

# Does a Strong Safety Climate Protect Home Care and Hospice Nurses from Blood Exposure?

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**Abstract:** In order to determine the association between safety climate and blood exposure in a population of home care/hospice nurses, a mail survey was conducted in 2006 in North Carolina, USA. Safety climate, defined as employees' shared perceptions regarding safety within their work organization, was examined according to level of use of safety-engineered medical devices and personal protective equipment (PPE), work experience, type of employment, and characteristics of the work environment. The adjusted response rate was 69%. The overall exposure rate was 27.4 per 100,000 home visits. Nurses who had a weak safety climate had nearly 2½ times the risk of total blood exposure and twice the risk of needlestick as nurses who had a strong safety climate. Similar relationships were found for safety climate by use of safety devices and PPE, work experience, type of employment, and characteristics of the work environment. The author concluded that safety climate appears to be associated with reduced blood exposure among home care and hospice nurses. Safety climate may be among the factors that management can strengthen in order to reduce home care/hospice nurses' risk of blood exposure.

**Keywords:** Blood exposure, epidemiology, home care, needlestick and sharps injuries, nurse, safety climate, survey, risk

## 1 Introduction

Public health efforts in the United States to prevent bloodborne pathogen infection among home care and hospice nurses include mandated provision of personal protective equipment (PPE) and safety-engineered medical devices (safety devices) [1]. This issue is important because the potentially exposed population is already large and is expanding rapidly due to increasing employment in this sector [2], and is at risk of life-threatening infection from human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) [3]. Although some home care/hospice agencies do not always provide their nurses with the necessary PPE and safety devices, even when these items are available they are not always used [4, 5]. Although employers are generally required to ensure employees' use of PPE and safety devices when appropriate, because the home care environment is not under the control of the employer or any public health agency, this requirement is waived for care given in the patient's home [6].

Safety climate has been associated with PPE use in a number of settings [7, 8]. Moreover, a strong safety climate has been shown to be associated with PPE use among home care and hospice nurses [9]. However, it is not known whether safety climate, which is defined as employees' shared perceptions regarding safety within their work organization [10], is associated with reduced blood exposure in this population. If it is, providing a strong safety climate may be a powerful and cost-effective way for home care/hospice agencies to reduce blood exposure among their nurses. Therefore, the objective of the present study was to examine the association between safety climate and blood exposure in a population of home care and hospice nurses. This study builds on previous work by examining safety climate and blood exposure in the context of other factors that have been found to be associated with reduced exposure, including use of PPE and safety devices, work experience, type of employment, and characteristics of the work environment [11-14].

## 2 Subjects and Methods

The North Carolina Study of Home Care and Hospice Nurses was a mail survey conducted in 2006 of registered nurses listed in the licensing database of the North Carolina Board of Nursing as working in home care or hospice in non-administrative positions. The questionnaire is included in the online supplemental material to this paper. SAS 9.2 (SAS Institute, Cary, NC) was used to calculate percentages, rates, ratios, and confidence intervals. Complete details of the study design have been published previously [11]. This study was approved by the Institutional Review Board of Weber State University.

### 2.1 Safety Climate

Items that are applicable to home-care nursing (as opposed to hospital-based nursing) were selected from Gershon et al.'s [15] safety climate scale. The eight items cover a broad range of subcategories and include support for safety programs, senior management support for safety, communication and feedback about safety, and training and education. The eight items were "The protection of workers from occupational blood exposures is a high priority with management," "Reporting blood exposures helps management protect nurses from future blood exposures," "Employees, supervisors, and managers all work together to ensure the safest possible working conditions," "Employees are encouraged by management to make suggestions for improving worker safety," "My supervisor often discusses safe work practices with me," "When a new device is introduced, there are procedures in place to ensure I've been correctly trained to use the new device," "Supervisors correct unsafe work practices," and "Employees are taught to be aware of and to recognize potential health hazards at work." Response options were numbered 1 (labeled "strongly disagree") to 5 (labeled "strongly agree"). These eight items were highly correlated (Cronbach alpha = 0.94) and were combined into a dichotomous composite measure (equivalent to a median split) indicating a strong (combined score > 3) or weak ( $\leq 3$ ) safety climate.

### 2.2 Blood Exposure

Possible routes of blood exposure (needlestick; exposure to the eyes, nose, and mouth; and blood on non-intact skin) were identified in preliminary research [16]. As a result, for the present survey, several questionnaire items asked about these types of blood exposure incidents during the previous 12 months. Nurses were considered to have had a blood exposure if they indicated that, during this time period, they had been stuck by a needle or lancet after it had been used on a patient; had gotten patient's blood or body fluid containing visible blood in their eyes, nose, or mouth; or had gotten patient's blood or body fluid containing visible blood on non-intact skin. For the present analysis, the number of such incidents was counted.

### 2.3 Use of Safety Devices

Use of safety devices was measured by six questions that referred to the last time the nurse used a particular type of device and asked whether it had the appropriate safety feature. For example, "The last time you used an IV catheter, did it have a shielded or blunted stylet?" The six types of devices asked about were winged steel needle (was it shielded?), lancet (retracting/shielded?), syringe (sliding shield, hinged cap, or retracting needle?), IV catheter, straight needle (hinged cap/shield?), and blood tube holder (hinged cap?). Response options were *yes* and *no*. Additional analyses of these data were presented previously [4].

### 2.4 Use of PPE

Use of PPE was measured by posing patient care scenarios in which use of the equipment was indicated to prevent blood exposure. In response to the scenarios, nurses could indicate that they always used the equipment when performing that procedure, or they could select from several reasons for not using the equipment. One of the scenarios was relevant for this study: whether, the last time the nurse provided ostomy care, a fluid-impermeable apron was worn. This equipment is intended to prevent exposure from

blood getting on non-intact skin [17]. Scenarios involving PPE designed to prevent blood exposure to the eyes, nose, and mouth are not shown because of the small number of exposures by this route. Additional analyses of these data were presented previously [5].

## 2.5 Work Experience, Type of Employment, and Characteristics of the Work Environment

Work experience was calculated from dates reported by the respondent. Type of employment (full time or part time/contract) was also self-reported. Two types of characteristics of the work environment were examined. One was whether the nurse reported agreeing with the statement, "I always have enough time during a home visit so that I don't have to rush." Responses were indicated on a five point scale ranging from *strongly disagree* to *strongly agree*. Nurses were categorized as not having to rush (responses of 4 or 5) or having to rush (responses of 1, 2, or 3). Additional analyses of these data were presented previously [18].

Secondly, characteristics of homes visited were measured by four items asking how often the nurse visited homes with unrestrained pets; unsupervised, unruly children; poor lighting; and "cluttered homes where I have to clear a space around the patient to place my medical supplies," (i.e., *adverse conditions*). Response options were *never*, *sometimes*, *usually*, and *always*. Nurses were categorized as usually/always (or *often*) or sometimes/never (*not often*) visiting homes with at least one of these characteristics. A detailed analysis of these data was presented previously [18].

## 3 Results

Questionnaires were received from 833 eligible nurses, whereas 640 nurses did not return the questionnaire or refused to participate in the study. Based on the assumption that the proportion of eligible nurses from among those who did not return the questionnaire or could not be contacted was similar to the proportion among those who did return the questionnaire, the adjusted response rate was 69%. Participants were primarily white (91%), female (96%), and between the ages of 36 and 55 years (63%).

Eighty-five percent of nurses reported a strong safety climate. Nine percent of nurses reported one or more blood exposures during the past year. The overall incidence rate was 27.4 (95% confidence interval (CI): 20.2, 34.6) exposures per 100,000 home visits.

The percentage of nurses who reported using the specified safety device the last time they used that type of device was 85% (winged steel needle), 76% (lancet), 82% (syringe), 85% (IV catheter), 70% (straight needle), and 57% (blood tube holder). The percentage who reported always wearing a fluid-impermeable apron when providing ostomy care was 20%. Sixty-one percent of nurses had six or more years of experience working in home care/hospice; 77% worked in their jobs on a full-time basis. Fifty-five percent of nurses agreed that they do not have to rush during a visit; 63% often visited homes with at least one of the specified adverse conditions.

Nurses who worked in an environment with a weak safety climate had nearly two and a half times the risk of total blood exposure as nurses who worked in an environment with a strong safety climate (risk ratio, 2.4 (95% CI: 1.6, 3.2)). They had twice the risk of needlestick (Table 1). Furthermore, both nurses who did and did not use the specified safety device had lower risk of exposure if they worked in an organization that had a strong safety climate. Ratios between the weak and strong safety climate groups could not be calculated for all of the devices because of small n's. Nevertheless, for all devices, the rate of exposure was greater in the weak safety climate group than in the strong safety climate group. (Rates of exposure could not be calculated for two types of devices (winged steel needle and blood tube holder) for one of the safety device categories because the number of exposures was 0.)

**Table 1.** Blood exposure rates (per 100,000 home visits) from needlestick among home care and hospice nurses, by type of medical device, whether it was safety-engineered (the last time the nurse used that type of device), and safety climate, North Carolina, 2006 (N=833)

Type of Device	Was safety device?	Safety Climate	Rate ratio <sup>b</sup>				
			n	Rate	95% CI	Ratio	95% CI
Total <sup>a</sup>		Weak	20	24	(9.8, 39)		
		Strong	47	12	(7.7, 17)	2.0	(1.2, 2.8)
Winged steel needle	No	Weak	0				
		Strong	5	5.7	(0, 13)		
	Yes	Weak	5	12	(0, 26)		
		Strong	16	3.1	(1.3, 4.8)	3.9	(1.6, 6.2)
Lancet	No	Weak	4	17	(0, 38)		
		Strong	9	7.4	(1.3, 14)		
	Yes	Weak	2	3.8	(0, 10)		
		Strong	10	1.6	(0.2, 3.0)		
Syringe	No	Weak	3	17	(0, 44)		
		Strong	3	2.3	(0, 6.2)		
	Yes	Weak	3	5.1	(0, 11)		
		Strong	18	3.7	(1.7, 5.7)		
IV catheter	No	Weak	3	18	(0, 44)		
		Strong	7	3.7	(0, 8.1)		
	Yes	Weak	3	5.3	(0, 12)		
		Strong	11	1.9	(0.3, 3.4)		
Straight needle	No	Weak	4	12	(0, 29)		
		Strong	8	3.6	(0, 7.4)		
	Yes	Weak	2	6.8	(0, 17)		
		Strong	13	3.6	(1.5, 5.7)	1.9	(0.8, 3.0)
Blood tube holder	No	Weak	6	14	(0, 28)		
		Strong	7	2.7	(0.1, 5.3)	5.1	(0.2, 10)
	Yes	Weak	0				
		Strong	10	2.1	(0.2, 4.0)		

n, number of blood exposures; CI, confidence interval. <sup>a</sup>All nurses. <sup>b</sup>Comparing weak to strong safety climate within strata. Some ratios were not calculated because of small n's.

Similar relationships were found between safety climate and blood exposure among nurses who did and did not always wear a fluid-impermeable apron when providing ostomy care (Table 2).

**Table 2.** Blood exposure rates (per 100,000 home visits) from getting blood on non-intact skin among home care and hospice nurses, by use of PPE and safety climate, North Carolina, 2006 (N=833)

Scenario	Use of PPE	Safety Climate	n	Rate ratio <sup>a</sup>			
				Rate	95% CI	Ratio	95% CI
When providing ostomy care, uses fluid-impermeable apron...	Not always	Weak	20	30	(14, 48)		
		Strong	43	18	(12, 25)	1.7	(1.1, 2.4)
	Always	Weak	0				
		Strong	4	2.5	(0, 7.2)		

PPE, personal protective equipment; n, number of blood exposures; CI, confidence interval. <sup>a</sup>Comparing weak to strong safety climate within strata. The ratio for nurses who always used the requisite PPE for that procedure was not calculated because of small n's.

Furthermore, a strong safety climate was associated with lower blood exposure among nurses who did and did not have six or more years of home care/hospice experience, worked full time (but not part time/contract), did and did not have to rush during home visits, and did and did not often work in homes with adverse conditions (Table 3).

**Table 3.** Blood exposure rates (per 100,000 home visits) among home care and hospice nurses, by four factors previously found to be associated with risk of blood exposure or use of PPE/safety medical devices, safety climate, and route of exposure, North Carolina, 2006 (N=833)

Factor	Level of Factor	Safety Climate	Total <sup>a</sup>					Needlestick <sup>b</sup>			Blood on non-intact skin				
			n	Rate	95% CI	Rate ratio <sup>c</sup>		n	Rate	95% CI	n	Rate	95% CI	Rate ratio <sup>c</sup>	
						Ratio	95% CI							Ratio	95% CI
Years of experience in home care/hospice nursing	≤5	Weak	31	82	(13, 152)			4			11	34	(3.6, 64)		
		Strong	36	31	(20, 42)	2.6	(1.7, 3.6)	11	5.9	(2.0, 9.7)	22	23	(13, 34)	1.5	(0.8, 2.2)
	6+	Weak	14	25	(10, 39)			2			9	18	(4.9, 31)		
		Strong	42	13	(4.4, 21)	1.9	(0.7, 3.2)	10	1.7	(0.1, 3.3)	25	5.1	(1.7, 8.5)	3.5	(1.2, 5.8)
Type of employment	PT	Weak	8	30	(2.9, 58)			2			5	19	(0, 43)		
		Strong	12	27	(13, 40)	1.1	(0.6, 1.7)	4			7	20	(8.2, 31)	1.0	(0.4, 1.5)
	FT	Weak	37	53	(15, 91)			4			15	26	(8.6, 44)		
		Strong	66	18	(10, 26)	2.9	(1.7, 4.2)	17	2.5	(1.0, 4.1)	40	10	(5.0, 15)	2.6	(1.3, 3.9)
Has to rush on home visit	Yes	Weak	36	52	(12, 92)			4			15	23	(5.9, 41)		
		Strong	49	18	(9.3, 28)	2.9	(1.4, 4.3)	10	2.7	(0.4, 5.0)	33	13	(4.5, 22)	1.8	(0.6, 2.9)
	No	Weak	9	39	(8.0, 69)			2			5	27	(0, 54)		
		Strong	27	16	(10, 22)	2.4	(1.6, 3.3)	11	3.9	(1.3, 6.4)	14	12	(6.7, 17)	2.3	(1.3, 3.2)
Adverse conditions in homes visited	U/A	Weak	35	49	(10, 87)			4			15	23	(5.7, 40)		
		Strong	59	23	(13, 33)	2.1	(1.2, 3.0)	14	4.2	(1.8, 6.6)	37	13	(6.2, 19)	1.8	(0.9, 2.7)
	S/N	Weak	10	46	(12, 80)			2			5	29	(1.0, 57)		
		Strong	19	15	(7.9, 21)	3.1	(1.7, 4.5)	7	2.0	(0, 4.4)	10	12	(5.7, 18)	2.4	(1.2, 3.6)

PPE, personal protective equipment; n, number of blood exposures; CI, confidence interval; PT, part time or contract; FT, full time; U/A, usually or always, i.e., often; S/N, sometimes or never, i.e., seldom. <sup>a</sup>Includes blood exposure to the eyes, nose, and mouth. This route is not shown separately because of its small number of exposures. <sup>b</sup>Ratios and some rates were not calculated because of small n's. <sup>c</sup>Comparing weak to strong safety climate within strata.

## 4 Discussion

Safety climate appears to be associated with reduced blood exposure among home care and hospice nurses. This study found that the association holds for nurses who did and did not use a safety-engineered medical device the last time they used that particular type of device, do and do not always use the selected item of PPE when it is indicated, had fewer or greater years of experience in home care/hospice, worked full time, did and did not have to rush during home visits, and seldom or often visited homes with adverse conditions. The findings for these subgroups are important because these factors are prevalent in home care/hospice [18] and several have been associated with blood exposure [11, 12]. If the association between safety climate and blood exposure proves to be causal, these findings will indicate that, while improving the above factors is important for reducing nurses' blood exposure [11], such improvement will need to be accompanied by a strong safety climate in order to further reduce their exposure.

The finding that a strong safety climate is associated with reduced blood exposure is consistent with the results of other studies, which have found reduced blood exposure associated with a strong safety climate among other populations of home care/hospice [10] and hospital-based nurses [19, 20] as well as reduced injury or accident rates among workers in a variety of industries [21, 22]. One difficulty in

drawing firm conclusions from this diverse literature is the different ways in which safety climate has been operationalized. Future research should develop measures of safety climate that can be used across many different types of work environments [23].

Future research should also elucidate steps that management can take to produce a strong safety climate [24-26]. Some factors that have been proposed as important include leadership [27] and organizational justice [28].

The direction of causality in the association between safety climate and blood exposure cannot be determined from the present study. Furthermore, many of the rates and ratios were estimated with low precision (i.e., wide confidence intervals) due to the small number of exposures in the relevant groups, especially for needlestick exposures. Kim et al. [29] have shown the validity of using “near-misses” to increase the number of exposures available for study. In order to strengthen the conclusions drawn from future studies, research should investigate the direction of causality in the association between safety climate and blood exposure using sufficient number of exposures.

**Acknowledgments.** This survey upon which this study is based was funded by Grant OH008241 from the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health. The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health. The author thanks Linda Lacey of the North Carolina Center for Nursing for help with the Board of Nursing data; Kathy Culliton, MS, APRN and Cynthia Gecik, MSN, RN for help in understanding the PPE data; and members of the study team: Cynthia Klein, PhD, Jennifer T. Lyden, MPH, Rahel Mathews, MPH, Kathleen L. Sitzman, RN, PhD, Abenah Vanderpuije, MPH, and Mary Agnes Kendra, RN, PhD.

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