Preventing surgical site infections (SSI): Are safety climate level and its strength associated with self-reported commitment to, subjective norms towards, and knowledge about preventive measures?"

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ABSTRACT (max. 250 words)

Objectives. Surgical site infections (SSI) represent a major source of preventable patient harm. Safety climate in the operating room personnel is assumed to be an important factor, with scattered supporting evidence for the association between safety climate and infection outcome so far. This study investigated perceptions and knowledge specific to infection prevention measures and their associations with general assessments of safety climate level and strength.

Methods. We invited operating room personnel of hospitals participating in the Swiss SSI surveillance program to participate in a survey (response rate 38%). N=2'769 responses from 54 hospitals were analyzed. Two regression analyses were performed to identify associations between subjective norms towards, commitment to, as well as knowledge about prevention measures and safety climate level and strength, taking into account professional background and number of responses per hospital.

Results. Commitment to perform prevention measures even when situational pressures exist, as well as subjective norm of perceiving the expectation of others to perform prevention measures were significantly ($p<.05$) related to safety climate level, while for knowledge about preventative measures this was not the case. None of the assessed factors was significantly associated with safety climate strength.

Conclusions. While pertinent knowledge did not have a significant impact, the commitment and the social norms to maintain SSI prevention activities even in the face of other situational demands showed a strong influence on safety climate. Assessing the knowledge about measures to prevent surgical site infections in operating room personnel opens up opportunities for designing intervention efforts in reducing SSI.

Introduction

Healthcare-associated infections (HAI) are an indicator of patient harm and are largely preventable when appropriate measures are consistently applied [1]. One of the most common HAI, surgical site infections (SSI), represent a source of significant harm. SSI occur in 2-5% of surgeries, prolong hospitalizations and increase the risk of death [2]. To explain and improve clinical outcomes such as surgical site infections, safety climate has been proposed as one important factor. Safety climate encompasses shared perceptions of safety policies and practices [3] in a team, unit or healthcare institution. It reflects work-related attitudes and perceptions that are accessible using quantitative surveys [4,5]. Despite the widespread expectation of safety climate being a leading indicator for safe outcomes [6], prior research in healthcare yielded only limited supporting evidence [7], with the associations between safety climate and the outcomes of infection prevention measures or other safety outcomes remaining largely unclear [8].

Accordingly, there is scattered evidence from prior research indicating that safety climate may be associated with HAI, and specifically, surgical site infection rates: For colon surgery, Fan et al. [9] found only certain dimensions of safety climate ratings being associated with SSI rates. For evaluating a program to reduce SSI after colorectal surgery in Hawaiian hospitals, Lin et al. [10] assessed safety climate at baseline and after implementation of the program. No consistent pattern of association of change of SSI rates with change of safety climate dimensions was identified. Recently, from an array of important clinical metrics, Profit et al. [11] found solely the absence of HAI to be associated with high safety climate ratings. They suspected that this association may be traced back to the fact that the HAI prevention measures represent concrete behaviors directly linked to a desirable outcome, while for other clinical outcomes, multifactorial and less specific influences need to be taken into account, such as good communication, flat hierarchies, etc. They concluded that future research should investigate the perceptions around specific care practices in order to better understand how clinical outcomes are related to safety climate ratings. For example, Sakamoto et al. reported a strong association between a sum score of safety climate items and the adoption of infection prevention measures in Japanese hospitals [12].

Gaining a better understanding of how safety climate relates to successful infection prevention, i.e., the reliable performance of evidence-based prevention practices, is therefore an important area of research [13]. In addition to identifying associations of general safety climate dimensions with SSI rates, current research needs to take into account the attitudes regarding specific behaviors relevant for achieving low infection rates. This study addressed this research gap in investigating perceptions and assessments relating specifically to the national epidemiology of SSI. In Switzerland, the National Center for Infection Prevention (Swissnoso) developed guidelines for the prevention of SSI, and also an intervention module for hospitals to reduce their SSI rates. The main aim of this module was to achieve 90% adherence with three recommended preventive measures (hair removal, preoperative skin disinfection, and antibiotic prophylaxis). In 2016, these specific measures to reduce SSI rates were communicated in guidelines on a national level in Switzerland. Each hospital was expected to train their employees and implement the measures; however, no systematic national assessment of the uptake was conducted.

In order to study specific perceptions of infection prevention practices, and their relationship with safety climate assessments, we considered the following concepts:

An important influence on the motivation to perform a specific behavior is the perception of social pressure to do so, i.e., whether a person believes their peers and leaders expect them to perform infection prevention actions (known as “subjective norms”, [14]). Additionally, ‘production pressure’ is a commonly cited reason for taking shortcuts and not performing preventive measures. Therefore, the commitment to apply specific preventive measures and adhere to them even under high work demand or other situational pressures, is assumed to be an important predictor for low SSI rates. Finally, as solid knowledge about evidence-based preventive measures [15] is a plausible precondition for the successful reduction of SSI, an additional focus was placed on assessing the knowledge basis regarding SSI prevention measures. A recent study [16] identified a need for improvement in the level of knowledge about SSI prevention in physicians, suggesting that knowledge may be an important factor regarding safety climate.

As safety climate is conceptualized as a characteristic of a unit, group, or organization, it is not only important to take the level of safety climate ratings into account, but also their strength: climate strength indicates how much a certain group agrees in their answers to a climate survey [17,18]. Even if the level of safety climate scores may not change, their strength may alter indicating consensus or divergence of perceptions regarding safety climate within a group [19]. Thus, in this study, both *level* and *strength* of safety climate were considered [19,20].

The aim of this study was to investigate whether the following measures related to specific SSI prevention practices are associated with safety climate level and strength in operating room personnel in Switzerland: 1) subjective norms relating to SSI prevention, i.e., how much social pressure the respondent perceives to perform preventive measures; 2) commitment to performing SSI prevention measures, despite situational pressures demanding a focus on other actions; and 3) knowledge about said measures. Shedding light on these associations will increase our understanding of the processes mitigating and influencing the relationship between safety climate and infection rates. Additionally, as knowledge was considered a foundational precondition for performing preventative measures, the level of knowledge about SSI prevention measures, about the risk and frequency of SSI, and regarding the effectiveness of prevention measures was explored and compared between professional groups.

Methods

Sample

All Swiss acute care hospitals (and hospital groups) participating in the Swissnoso SSI surveillance module (N= 143) were invited to this study, of which 54 hospitals agreed to participate. Of these, all operating room personnel of any professional background received the survey. From all surveys sent out, 38% were responded to. Overall, 2769 responses were analyzed, after excluding implausible responses relating to personal characteristics (n=7), and respondents not answering more than a third of all items (n=36).

Assessed Measures

In order to assess safety climate, the Safety Climate Scale (SCS, 22 items) of the Safety Attitudes Questionnaire (SAQ) [21] was used. The internal consistency of the SCS was high with Cronbach's Alpha = .89, underlining the robust psychometric properties of the SAQ. Five items were designed to assess subjective norms (labeled as NORM) related to SSI prevention measures (for an English translation, see appendix) yielding an internal consistency of Alpha = .79. Four items were designed to assess the commitment to perform SSI prevention measures (COMMIT) and had a considerable lower Alpha = .50. All items were answered on a Likert scale ranging from 1 to 5, with negatively worded items being recoded, so that higher scores reflect positive evaluations.

Knowledge about preventive measures relating to SSI (KNOW) was assessed by adapting 5 items from Albishi et al.'s survey [16]. Additionally, two items assessed the knowledge about a) the probability of an average patient developing an SSI, and b) the percentage of SSI that can be reduced by applying preventive measures. As the responses were coded dichotomously (answer right/wrong), the internal consistency of KNOW was assessed using the Kuder-Richardson Formula-20 (KR20) [22,23], The internal consistency was very low: KR20 = .06. As the knowledge score can be used as a simple sum score, we still used it for the analysis. For each correct answer, one point was attributed, resulting in a range of 0-5, indicating none of the items was correctly answered up to all 5 items were correctly answered.

The survey was conducted in three Swiss national languages (German, French, and Italian). A previous study developed a Swiss version of the Safety Climate Scale in German and French [24], whereas the Italian version still needed to be developed. The items were translated into Italian and then back-translated into German by different translators blinded to the original items. The emergent differences were resolved and the items were tested in two sites by operating room personnel for understandability and correctness. The other dimensions (subjective norm, commitment to SSI prevention practices, and knowledge about measures and incidence) were developed and pretested for understandability in German, and then translated and back-translated into French and Italian.

Analyses

Data were analyzed on both the individial response and the hospital level. Safety climate level was measured on the hospital level as percent positive responses per item (PPR). Percentage of positive respondents was calculated counting each respondent's score as positive for their unit if their mean score on the SCS was 4.0 or greater, in line with the procedure applied by Tawfik et al. [25]. Safety climate strength was determined by calculating the standard deviation from each hospital's mean safety climate score, in accordance with other research [25]. As the distribution was not symmetric, we log-transformed the strength scores.

To investigate the level of SSI-related knowledge, the percentages of correct answers were examined. Differences in knowledge levels between professional groups were examined, i.e., nurses and physicians from surgical and anaesthesiology departments using Wilcoxon-Test. To investigate the associations with safety climate level (i.e., PPR *safclim* per hospital) and safety climate strength (SD *safclim* per hospital), we fitted a weighted multivariable linear regression model with mean knowledge about SSI prevention per hospital, the mean commitment to SSI prevention practices, and the mean subjective norm towards SSI practices as predictors, while controlling for the proportion of physicians (vs. nurses), the number of respondents per hospital and including weights for the number of respondents per hospital. All tests were two-sided and a level of $p < .05$ was considered significant. Regression analyses were also performed on 20 multiply imputed datasets making the missing at random assumption.

All analyses were performed in Stata version and R (the latter for regression analyses on multiply imputed data).

Results

The respondent characteristics are listed in table 1. Scale means and standard deviations of the assessed scales are presented in table 1. Mean safety climate scale PPR per hospital was 50.7% (SD 18.7%, IQR 22.6, range 0-100), and mean safety climate strength was 0.49 (SD 0.09, IQR 0.11; range 0.24-0.70).

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Insert table 1 about here

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As can be seen in table 2 a, COMMIT and NORM were both significant predictors of the safety climate level ($p<.05$), but the same did not apply to KNOW. In contrast, none of the predictors was significant for safety climate strength, see table 2 b. Figures 1 a-c and 2 a-c of the appendix display example scatterplots for the correlation.

A second regression model was fitted with safety climate *strength* as outcome and the same predictors as the model above. Here, only COMMIT was found to be a significant predictor of safety climate strength ($p<.05$) but not KNOW and NORM.

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Insert table 2 about here

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Table 3 shows the percentage of correct answers per knowledge item of the scale KNOW and the two separate items about SSI risk and efficacy of preventive measures across different professional and specialty groups (see appendix for correct answers and full items). Items 2 and 4 have higher percentages than the other items.

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Insert Table 3 about here

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When asked to estimate the probability of an average patient to develop SSI (single item 1), less than half of the respondents (38%) correctly answered (option B), only 10% of the respondents underestimated the risks for an average patient to develop a SSI (answer option A), 28% overestimated it (answer option D), and 17% heavily overestimated it (answer option E).

Discussion

In this study, we addressed the association of subjective norms, commitment and knowledge regarding SSI preventive measures with safety climate level and strength assessments in a large sample of Swiss operating room personnel. Our study shows that a) subjective norms, the perceived expectation of relevant coworkers to perform the prevention measures, was significantly associated with safety climate, indicating that a positive safety culture may be closely related to the perceived social pressure to perform specific safety relevant infection prevention measures; and b) that being committed to perform preventative measures in the face of competing situational demands also was associated with safety climate. In contrast, interestingly, being knowledgeable about these specific practices appeared not to be associated with safety climate ratings. These associations indicate that there is a relationship between the rather general assessments of safety climate with perceptions evaluating the more specific safety relevant behaviors.

The results also provided evidence that differentiating between safety climate level and strength is important and sensible. The perceived social pressure was not significantly related to the extent of agreement relating to safety climate assessments in hospitals. In other words, strong norms can co-exist with either highly coherent or less coherent safety climate perceptions among employees. Accordingly, commitment was not significantly associated with safety climate strength. These results point to a need for further research of how specific practice-based measures are associated with assessments of safety climate levels and strengths. Professional background was a significant predictor for safety climate strength, with the higher the proportion of nurses, the lower the safety climate strength. This may point to different subcultures that exist in professional groups and that lead to different climate strengths.

Even though it is highly plausible and intuitive to assume that knowledge is an important precursor for "doing the right thing", knowledge about prevention measures was not associated with safety climate level and strength on hospital level. These findings raise different questions for future research: Firstly, it is possible that the relevant knowledge needs to be defined more specifically in the questionnaire, i.e., for professional groups along their specific tasks in the relevant work steps. Secondly, it could be concluded that safety climate as a concept is assessing attitude-related aspects that are not related to the knowledge underlying specific safety-relevant behaviors. While the associations between safety climate and the outcomes of infection prevention measures or other safety outcomes remain to be clarified further [8], compliance with the implementation of infection prevention interventions is thought to be influenced by the prevailing safety culture of the unit or organization [13]. To advance research in this area, not only taking safety climate into account but also details concerning the knowledge basis could strengthen the relationship between safety climate factors and safety outcomes and help explain implementation successes or failures of specific interventions.

Knowledge levels about SSI prevention measures differed across items: Only around a third of the respondents were able to identify the three correct preventive measures proposed by Swissnoso from a set of five options given. While the optimal timing for administering antibiotics seemed to be quite clear, knowledge about when to stop them seemed to be much less so. This may in some way reflect the clarity of tasks in the work process from preparing a patient for surgery, doing the surgery, and taking care of the patient after surgery: the task of administering antibiotics appears to be part of a clear and highly internalized process, while there is more room for decision making in stopping antibiotics and it is often done by caretakers other than OR professionals. These results also highlight the importance of educational training about SSI preventative measures for all involved personnel on a regular basis.

Overall, the scores suggest that knowledge of the guidelines issued by Swissnoso is rather low among operating room personnel. Interestingly, 45% of the respondents overestimated the risk of an average patient developing an SSI. The low internal consistency of the knowledge items also indicates that there may be no clear set of procedures or practices that everybody is aware of, or that they are not part of the standard education of OR personnel. In future research, the body of knowledge to reach good clinical and safety outcomes needs to be identified specifically for specific professional groups and specialties for studying the relevance of knowledge for safety climate and safe outcomes. Thus, training interventions targeted to different OR staff groups could be designed to teach specific knowledge and actions that are important for minimizing SSI rates.

Our study has also some limitations that need to be considered: Both scales, commitment and subjective norms, potentially share common method bias with safety climate assessment. Furthermore, selection bias may have influenced the results, as participating in the survey was voluntary for hospitals and respondents. Additionally, data was aggregated on hospital level, which may have led to neglecting putative unit subcultures in larger hospitals. In large hospitals, several departments may exist for what is summarized in one department or discipline in a smaller hospital, making unit-based comparisons difficult. However, as we focused on operating room personnel, and respondents share the work of completing surgery-related tasks, we believe it is appropriate to aggregate on the hospital level. Furthermore, other unmeasured factors may contribute to safety climate and strength. Other studies investigating the relationship of infection prevention and safety climate pointed to factors such as staff turnover, sufficient staffing, or high bed occupancy [13,26]. Accordingly, Olds et al. [27] suggest based on their survey that evaluations of the nurses' work environment were more relevant for patient mortality than safety climate evaluations. The rather low internal consistency of the scale assessing commitment may be due to the two negatively worded items. Future research may formulate them positively and evaluate its effect on Cronbach's Alpha. Additionally, the generalizability of the results may be limited to comparable national cultures, where for example authority gradients are similar [28]. Still, the operating room cultures may be similar to each other even across national cultures [29]: thus the influence of national cultures on the studied relationships is subject to further evaluation.

There is a growing body of research developed under the assumption that safety culture needs to be improved before, or concurrently with, the introduction of infection prevention measures, or when an infection prevention measure is not effective. However, safety culture may be improved without showing any positive change in clinical outcomes, and vice versa [11]. This study shows that it is worthwhile taking a closer look at specific, outcome-related practices to explain how safety climate - and work culture overall - is related to clinical outcomes such as SSI or other HAI. Culture is commonly defined as "the way we do things around here", which hints to the applied work practices and processes. For example, intraoperative case-relevant communication was associated with fewer organ / space SSI [30], pointing to specific behaviors that may connect safety climate and SSI rates. Similarly, it is not the surgical checklist per se that improves outcomes but certain behaviors that become more likely once a checklist is used [31]. Recent research even points out that having a high compliance in checklist use may lead to a better safety climate in the OR [32], indicating the opposite effect from that expected. Future research will need to assess the performance of specific safety practices, such as infection prevention measures, and their related perceptions. Thus, the practices relevant for achieving safe outcomes will be better understood in their relationship to safety climate evaluations, clarifying the relationship between safety climate and safety outcomes, as the practice-related assessments "bridge the way" from general safety climate assessment to a specific clinical or safety outcome. Specifically, this study's results propose to consider the commitment to perform specific prevention measures despite other situational pressures, and the social norms around specific prevention practices. Thus, rather than thinking simply in cause-effect relationships in safety climate research, future approaches should take into account complex interdependencies [33] across time and between specific safe practices and general safety climate assessments. For interventions to reduce SSI rates, we recommend developing theoretical models of safety climate and their relationships to concepts specific to prevention practices, in order to assess the effects of the intervention [34] longitudinally during the implementation process.

Conclusion

In exploring the links of perceptions related to specific prevention practices and climate ratings, we gained a better understanding of how general safety climate ratings are related to specific safety practice evaluations. While pertinent knowledge did not have a significant impact, the commitment and the social norms to maintain SSI prevention activities even in the face of other situational demands showed a strong influence on safety climate. Assessing the knowledge about measures to prevent surgical site infections in operating room personnel opens up opportunities for designing intervention efforts in reducing SSI.

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Table 1: Hospital and respondents' characteristics

Characteristic	Hospital size <200 beds	Hospital size 200-499 beds	Hospital size 500+beds	Total	Nurses	Physicians
nr of hospitals	38	10	6	54		
nr of respondents (percentage of total)	1074 (38.8)	608 (22.0)	390 (14.1)	2769	1495 (54.0)	1101 (39.8)
Median age (IQR)	44.4 (19)	41.6 (19)	39.6 (16)	42 (19)	42.8 (19)	40.9 (19)
Gender male (female) %	42.6 (53.4)	35.6 (61.4)	40.4 (57)	39.8 (57.0)	26.6 (71.7)	60.1 (37.7)
Managerial Function No %	70.2	74.7	73.7	72.7	82.5	62.8
Managerial Function Yes %	24.1	21.1	23.2	22.9	14.9	35.2
Years professional experience						
0 - 2 years	11.9	12.3	9.9	11.4	6.1	19.5
2 – less than 5 years	11.7	20.4	24.2	18.2	13.0	26.9
5 – less than 10 years	14.4	17.3	22.6	17.8	17.7	17.7
10 – less than 20 years	29	23.7	23.7	25.8	30.0	21.7
more than 20 years	30.4	23.3	17.9	24.3	32.2	13.8
% nurses responded, mean per hosp	56.6	53.5	51.3	54	-	-
% physicians responded, mean per hosp	39.5	39.5	44.5	39.8	-	-
Scale means (SD)						
SAFCLIM (range 1-5)	3.9 (0.54)	3.9 (0.51)	3.9 (0.51)	3.9 (0.52)	3.8 (0.52) *	4.1 (0.50) *
COMMIT (range 1-5)	4.2 (0.63)	4.0 (0.62)	4.1 (0.59)	4.1 (0.62)	4.0 (0.62) *	4.2 (0.59) *
NORM (range 1-5)	4.3 (0.65)	4.3 (0.59)	4.3 (0.63)	4.3 (0.63)	4.2 (0.64) *	4.5 (0.56) *
KNOW (range 0-5)	2.6 (1.04)	2.6 (0.98)	2.5 (0.97)	2.6 (1.0)	2.6 (1.03)	2.6 (0.95)
PPR SAFCLIM mean (SD) per hosp	51.5 (20.5)	49.2 (16.4)	47.9 (10.4)	50.7 (18.7)	-	-
SAFCLIM strength mean per hosp	0.49 (0.11)	0.49 (0.07)	0.48 (0.03)	0.49 (0.09)	-	-

Note. Percentages in parenthesis, if not indicated differently. Data not adding up to 100 % are due to missing values. *professional groups means differ significantly in Wilcoxon-Test, $p<0.001$.

Table 2: Estimates following fitting of unadjusted and adjusted weighted linear models with 20 multiply imputed data sets

a. Safety Climate Level

Endpoint: *safclimmean*	Univariable		Multivariable	
	estimate (se)	p-value	estimate (se)	p-value
COMMIT	0.73 (0.13)	<0.001	0.47 (0.15)	0.003
NORM	0.79 (0.14)	<0.001	0.54 (0.17)	0.003
KNOW	0.12 (0.07)	0.09	0.004 (0.06)	0.4
Professional group				
Nurses	reference		reference	
Physicians	0.23 (0.11)	0.05	-0.035 (0.10)	0.4

se - standard error

b. Safety climate strength

Endpoint: *safclimsd*	Univariable		Multivariable	
	estimate (se)	p-value	estimate (se)	p-value
COMMIT	-0.11 (0.06)	0.05	-0.11 (0.07)	0.1
NORM	-0.11 (0.06)	0.09	-0.11 (0.08)	0.1
KNOW	-0.03 (0.03)	0.2	0.01 (0.03)	0.4
professional group	0.04 (0.04)	0.3	0.10 (0.05)	0.05

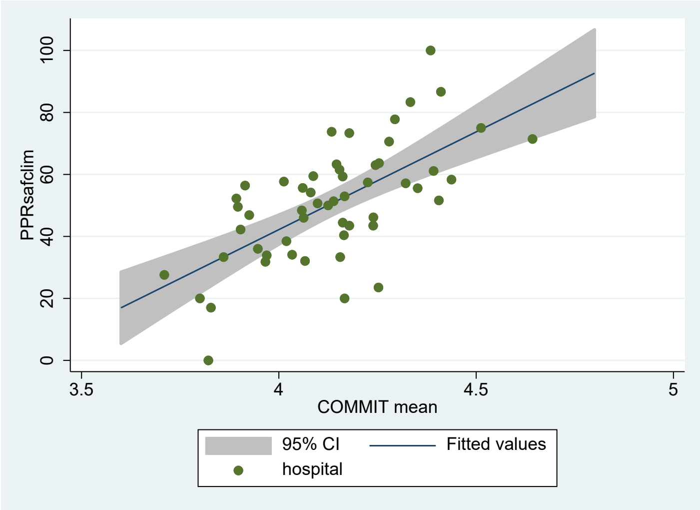
Table 3: Correct knowledge about SSI and its prevention among OR personnel

Item	Anesthesia nurses (n=448)	Anesthesia physicians (n=225)	Surgery nurses (n=818)	Surgery physicians (n=796)	Nurses (n=1495)	Physicians (n=1101)	Total (n=2769)
1) identify the 3 recommended prevention measures (KNOW)	34.2	34.2	31.7	30.9	31.2	32.4	31.4
2) best time for administering antibiotics (KNOW)	94.9	98.7*	76.5	93.5**	81.5	94**	85.8
3) best time to stop antibiotics after surgery (KNOW)	31.7	26.2	22.3	27.1	26.2	27.2	26.1
4) best time for hair removal (KNOW)	76.1	72	73.6	75.6	72.2	74.5	72.1
5) best method for hair removal (KNOW)	28.6	29.3	49.5	29.2**	39.5	28.6**	34.4
Estimated chances of developing SSI for patient	32.4	41.8*	37	45.6*	34.2	44.7**	38.0
Estimated percentage of SSI that could be prevented by measures	49.6	64**	36.3	60.9**	41.6	61.1**	48.8

Note. Percentage correct answers indicated, from full sample, including potential non-respondents. * significant group difference between nurses and physicians on 5% level, **significant on 1% level in Wilcoxon-Test

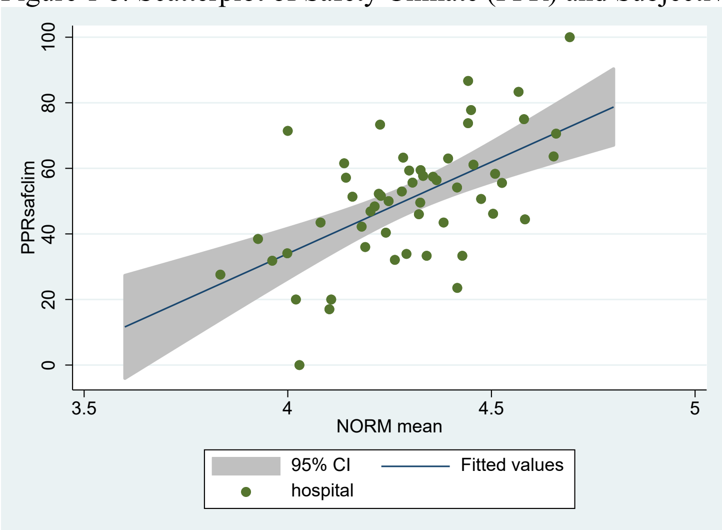
Appendix

Figure 1 a: Scatterplot of Safety Climate (PPR) and Commitment (mean)



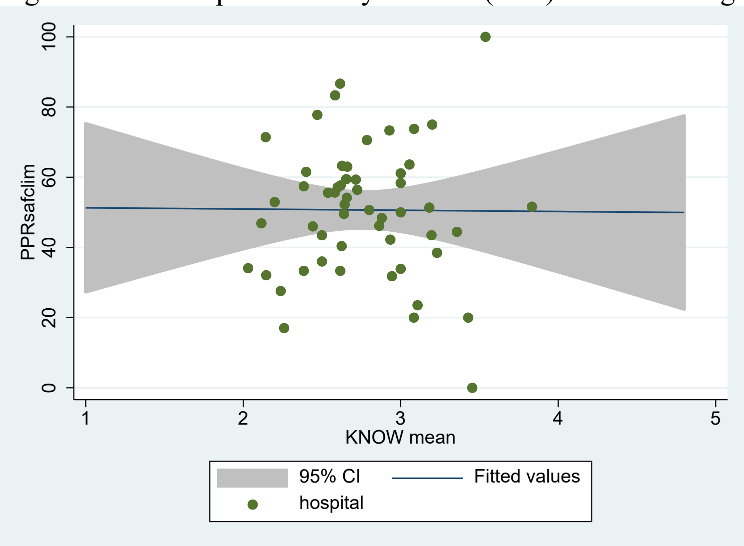
Note. For the purposes of plotting, respondents' missing answers were replaced with the mean if they answered at least 75% of the items of the scale. PPR = percentage of positive responses

Figure 1 b: Scatterplot of Safety Climate (PPR) and Subjective Norm (mean)



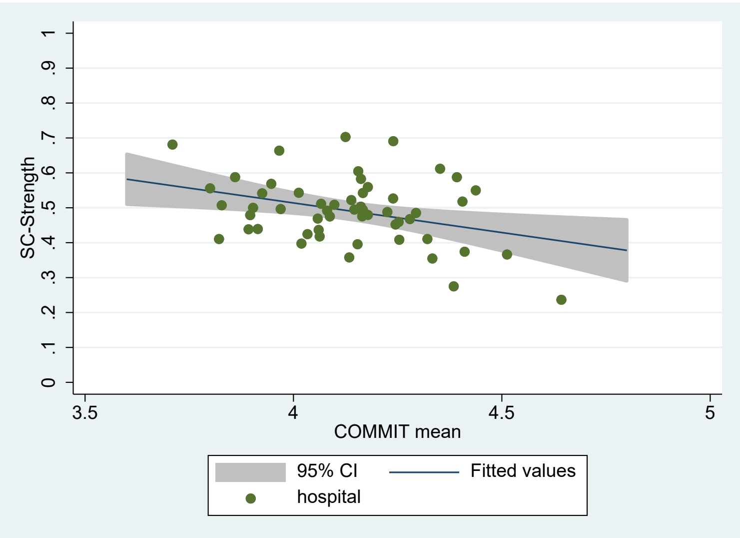
Note. Respondents' missing answers were replaced with the mean if they answered at least 75% of the items of the scale. PPR = percentage of positive reponses

Figure 1 c: Scatterplot of Safety Climate (PPR) and Knowledge (mean)



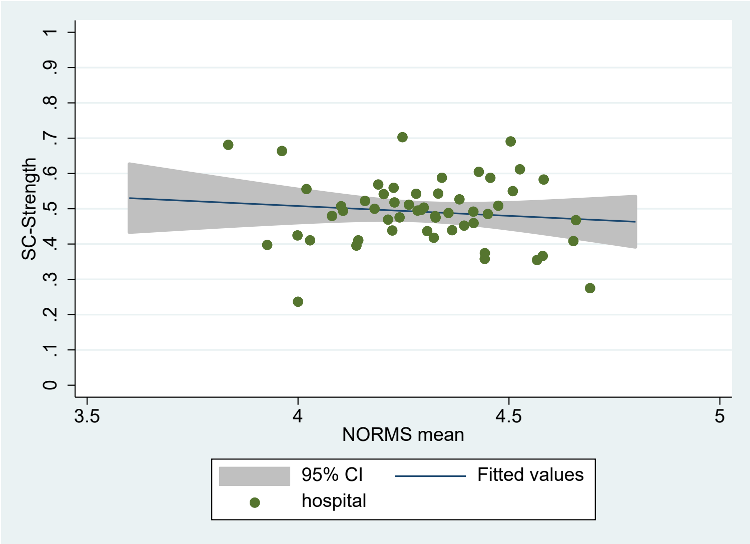
Note. Only respondents with no missing answers considered for establishing the KNOW hospital mean (n=2377). PPR = percentage of positive responses.

Figure 2 a: Scatterplot of Safety Climate Strength (hospital SD) and Commitment (mean)



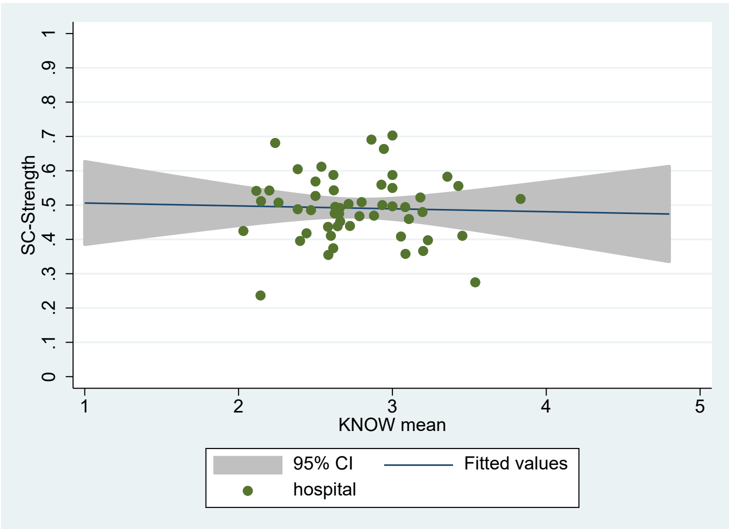
Note. Respondents' missing answers were replaced with the mean if they answered at least 75% of the items of the scale.

Figure 2 b: Scatterplot of Safety Climate Strength (hospital SD) and Subjective Norm (mean)



Note. Respondents' missing answers were replaced with the mean if they answered at least 75% of the items of the scale.

Figure 2 c: Scatterplot of Safety Climate Strength (hospital SD) and KNOW (mean)



Note. Only respondents with no missing answers considered for establishing the KNOW hospital mean (n=2377).

Appendix: Table of scales and their items

	Recoded
SCS Safety Climate Scale (SCS)	
(1) The culture of this clinical area makes it easy to learn from the mistakes of others.	
(2) Medical errors** are handled appropriately in this clinical area. ** Medical error is defined as any mistake in the delivery of care, by any healthcare professional, regardless of outcome.	
(3) The senior leaders in my hospital listen to me and care about my concerns.	
(4) The physician and nurse leaders in my area listen to me and care about my concerns.	
(5) I am encouraged by my colleagues to report any safety concerns I may have.	
(6) I know the proper channels to direct questions regarding patient safety.	
(7) Leadership is driving us to be a safety- centered institution.	
(8) I receive appropriate feedback about my performance.	
(9) I would feel safe being treated here as a patient.	
(10) I am satisfied with the availability of clinical leadership (please respond to all three):	
a) Physician;	
b) Nursing;	
c) Pharmacy	
(11) Briefing personnel before the start of a shift (i.e., to plan for possible contingencies) is an important part of patient safety.	
(12) Briefings are common here.	
(13) This institution is doing more for patient safety now than it did one year ago.	
(14) I believe that most adverse events occur as a result of multiple system failures and are not attributable to one individual's actions.	
(15) The personnel in this clinical area take responsibility for patient safety.	
(16r) Management/leadership does not knowingly compromise safety concerns for productivity.	recoded
(17r) Personnel frequently disregard rules or guidelines that are established for this clinical area.	recoded
(18) Patient safety is constantly reinforced as the priority in this clinical area.	
(19r) In this clinical area, it is difficult to discuss errors.	recoded
(20) My suggestions about safety would be acted upon if I expressed them to management.	
Commitment to perform SSI measures (COMMIT)	
(1) Under time pressure, we cannot always assure to administer the antibiotic prophylaxis before a surgery.	recoded
(2) The disinfection of the skin is often not performed, because the personnel has to get done other important things.	recoded
(3) The correct hair removal before surgery is always performed without exception, if indicated.	
(4) We always comply with all guidelines for preventing surgical site infections.	
Subjective Norm related to SSI measures (SN)	
(1) My leader considers it very important, that we start antibiotic prophylaxis early.	
(2) My colleagues take antibiotic prophylaxis very seriously.	
(3) My leader expects from me to comply with the guidelines to prevent surgical site infections.	
(4) It is expected that I assure that antibiotic prophylaxis is always performed.	
(5) It is important to my colleagues in the operation theatre to perform all measures to reduce surgical site infections.	
Knowledge about preventive SSI measures (KNOW)	
Sum score 0-5 points could be reached, per correct answer 1 point	
(1) The best time for administrating prophylactic antibiotic using current antibiotics Cefazolin or Cefuroxime is: (Please select the correct answer.)	
(A) 60 min or less prior to surgery (correct)	
(B) 90 min or less prior to surgery	
(C) 120 min or less prior to surgery	
(D) 180 min or less prior to surgery	
(2) The recommendations of Swissnoso for the prevention of surgical site infections include the following measures: (Please select, multiple answers are possible).	
(A) Pre-operative showering with antimicrobial soaps	
(B) Disinfection of skin in the surgical area (*correct*)	
(C) Correct hair removal in surgical area (*correct*)	
(D) timely and weight-adapted antibiotic therapy (*correct*)	
(E) Blood glucose target level of less than 250 mg/dl	
(3) Administration of antibiotic prophylaxis is stopped latest how many hours after surgery: (Please select correct answer)	
(A) 4 to 8 hours	
(B) 12 to 18 hours	
(C) 24 to 48 hours (*correct*)	

(D) 48 to 72 hours
(4) The best time for hair removal for surgical patient is: (Please select correct answer)
(A) just prior to incision (*correct*)
(B) the night prior to surgery
(C) 6 hours prior to surgery
(D) 12 hours prior to surgery
(5) The recommended method for hair removal on the day of surgery is: (Please select correct answer)
(A) Shaving
(B) Clipping (*correct*)
(C) Waxing
(D) using hair removal cream

Single items

(1) Averaged across all kinds of surgeries, the probability for an average patient to develop a surgical site infection is at: (Please select correct answer)
(A) clearly below 1%
(B) 1-3% (*correct*)
(C) 3-5%
(D) 5-10%
(E) 10-15%
(2) How large is the proportion of surgical site infections that can be prevented by performing the prophylactic measures? (Please select correct answer)
(A) below 25%
(B) 25-75% (*correct*)
(C) 75-100%

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

ETHICAL APPROVAL

The Cantonal Ethics Committee (Bern, Project ID 2019-00294) approved the study.

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