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## Major article

## Hospital unit safety climate: Relationship with nurses' adherence to recommended use of facial protective equipment



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**Background:** Despite the existence of formal guidelines for the acute health care sector, nurses' adherence to recommended use of facial protective equipment (FPE) to prevent occupational transmission of communicable respiratory disease remains suboptimal. In addition to individual factors such as knowledge and education, group factors such as shared perceptions of organizational support for safety may influence adherence. These group safety climate perceptions can differ depending on the pace and type of work, local leadership, and organizational structure of each unit.

**Methods:** An analysis of a data set from a cross-sectional survey of 1,074 nurses in 45 units of 6 acute care hospitals was conducted. Variance components analysis was performed to examine the variance in perceptions of safety climate and adherence between units. Hierarchical linear modeling using unit-level safety climate dimensions was conducted to determine if unit-level safety climate dimensions were predictors of nurses' adherence to FPE.

**Results:** Findings revealed statistically significant unit variances in adherence and 5 of the 6 unit-level safety climate dimensions ( $P < .05$ ). Furthermore, a hierarchical model suggested that tenure and unit-level communication were significantly associated with increased adherence to FPE ( $P < .05$ ).

**Conclusion:** Unit-level safety climate measures varied significantly between units. Strategies to improve unit-level communication regarding safety should assist in improving adherence to FPE.

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In recent years, highly infectious diseases such as severe acute respiratory syndrome and influenza A have escalated concern for the well-being of health care workers.<sup>1</sup> This has led to the development of multiple guidelines for the use of facial protective equipment (FPE) as an important strategy to prevent transmission of occupational respiratory disease.<sup>2</sup> Despite the existence of these guidelines, the literature shows adherence to such precautions remains suboptimal. A review of the evidence on compliance of health care practitioners to standard precautions before the 2009 influenza A

epidemic found that, on average, adherence to FPE was 30% (range, 4%-55%).<sup>3</sup> More recently, a study of 21 intensive care units in China found that 55% of health care workers complied with the proper use of FPE.<sup>4</sup> Two studies from Canada found 44% of nurses in 6 hospitals<sup>5</sup> and 11% of doctors in 14 hospitals reported they properly adhered to FPE.<sup>6</sup> Such suboptimal adherence rates are of great concern because it is estimated that 1 in 4 health care workers contract a communicable respiratory illness through work.<sup>7</sup> Furthermore, FPE has been cited as the most uncomfortable and problematic of all types of personal protective equipment, and is often more poorly adhered to than other components of standard precautions such as hand washing and glove use.<sup>3,8</sup> Together, these findings highlight the need to develop strategies to improve adherence to FPE, especially among nurses, who represent the largest occupational workgroup in the health sector and have the most patient interactions.<sup>9</sup>

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A review of the literature showed that the majority of interventions to improve adherence focused on individual factors such as education and training; however, many of these studies report no or minimal improvements in adherence.<sup>10</sup> Such findings have raised concerns about the key assumption in the literature that safe work behaviors are predominantly determined by individuals' knowledge and beliefs.<sup>11</sup> In response, a growing body of literature has demonstrated that organizational and psychosocial aspects of the workplace may play a significant role in determining safety behaviors and outcomes,<sup>12,13</sup> and the product of individual and group attitudes, perceptions, and patterns—also described as safety climate—may determine an individual's, team's, or organization's commitment to safety.<sup>14–16</sup>

Using a 6-dimension safety climate scale model, researchers have shown an association between individuals' safety climate perceptions and their compliance with standard precautions in hospitals.<sup>14</sup> Furthermore, studies have identified particular dimensions of safety climate that are most influential in predicting behavior.<sup>8,14</sup> However, these studies did not examine group-level differences within hospitals, such as specific nursing units. In hospitals, “units differ by type of patients, acuity, pace of clinical care activities, workload, as well as by staff composition, local leadership, and organizational structure.”<sup>17</sup> These factors create discrete microsystems that develop their own interpretation of the global or hospital organizational climate.<sup>18</sup> As a result, heterogeneity exists between units, and this phenomenon has been recently demonstrated across intensive care units of a single hospital, as well as across different types of units in multiple hospitals.<sup>17,19</sup> Despite such findings, no research has been conducted to examine the effect of unit-level perceptions of safety climate on adherence to FPE. We examined 6 dimensions of unit-level safety climate in 45 hospital units, and their relationship with nurses' self-reported adherence to recommended use of FPE.

## METHODS

### *Setting, subjects, and study design*

This study was a secondary analysis of data collected by Nichol et al.<sup>5</sup> The group conducted a cross-sectional study to describe nurses' adherence to recommended use of FPE to prevent occupational transmission of communicable respiratory illness, and to determine specific factors that influence adherence.<sup>5</sup> A total of 1,074 registered nurses and registered practical nurses in 45 distinct units located in 6 different hospitals in Toronto, Canada, completed a questionnaire (response rate 82%).<sup>5</sup> The questionnaire was derived from Moore's framework, which divides factors associated with self-protective behavior at work into 3 categories: organizational, environmental, and individual factors.<sup>20</sup> The questionnaire consisted of 84 items, primarily based on a 5-point Likert response scale that ranged from strongly agree to strongly disagree. Scales to measure organization and environmental factors were tested for reliability using Cronbach's  $\alpha$  raw scores, and all had reliability scores of 0.7 and above.<sup>5</sup> Ethics approval for the initial study was obtained from the administering organization, the partner academic institution, and all 6 participating hospitals. Ethics approval for this secondary analysis was obtained from the administering hospital's Research Ethics Board.

This secondary analysis focused on 42 of the 84 items to identify and define demographic variables, safety climate dimensions, and adherence. Safety climate was measured using a combination of 3 environmental and 3 organizational factors. These 6 factors, or dimensions, were based on a revised version of a tool developed by Gershon et al.<sup>21</sup> to examine safety climate in health care settings.

Scales in the original tool were tested for reliability and all had Cronbach's  $\alpha$  scores of 0.7 and above.<sup>21</sup>

### *Demographic variables*

Eight demographic variables were included in this analysis. These included age, education, gender, nurse type (registered nurse or registered practical nurse), supervisory status, tenure as a nurse, tenure on the unit, and work status (full-time or part-time).

### *Safety climate dimensions*

Safety climate was characterized using 6 dimensions: availability of FPE, absence of job hindrances, cleanliness and orderliness of unit, minimal conflict and good communication practices, organizational support for health and safety, and safety-related training and fit testing. Availability of FPE, absence of job hindrances, and cleanliness were measured with 3-item scales. Communication was measured using an 8-item scale, whereas organizational support and training and fit testing used 6-item scales. Examples of items include “my work area is kept clean” (cleanliness) or “there is open communication between supervisors and staff” (communication). For the first 5 dimensions, a participant received a score of 1 for a safety climate dimension if they answered “strongly agree” or “agree” to all items within the scale. For training and fit testing, a score of 1 was given when a participant was fit tested within the past 2 years and answered “strongly agree” or “agree” to 5 out of the 6 items within the scale.

### *Adherence*

Individual adherence was defined as a participant responding always or mostly to at least 7 of the 8 items within the adherence scale.

### *Statistical analyses*

SPSS version 21.0.0.0 software (IBM-SPSS Inc, Armonk, NY) was used to perform descriptive statistics and to aggregate individual perceptions of the 6 safety climate dimensions to the unit level.<sup>22</sup> Before aggregation, the 1,074 participants were sorted according to their unit of work. Individual safety-climate dimension scores were summed, averaged by the number of participants in the unit, and multiplied by 100% to generate a positive percentage score for each unit. To remain consistent with the primary study published, where individuals received a 0 or a 1 for each safety climate dimension,<sup>5</sup> all unit-level safety climate scores were analyzed as dichotomous variables. Due to the low percentage of positive responses observed in this dataset, a cutoff of 50% was chosen instead of the 60% recommended in the literature. Therefore, if a unit had >50% of individuals reporting a positively for a safety climate dimension, the unit received a score of 1.

Hierarchical linear modeling was used as participating nurses were nested within units, and units were nested within hospitals.<sup>23</sup> HLM software version 7.01 (Scientific Software International, Skokie, Ill) was used to perform variance component analysis,<sup>24</sup> and R software version 3.1.0 (R Foundation for Statistical Computing, Vienna, Austria) was used to compute bivariate analyses and logistic hierarchical model using individual factors and unit-level safety climate dimensions.<sup>25</sup> A  $P < .2$  cutoff was used as the inclusion criterion for a generalized logistic mixed model consisting of 3 levels: individual, unit, and hospital.<sup>23,26</sup> This model was then simplified using backward selection and a cutoff of  $P < .2$  to yield a final model that predicted nurses' adherence to FPE.<sup>26</sup>

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