereas perception of management deteriorated.

Similar trends were found in the stable group of participants. The same four dimensions (teamwork climate, safety climate, perception of management and working conditions) improved significantly among employees with a medium-cycle higher education. Job satisfaction and stress recognition improved as well, though not significantly. Among participants with long-cycle higher education, no changes in mean scores reached statistical significance. Due to the uneven distribution of gender within groups, we examined the stable groups further. By excluding all male participants, we found no significant changes among the medium-cycle higher education group. However, when excluding male long-cycle higher education participants, % difference estimates in mean score changed more than ±1 percentage point within the dimensions; teamwork climate, job satisfaction and working conditions.

DISCUSSION

To our knowledge, this is the first study to investigate whether changes in PSC depend on length of education. The main findings show differences in PSC, depending on time of measurement and length of education. Overall, results in both % positive (table 3) and mean scores (table 4) indicate that employees with a long-cycle higher education score higher at baseline than employees with a medium-cycle higher education. However, when examining changes in PSC at the second follow-up, we found that scores indicate a larger improvement among employees with a medium-cycle higher education. Looking at the stable groups, the mean scores improved significantly in four of six dimensions among employees with a medium-cycle higher education. Employees with a long-cycle higher education did not improve significantly in any dimension. Yet, this could be due to the differences in number of participants in the two groups. A higher number of stable participants in the medium-cycle higher education group vs the long-cycle higher

Table 3 Percentage of staff with a positive attitude at baseline, first follow-up and second follow, and difference over time

	Baseline	First follow- up	Second follow-up	Difference in % positive over time*	
	% Positive	% Positive	% Positive	% Diff	% Diff for stable group
Medium-cycle higher education (n)	633	553	472		329
Teamwork climate	71.3	72.51	74.58	3.3	5.3
Safety climate	46.9	52.8	57.8	10.9	5.6
Job satisfaction	73.6	76.1	77.5	3.9	2.7
Stress recognition	54.7	54.4	54.7	0.0	1.0
Perceptions of management	47.1	51.9	55.1	8.0	1.7
Working conditions	68.1	73.8	76.9	8.8	8.3
Long-cycle higher education (n)	176	171	117		75
Teamwork climate	85.2	84.2	89.7	4.5	0.0
Safety climate	57.9	52.6	57.3	−0.6	−4.0
Job satisfaction	85.8	78.4	84.6	−1.2	−2.7
Stress recognition	55.1	64.9	56.4	1.3	2.7
Perceptions of management	76.1	64.3	75.2	−0.9	−1.3
Working conditions	83.5	79.0	80.3	−3.2	−6.7

*Difference in % positive from baseline to second follow-up defined by mean scale scores ≥75 on Danish version of The Safety Attitudes Questionnaire.

education group (n=329 vs n=75) contributes to more accurate estimates in the medium-cycle higher education group. Despite the number of participants though, estimates are still indicating a larger difference among the medium-cycle higher education group.

By examining mean scale scores in PSC dimensions further in the stable medium-cycle higher education group, significant changes appear within the dimensions; teamwork climate, safety climate, perceptions of management and working conditions. By using simulation to train, for example; problem solving, teamwork, leadership and communication, these significant changes align with these mentioned team-based skills included in the simulation training.[5 23]

Comparison with other studies

Several studies have investigated strategies aiming to improve PSC.[10 11] Yet, only few have explored the benefits of in situ simulation associated with PSC depending on length of education. Two Danish studies investigated PSC across the Danish healthcare system, of which one indicated that nurses scored statistically non-significantly higher in PSC attitudes than doctors.[18] These findings are inconsistent with our findings in which employees with long-cycle higher education (doctors) scored higher in PSC attitudes at baseline.

According to previously mentioned reviews, most existing studies investigating differences in perception of PSC over time are characterised by poor implementation and limited management support. Furthermore, most studies had single-group pre–post designs with relatively small to moderate sample sizes.[10 11] Since hospitals are dynamic and hierarchically organised, Morello *et al* advocate for culture strategies to be flexible.[11] The in situ simulation intervention implemented in this study may be considered a flexible strategy since it applies interdisciplinary simulation including several professions. Furthermore, learning objectives during simulation sessions comprise teamwork, leadership and communication competencies, among others.[5 23]

Strengths and limitations

Across measurements, the number of invited employees varied from n = 1,230 (response rate 65.8%) at baseline to n = 882 (response rate 66.8%) at the second follow-up. Compared with other studies investigating PSC,[15 29 30] the number of respondents in this study is considered sufficiently high and the response rate rather high. The applied repeated cross-sectional study design is considered a strength, since it allows for observations of differences in PSC over time.

However, this study lacked a control group, where potentially unknown factors may have influenced the PSC during the second follow-up period. Although, according to personal communication with hospital management, no other impactful initiatives were implemented during the follow-up period. In regard to the number of participants, employees are somewhat unevenly distributed in terms of gender and length of education. At baseline, the 176 employees with a long-cycle higher education represent only 21.8% of all participants. The limited number of participants may partly explain the lack of significance of changes in mean scores among the stable group of employees with a long-cycle higher education over time. Furthermore, 97% of all participants with a medium-cycle higher education were female compared with 54% with

Table 4 Mean score results at baseline, first follow-up and second follow-up, and difference over time

	Baseline	First follow-up	Second follow-up	Difference in mean score over time*	
	Mean score (SD)	Mean score (SD)	Mean score (SD)	% Diff (95% CI)	% Diff (95% CI) for stable group
Medium-cycle higher education (n)	633	553	472		329
Teamwork climate	79.5 (16.6)	80.1 (80.1)	81.4 (15.0)	1.9 (0.0 to 3.8)	2.0 (0.2 to 3.7)†
Safety climate	70.1 (17.9)	72.0 (72.0)	74.0 (17.0)	3.9 (1.8 to 6.0)	2.5 (0.9 to 4.1)†
Job satisfaction	81.2 (18.9)	82.6 (18.5)	83.0 (17.9)	1.8 (–0.4 to 4.0)	1.7 (0.1 to 3.3)
Stress recognition	70.7 (22.5)	70.8 (22.1)	70.6 (23.2)	–0.1 (–2.8 to 2.6)	1.1 (–1.3 to 3.4)
Perceptions of management	68.5 (21.1)	70.9 (20.0)	71.9 (21.5)	3.4 (0.9 to 6.0)	2.4 (0.3 to 4.4)†
Working conditions	76.1 (24.7)	79.6 (22.9)	81.5 (21.2)	5.4 (2.6 to 8.2)	4.5 (2.6 to 6.3)†
Long-cycle higher education (n)	176	171	117		75
Teamwork climate	85.8 (12.7)	84.4 (14.5)	87.4 (12.7)	1.6 (–1.4 to 4.6)	1.2 (–2.1 to 4.5)
Safety climate	75.1 (15.8)	72.5 (16.4)	75.5 (16.6)	0.4 (–3.4 to 4.2)	–1.7 (–4.8 to 1.5)
Job satisfaction	86.5 (15.4)	83.3 (18.2)	88.0 (14.2)	1.5 (–2.0 to 5.0)	–0.8 (–3.1 to 1.6)
Stress recognition	71.5 (21.8)	74.4 (21.3)	72.6 (22.5)	1.0 (–4.2 to 6.2)	0.7 (–3.4 to 4.7)
Perceptions of management	82.0 (15.5)	77.1 (18.0)	80.5 (17.0)	–1.4 (–5.2 to 2.4)	–2.7 (–6.3 to 0.8)
Working conditions	84.2 (15.7)	81.3 (18.0)	84.9 (14.6)	0.7 (–2.9 to 4.3)	0.6 (–2.5 to 3.7)

*Difference in mean score from baseline to second follow-up on Danish version of The Safety Attitudes Questionnaire.
†Indicates a statistically significant difference over time (Based on paired sample).

a long-cycle higher education. Taking the large proportion of nurses into account, these numbers are consistent with the distribution of gender within the nursing care in Denmark and other western countries.[31] Furthermore, comparable studies show a similar picture, including a larger proportion of females.[17 20 21] Studies that investigate PSC among healthcare professionals included a similar background population in general.[16 17 21] As a result, we are comparing a group of females with a group of 50/50 male/female. By examining the stable groups, we found a change in % difference estimates in mean score, when excluding male long-cycle higher education participants. However, it is difficult to conclude whether this is due to gender or simply that half of the participants have been excluded. Thus, potential confounding caused by gender is an issue. Future research should investigate if gender and age influence PSC attitudes.

In this study, PSC attitudes within the groups of medium-cycle higher education and long-cycle higher education were different and changed differently over time. Still, there is a risk of misinterpreting the influence of length of education since other factors are also associated with a specific education, for example, the culture of a particular education. This raises the questions whether differences between doctors and other healthcare professionals are associated with length of education or with cultures within the professions, and whether it is reasonable to place nurses, midwives and radiographers in the same group.

Implications

We found significant changes in PSC within the stable group of employees with a medium-cycle higher education. This group of employees is characterised as the group of healthcare professionals who are employed for a longer period. Since healthcare systems in developed countries are under increasing pressure leading to huge challenges, this group of employees are of significant importance.[32–34] The stable group can be characterised as the employees that influence the culture to a great extent within an organisation, which should be prioritised and supported in future interventions. Furthermore, in another study investigating the same intervention, we found that leaders, instructors and simulation participants all experienced simulation as relevant and profitable.[35] Thus, policy-makers are able to use this information when prioritising and planning future simulation interventions. By investing in improvements of PSC, including patient safety, it is possible to obtain significant financial savings and, more importantly, create better patient outcomes.[1 3 9]

At first glance, our findings might indicate that employees with a medium-cycle higher education gain most in regards to a change in PSC. Yet, our findings might also invite the conclusion that the intervention should be restructured and aimed at employees with a long-cycle higher education. Even so, existing literature highlights a need for improvements among participants with a '% positive' PSC score below 60%.[36] In our study, no substantial differences were observed in regard to a score below 60% in relation to length of education (table 3), though employees with medium-cycle higher education had lower overall baseline scores than employees with a long-cycle higher education. As mentioned, the PSC sores obtained at baseline in this study are not consistent with other findings, which suggests a need for further research in this area.[18] However, two recent studies found that doctors are more motivated and satisfied, compared with nurses.[37 38] One study states that salaries are an important factor associated with job satisfaction.[38] Another study found that doctors, compared with nurses, were significantly more motivated. Doctors were significantly more motivated by accomplishing the goals of one's healthcare centre, good work relationships, positive work environment, possibilities for improvement, and independence at work.[37] These factors might be an explanation for the higher mean score at baseline among long-cycle higher education participants.

CONCLUSION

This study observed PSC over time, comparing groups with different length of education before and after an in situ simulation intervention. Employees with a long-cycle higher education scored higher in PSC attitudes at baseline than employees with a medium-cycle higher education. However, employees with a medium-cycle higher education improved more in PSC attitudes. The results indicate that level of education is associated with perceptions of PSC.

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Contributors As the guarantor AS was responsible for the overall content. CP, SK and HIJ planned the conception and design of the study. AS, GK-A and HIJ were responsible for data collection. SK and AS wrote the paper. MSL, SK and AS performed data analysis. Lastly, all authors critically revised the paper.

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Ethics approval Data were registered with the Danish Data Protection Agency (Journal no. 17/1942) and approved by hospital management. Participation was voluntary and all replies were treated with confidentiality. Every participant was anonymous regarding publication of results. Filling in the PSC questionnaires was considered as acceptance of participation.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. Not applicable.

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Appendix 1: Health professionals invited to participate in the SAQ-DK questionnaire

	Team 1 (Hospital 1)	Team 2 (Hospital 2)	Team 3 (mix)
	n	n	n
Instructors	20	18	15
Medical doctors	27	84	
Critical care, nurses	76	38	
Anaesthesia, doctors	22	22	
Anaesthesia, nurses	33	42	
Midwives	81		
Gynaecology, doctors	28		
Orthopaedic surgery, nurses	27		
Gynaecological , nurses	25		
Radiographs	31		
Emergency room, nurses	51	22	
Emergency department, nurses	69		
Emergency visitations unit, nurses		33	
Oncology, doctors		41	
Oncology, nurses		24	
Cardiology, doctors		18	
Cardiology, nurses		38	
Cardiology 2, doctors		10	
Cardiology 2, nurses		42	
Ophthalmic, nurses (Hospital 2)			30
Padiatric ward 1 (Hospital 1)			22
Paediatric ward 2 (Hospital 1)			26
Paediatrician doctors (Hospital 1)			33
Dialysis (Hospital 1)			45
Neonatal intensive care (Hospital 1)			34
Abdominal surgery nurses (Hospital 1)			28
Orthopedic surgeons (Hospital 1)			25
Otorhinolaryngology nurses (Hospital 2)			34
Otorhinolaryngology doctors (Hospital 2)			16
Total	490	432	308

Appendix 2: Need analysis and instructor course curriculum

Why	Hospital management was in dialogue with MidtSim making an agreement on how MidtSim should offer an educating program. It was decided that there was a need for approximatly 40 instructors total in the clinic.
Mission	To coordinate, plan, facilitate and support simulation for health professionals in order to contribute to the employees' competence development, organisational learning and patient safety.
Theory	Based on Curriculum Development for Medical Education using the theory 'A Six-Step Approach'[1], MidtSim prepared a proposal for the in situ simulator instructor program. The proposal is rooted within evidence-based knowledge about learning and competence development, organizational learning and finally the overall aim of clinical simulation.
Aim	To create optimal conditions including relevant experience and learning for all participants before simulation is actually implemented in the hospitals. To actively include participants to support transfer and increase learning outcomes. To support the implementation of simulation and networking between the instructors.
Content	Module 1: Theory and practical exercises - Theoretical presentations by simulation experts employed in MidtSim. - Participants practicing the role of being an instructor. Module 2: Performing simulation in situ - Two instructors (doctor and nurse) design a scenario and facilitate it in front of colleagues. - The instructors practice feedback, and prepare for module 3. Module 3: Feedback and qualification - The two instructors facilitate their own scenario and receive feedback from another participant including MidtSim's simulation experts.

Note: 1 Thomas PA, Kern DE, Hughes MT, et al. Curriculum Development for Medical Education : A Six-Step Approach. Baltimore, UNITED STATES: : Springer Publishing Company, Incorporated 2015. http://ebookcentral.proquest.com/lib/asb/detail.action?docID=4398487