REUSABLE R
The Impact on Safety Clim

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THE SHARED PERCEPTIONS of policies and practices that prioritize worker safety and health are referred to as an organization's safety climate (Dollard & Bakker, 2010; Zohar, 2010) and has been used as a leading indicator of workers' physical safety, mental health and well-being (Zadow et al., 2021). Within healthcare, safety climate dimensions including management support of safety and health programs, employee communication, safety-related feedback and training, and availability of PPE have been shown to impact worker perceptions and subsequent mental health outcomes (DeJoy et al., 2017; Gershon et al., 2000).

At the onset of the COVID-19 pandemic, the shortage of disposable N95-filtering facepiece respirators was linked to adverse mental health outcomes among health workers (e.g., Arnetz et al., 2020; Khajuria et al., 2021; Spoorthy et al., 2020). Although research has documented negative outcomes because of disposable respirator shortages, no research has identified the role of reusable respirators, which were increasingly used during the COVID-19 pandemic after the U.S. Food and Drug Administration granted an emergency use authorization to use NIOSH-Approved elastomeric half-mask respirators (EHMRs) in health settings (HHS, 2020a).

Consequently, NIOSH worked with health settings as they integrated reusable EHMRs into their workplace over a 12-month period. However, with the provision of EHMRs in the workplace, updates to OSHA-mandated respiratory protection programs (RPPs) were necessary. RPP components include medical evaluations, fit testing, procedures for cleaning, disinfecting, storing (if applicable) and training. Although many parts of an RPP may remain static, procedures for respirator selection may need to be updated based on emerging hazards such as SARS-CoV-2 (OSHA, n.d., 2019). In other words, introducing EHMRs required RPP updates to reflect changes in workplace conditions, processes that affect respirator use, and updated resources and education.

KEY TAKEAWAYS

- **Receiving reusable respirators and corresponding ongoing communication and training may improve worker well-being, serving as a tangible indicator of organizational support.**
- **From an emergency preparedness standpoint, organizations may consider stockpiling reusable elastomeric half-mask respirators and updating their respiratory protection program (RPP) to include education about these respirators.**
- **From a health promotion standpoint, it may behoove organizations to develop comprehensive programs that emphasize management practices to increase worker perceptions of safety climate and, consequently, worker mental health and well-being.**
- **Supervisor or frontline leadership communication and engagement in the implementation of RPPs is critical to foster trust and adoption of new respirators. Ongoing role modeling and support by management to comply with the RPP or other safety and health plans are necessary to garner employee-wide participation in respiratory protection.**

Respirator Demonstration Projects

In September 2021, the U.S. Strategic National Stockpile (SNS), which is part of the U.S. federal government's emergency response infrastructure situated within the Administration for Strategic Preparedness and Response, procured and shipped EHMRs to 49 organizations that responded to a public *Federal Register* notice (HHS, 2020b). After NIOSH's Institutional Review Board deemed the study exempt, these organizations were invited to make an online survey available to workers who were fit tested for an EHMR, or for leaders who had program oversight or oversaw aspects of fit testing, to participate in virtual interviews to provide an aggregated, holistic view of how and, if applicable, why employees' perceptions of safety climate changed throughout the demonstration project as well as ways that PPE management practices—including updates made to RPPs—may have impacted employee perceptions of safety climate.

Forty-three organizations (87.8%) participated in at least one interview and 32 (65.3%) made the survey available to their workers. Of the 43 organizations, 17 were healthcare and 26 were public safety settings across 16 states. Thirty-one percent (n = 16,178) of EHMRs received from the SNS were distributed. Key takeaways discussed throughout the yearlong project included providing workers autonomy and trust, increasing communication, swiftly updating written protocols, and offering management support in terms of leading by example with respect to wearing and supporting the use of respirators.

Survey Instrument, Data Collection & Respondents

NIOSH developed and deployed a voluntary 20-min online survey from October 2021 to November 2022 to accommodate fit testing timelines and educational programs while accounting for the additional burden on workers during the pandemic. Workers were asked if they received their EHMR, if they knew what an RPP was, and if they had previously seen or reviewed any

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portion of their RPP ("yes" or "no" prompts). Four safety climate constructs were measured [i.e., PPE safety climate (Peterson et al., 2016); psychosocial safety climate (Dollard & Bakker, 2010); organizational priority toward safety and health during routine operations (Flin et al., 2006) and during the COVID-19 pandemic (Haas et al., 2022)] using a five-point Likert scale ("never" to "always") with 5 representing a more positive perception.

Of the 882 respondents, 63.4% were regular hourly employees. Salaried employees (21.7%) and other temporary or contracted employees (14.6%) also participated. Reported positions included dietician, dentist, environmental services technician, infection preventionist, occupational therapist, physician, physical therapist, radiologic technician, respiratory therapist, registered nurse, speech-language pathologist, paramedic, emergency medical technician, firefighter, police officer and prehospital registered nurse. Table 1 (p. 22) details respondent demographic characteristics including age and time in current job.

Interview Instrument, Data Collection & Respondents

Organizational points of contact voluntarily participated in virtual, semi-structured interviews between October 2021 and November 2022. Every organization participated in at least one interview with 65.8% (n = 25) participating in two or three interviews—approximately 3 to 4 months apart—and were asked progressive questions about their program deployment and maintenance. Specifically, interview questions probed RPP processes including practices around EHMR cleaning, disinfection and storage, and worker experiences using EHMRs. Other questions focused on processes used to communicate and educate workers about EHMRs. All organizations indicated compliance with OSHA's RPP guidelines (OSHA, n.d.), demonstrating that questions around RPPs were appropriate to ask.

Even though redundancy of information was prevalent after the first round of interviews, researchers sought to understand how initial concerns or barriers were overcome (if applicable), and lessons learned to inform future guidelines. NIOSH interviewed 73 individuals designated as a primary point of contact for their organization's EHMR program. Researchers emailed an informed consent document that was debriefed before beginning the interview. One member of the team facilitated the discussion while another took notes. Interviews ranged from 20 to 65 min [mean (M) = 37 min]. Points of contact included executive leadership roles (e.g., chief medical

officer, vice president of safety); director roles in infection prevention, emergency management, employee health, and industrial hygiene; and police or fire department officers including lieutenants, captains and fire chiefs. Table 2 summarizes the themes, definitions and topics discussed.

Results

Regarding survey and interview data analyses, various statistical methods and coding were completed to determine whether receipt of an EHMR impacted worker perceptions of safety climate, if knowledge of the organization's RPP impacted perceptions of safety climate, and whether perceptions of safety climate significantly changed based on when workers responded to the survey during the 1-year program. Concurrently, the interviews helped to further elucidate the interconnections of safety climate and worker mental health and well-being, as well as implications for improved safety, health and respirator protection programming.

Impact of Respirator & Program Availability on Perceptions of Safety Climate

At the time of survey completion, 54% of end users received their EHMR and less than half (45%) had knowledge of their RPP. Of the 45% with RPP knowledge, 67.8% reported seeing or reviewing it. As noted, the survey included four safety climate measures. The mean and standard deviations for all four scales and respective items are shown in Table 3 (p. 24). This table shows that psychosocial safety climate—used to measure mental health and well-being—had the lowest average on the five-point scale. The lowest rating was "There is good communication here about safety issues which affect me."

Table 4 (p. 25) shows the mean (*M*) and standard deviation (*SD*) for each of the four safety climate constructs based on whether the elastomeric had been received ("yes" or "no") and whether there was knowledge of their RPP ("yes" or "no"). There were more favorable perceptions of all safety climate measures among those who received an EHMR, all being statistically significant at the $p < .05$ level. Similarly, those who reported knowledge of their RPP had a statistically significantly higher perception of the safety climate measures at the $p < .001$ level. The mean for organizational priority toward safety specific to COVID-19 had the highest average (*M*) and the lowest variance (*SD*) among those who received an EHMR and had knowledge of their RPP. Considering that a 2020 national survey of nurses found that lack of adequate PPE was a primary concern among 74% of respondents, it is not surprising that respondents who received EHMRs had more favorable safety climate perceptions (ANA, 2020).

TABLE 1
CHARACTERISTICS OF SURVEY RESPONDENTS

Demographic characteristics	Count	Percent
Job classification (28 missing[a])		
Salaried employee	186	21.7
Regular hourly employee	543	63.4
Other (e.g., temporary hourly employee, contracted/on-call employee)	125	14.6
Age range (15 missing)		
18 to 30	229	26.4
31 to 40	246	28.4
41 to 50	208	24.0
51 and older	184	21.2
Time in current job (27 missing)		
Less than 12 months	121	14.2
1 to 2 years	131	15.3
3 to 5 years	156	18.2
6 to 10 years	148	17.3
11 to 20 years	169	19.8
21 or more years	130	15.2
Representation by sector (0 missing)		
Hospitals and other healthcare systems	344	39.0
Dental clinics	130	14.7
Fire-based emergency medical service departments[b]	302	34.3
Emergency medical services/ ambulatory services	75	8.5
County systems supporting public health services	31	3.5

Note. [a] Missing data refers to the number of respondents who chose to not answer the specific question.
[b] Police departments had fewer than nine responses and were added into the fire-based EMS group.

Changes in Aggregated Perceptions of Safety Climate Over Time

Researchers sought to identify changes in perceptions of safety climate during different time points of the study. To this end, the 882-participant study sample was split into four groups: 32.3% ($n = 284$) completed the survey in Q4 of 2021, 13.3% ($n = 117$) in Q1 of 2022, 35.7% ($n = 315$) in Q2 of 2022, and 18.8% ($n = 166$) in Q3 of 2022. Averages at each aggregated time point in 3-month increments are shown in Figure 1 (p. 26). Employees' perceptions of each safety climate construct statistically significantly increased from the initial aggregate at baseline to Time 2 (at 3 to 6 months), perhaps due to the distribution of EHMRs and increased level of engagement around respiratory protection. However, perceptions decreased at Times 3 and 4. It is possible that as time passed the visibility of the EHMR program started to fade, perhaps contributing to declining perceptions in the second half of the year.

Implications for OSH Professionals

Organizational points of contact observed that EHMRs had a positive impact on worker well-being. For example, a long-term care facility noted, "It's a mental health thing—it gives them peace of mind to have these" (Organization 54). This terminology was used by several organizations, with a fire department also stating during the second interview, "The EHMRs offer peace of mind for COVID-19 cases and is making them happier on the job" (Organization 77). Although initial receipt of EHMRs may have contributed to favorable perceptions among workers at the onset of the demonstration project, once supply chains stabilized and disposable N95-filtering facepiece respirators became available, maintenance of EHMR programs started to wane as some organizations stopped distributing EHMRs. The next section discusses lessons learned among participating organizations to

TABLE 2

THEMES, DEFINITIONS & TOPICS DISCUSSED DURING INTERVIEWS

Theme	Definition	Topics and examples discussed
Implementation and dissemination approaches	EHMR distribution efforts resulted in the identification of barriers, lessons learned and practices. Discussions regarding training, education, communication, and internal or external influences on dissemination and use were emphasized.	• Bottom-up distribution • Top-down distribution • Changes to PPE and RPP policies • COVID-19 influences on PPE and RPP implementation • Supply chain influences on implementation
Organizational culture toward safety, health, PPE and well-being	Reflections on the role of organizational culture when integrating EHMRs and how this impacted employee adoption and perceptions. Feedback around employee anxiety and the role PPE had on worker mental health was emphasized as well as the importance of leadership support and communication.	• Stress and burnout • Anxiety around COVID-19 • Group and individual factors (accountability, perceived risk and preference) • Leadership support • Organizational support
Sustainability concerns and motivations	Challenges discussed in maintaining EHMR use (including education and communication around it) in the workplace. Resources to complete trainings and develop and revise parts of safety and health and RPP programming was discussed as a barrier to sustainability.	• Human-centric design considerations for the culture, beliefs and environments for all potential respirator users • Reducing waste • Lack of resources to sustain program (tangible and intangible) • Stockpiling efforts

maintain safety climate perceptions via organizational support and leadership communication.

Communicating Temporary & Changing Directives

Points of contact discussed job tasks that they temporarily changed to mitigate employees' exposure frequency and length to SARS-CoV-2. They also deferred to temporary directives to distribute new information or requirements as quickly as possible rather than making updates to their RPP or complementary safety and health program as a communication mechanism. One police department reflected, "Right now, with so many changes happening all the time we don't like to rewrite [respiratory programs] because then we would always be updating policies. Rather, we have been writing directives or maybe a note from the chief or myself" (Organization 21).

Similarly, a fire department stated, "We've been lax on making changes, but we did just get a directive out there. We do need to update that for the future though because EHMRs are here to stay" (Organization 77).

Many points of contact observed the added stress that changing communications and guidelines placed on employees at work. Over time, some points of contact found it more useful to have daily or weekly town hall meetings to relay new information and answer questions instead of or prior to sending emails with new guidelines. One participating hospital indicated that it had a three-page user guide about EHMRs, while another created an education sheet and comprehensive instructions specific to the pandemic response. Many organizations also expressed the desire for resources such as flowcharts to help identify the selection of certain respirators in various response situations or patient interactions.

Regardless of the medium used, points of contact noted the need for transparent communication, especially with current safety, health and RPPs being outdated to proactively respond to COVID-19. For example, several organizations engaged in targeted communication messaging around EHMRs to discuss their protective utility, which also had a positive, observed impact on employee perceptions and adoption of health-protective practices.

RPP Updates

Participating organizations indicated that training and fit testing around EHMRs took about 30 min per person, in comparison to about 10 min for an N95-filtering facepiece respirator. Therefore, adding not only more people to be included in their RPP but also a new type of respirator was a resource-intensive challenge for some participating organizations. From an emergency preparedness standpoint, integrating applicable respirators that may be selected at any point by an organization based on anticipated hazards could be beneficial.

An effective program goes beyond merely providing a respirator and fit testing workers (OSHA, 2009). RPP practices reflect a commitment from organizations by supporting data-driven policies, ensuring appropriate respirator use, and regularly evaluating and updating the program (The Joint Commission, 2014; OSHA, 2009; NIOSH, 2015). However, the COVID-19 pandemic required quick changes in organizational procedures and many points of contact

did not realize the programmatic updates that would be necessary to adequately integrate EHMRs. As one hospital reflected: "Things like when to replenish filters and how many to stockpile, having a repair plan for EHMRs that break—how those are exchanged and what parts we need to have on hand, and infection prevention for things I didn't necessarily think about at first, all these things that impacted implementation and use" (Organization 81).

Similarly, organizations noted that they were not able to develop educational tools as planned. For example, many expressed the intention to create EHMR training videos but lacked the time and resources. One hospital reflected that it was not until the hospital identified a mechanism for integrating EHMRs into employees' workflow—providing tips and tricks via information sheets and QR codes to quickly access digital information—that workers were receptive to using them.

No organization had fully implemented EHMRs into its RPP, and even if organizations had more than one respirator in their RPP (e.g., N95-filtering facepiece respirators and self-contained breathing apparatuses), adding another to select is still a change that required time and resources. These results support the importance of RPPs and perhaps other safety and health programming in being able to evolve during emergency scenarios to relay information to the workforce and support worker-adherent practices toward respiratory protection.

Further, although respirator fit testing and training occurs annually, continued management support and organizational updates to RPPs can serve as a more consistent communication mechanism for employees, especially during an emergency. For example, during the 2007 influenza pandemic, OSHA (2009) argued for more detailed emergency preparedness processes that accommodated different types of PPE. The current results also support more robust emergency preparedness plans that are accessible when a new change is introduced. However, such plans must be supported and sustained by leaders to have lasting effects.

Conclusion

The researchers used a convenience sample of organizations that implemented EHMRs on their own timeline. Therefore, findings are not representative nor generalizable. The survey results are subject to self-reporting bias as well as underreporting; specifically, not all organizations opted to make the survey available to their

TABLE 3
DESCRIPTIVE RESULTS OF SAFETY CLIMATE SURVEY ITEMS BY SCALE

Items by scale	*M* (five-point scale)	*SD*
Psychosocial safety climate (Cronbach's alpha = 0.954)	**3.59**	**0.953**
In my workplace, senior management acts quickly to correct problems or issues that affect employees' psychological health.	3.70	1.129
Psychological well-being of staff is a priority for this organization.	3.60	1.169
There is good communication here about safety issues which affect me.	3.50	1.167
Employees are encouraged to become involved in psychological safety and health issues.	3.53	1.172
Employees receive resources or support that assist in managing job demands.	3.63	1.088
Organizational safety climate (Cronbach's alpha = 0.917)	**4.09**	**0.780**
At my workplace, safety hazards are quickly corrected.	4.05	0.912
At my workplace, all reasonable steps are taken to minimize workers' risk of exposure to airborne infectious diseases.	4.19	0.875
The safety and health of workers is a high priority with management where I work.	4.26	0.890
The health and safety of workers is a high priority with coworkers where I work	4.20	0.859
Management communicates information about safety and health.	4.14	0.899
Management seeks feedback from workers about safety and health issues.	3.70	1.104
PPE safety climate (Cronbach's alpha = 0.884)	**3.95**	**0.953**
Workers at my workplace use respirators when they are required.	4.12	0.937
Supervisors correct workers if they do not wear a respirator when required.	3.93	1.11
Supervisors correct workers if they do not wear a respirator properly (e.g., if only one strap was used).	3.80	1.15
Organizational priority toward safety COVID-19 (Cronbach's alpha = 0.846)	**4.15**	**0.662**
My organization has been doing everything it can to protect the workforce during the COVID-19 pandemic.	4.23	0.873
My coworkers have been doing everything they can to protect themselves during the COVID-19 pandemic.	3.94	0.858
My coworkers have been taking extra precautions to protect the workforce during the COVID-19 pandemic.	3.92	0.867

employees. For those who did receive the survey, nonresponse could be due to the workload during the pandemic and the lack of a monetary incentive.

Although this design impacted survey results, the qualitative data provided deeper insight and context to the aggregated survey data. Regardless of the study limitations, the results demonstrate the importance of understanding PPE management practices that support worker perceptions and offer lessons learned among organizations during the COVID-19 pandemic to preserve worker safety, health, and well-being. **PSJ**

Acknowledgments & Disclaimer

Ethics approval: This study was reviewed by the NIOSH Institutional Review Board and deemed exempt.

Informed consent: A waiver of written consent was granted for this study, but informed consent was obtained from all individual participants included in the study.

Attribution: "N95" and "NIOSH Approved" are certification marks of the U.S. Department of Health and Human Services registered in the U.S. and several international jurisdictions.

Disclaimer: The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of NIOSH.

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TABLE 4

SAFETY CLIMATE AVERAGES

Safety climate perceptions for four constructs aggregated by quarter (i.e., every 3 months).

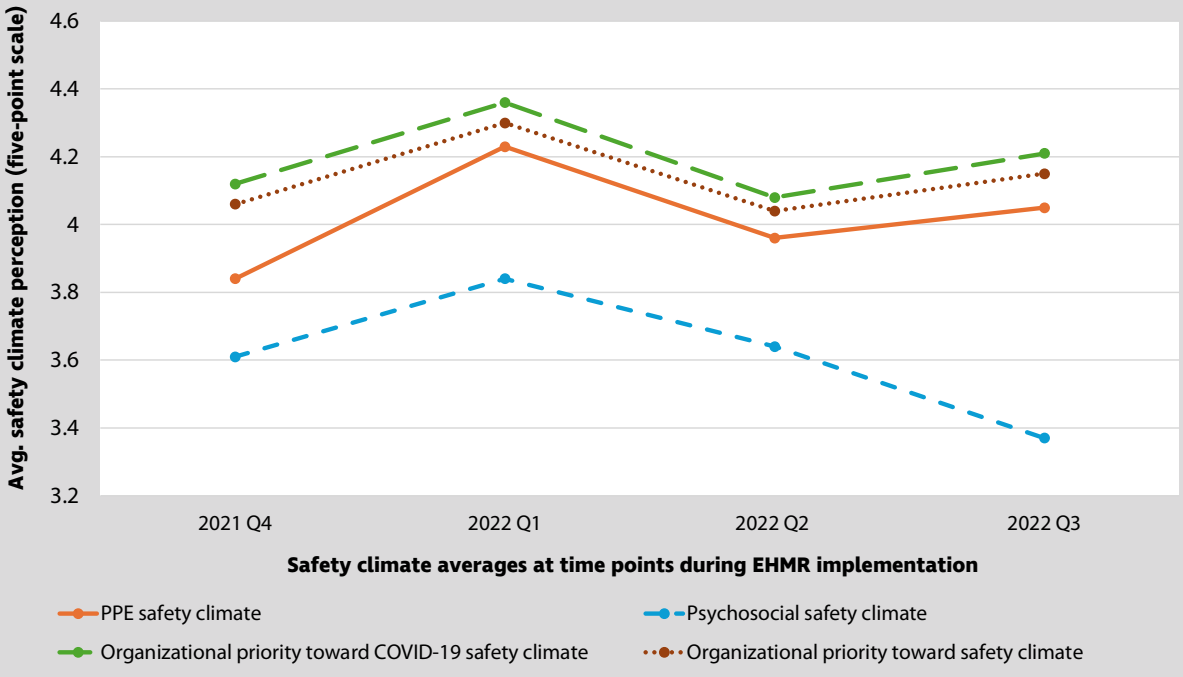
	Received EHMR				Knowledge of RPP			
	Yes (54%)		No (46%)		Yes (45%)		No (55%)	
Safety climate construct	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
PPE safety climate	4.06	0.85	3.85	1.02	4.11	0.87	3.84	0.96
Psychosocial safety climate	3.68	1.05	3.51	1.06	3.81	1.01	3.42	1.06
Organizational priority toward COVID-19 safety	4.21	0.61	4.08	0.70	4.29	0.58	4.04	0.69
Organizational priority toward safety	4.16	0.71	4.02	0.82	4.23	0.72	3.99	0.77
Psychosocial safety climate	3.68	1.05	3.51	1.06	3.81	1.01	3.42	1.06

Note. Aggregated respondent averages by quarter for each safety climate construct on a five-point scale where 5 is the most positive perception. Between Time 1 and Time 2 were statistically significant; from Time 2 to 3 and 3 to 4 were statistically significant for psychosocial safety climate; from Time 2 to 3 and 3 to 4 were not statistically significant for the remaining three safety climate variables. Statistically significant differences between specific time points on a linear combination of the dependent variables at the $p < .001$ level.

FIGURE 1

SAFETY CLIMATE CONSTRUCTIONS

Means and standard deviations of safety climate constructs comparing workers' perceptions based on receipt of an EHMR and knowledge of their RPP.



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Cite this article

Haas, E.J., Edirisooriva, M., Furek, A. & Casey, M. (2024, May). Reusable respirators: The impact on safety climate across health settings. *Professional Safety, 69*(5), 20-26.

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