COVID-19 Early Planning, Response & Lessons in OSH

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ON JAN. 9, 2020, World Health Organization (WHO) alerted that a coronavirus-related pneumonia had been discovered in Wuhan, China; on March 11 it declared that a pandemic had resulted. This news was quickly followed by a U.S. national emergency declaration, subsequent travel bans, stay-at-home orders, and the shuttering of schools, universities and nonessential businesses (AJMC, 2020). Organizations of every description and the employees serving them have since attempted to learn how to coexist with a lethal virus that spreads easily between people and mainly through respiratory droplets (CDC, 2020). There is no modern playbook describing how to best proceed since the most recent comparable event was more than 100 years ago (Barry, 2004; Kolata, 2019). Misinformation abounds (Brennen et al., n.d.; Kouzy et al., 2020; Pennycook et al., 2020), while reliable data emerges erratically at best (Del Rio & Malani, 2020).

Those serving as OSH professionals in innumerable workplaces have been no less challenged. Their charge is the prevention of workplace injury and illness (ASSP, 2020), yet no single approach is proven best. Even the basics of infection prevention are evolving and vary depending on the source considered (American Red Cross, n.d.; CDC, 2020; WHO, 2020a).

The surest prescription by OSH professionals, of course, would be to eliminate any and all possible interactions between workers. However, such an approach proves impractical. The task, then, has been to prescribe how best to dance with a metaphorical devil such that worker infection risk is minimized as organizations continue to operate or attempt to reopen. The accepted paradigm has been that the two propositions, albeit challenged, are not mutually exclusive, although OSH professionals have had to rapidly innovate, test and revise their strategies. Learning to fly a plane even as it is being designed proves an apt analogy. Already, there are lessons to be learned. This study was undertaken to produce a baseline of OSH professional COVID-19 response, and to begin the process of capturing lessons learned. The role of pandemic planning and relative organization OSH risk were thought specifically important variables to explore.

Planning is represented by the "P" of Shewhart's plan, do, check, act model (Best & Neuhauser, 2006). W. Edwards Deming was a loyal Shewhart disciple who incorporated his mentor's thinking widely throughout his renowned career (ASQ, 2020). Not surprisingly, the concept of planning has become engrained in OSH management systems thinking and is broadly accepted as requisite to sustained OSH success (ANSI/ASSP, 2016; ISO, 2018a). A basic study premise is whether the prevalence of pandemic planning among respondents has been significant to organization success managing the current crisis. Or, more broadly, does risk management matter?

A popular risk management maxim is "the greater the risk, the more systematic must be the controls," perhaps trite, but perhaps true. Each organization is rightly responsible for assessing its own risks, developing appropriate actions and monitoring systems that ensure acceptable outcomes (ISO, 2018b). Specifically of interest is whether organizations identified as higher risk are more systematic in their approach with respect to pandemic planning. Is risk a significant variable shaping respondent organizations' current reality? Perrow (1999) is acknowledged for providing an incident severity framework that has been adapted here for categorizing respondent organization relative OSH risk.

KEY TAKEAWAYS

- **This study provides a compendium of OSH professionals' early workplace response to SARS-CoV-2, popularly recognized as the COVID-19 pandemic.**
- **A consolidated list of practices adopted for health screenings, human interaction control, barriers, touch surfaces, cleaning and disinfecting, communication, reporting and quarantine are provided.**
- **Descriptive statistics of respondent perceptions about numerous related factors are also summarized, including response adequacy and impact to normal OSH routines.**
- **A significant association was found to exist between organization relative risk level and the frequency of pandemic planning. Statistically significant results were also found for pandemic planning and availability of PPE.**

Methods

An original survey instrument was developed that incorporated accepted elements of survey design (Harvard University, 2016). It included six demographic, three short answer and 13 Likert-scale questions. Likert scales are commonly accepted in social sciences when studying population perceptions (Croasmun & Ostrom, 2011; Norman, 2010).

The study population consisted of OSH professionals tasked with actively advising or managing an organization's safety and health daily program activities during the period of approximately March through June 2020. Retirees and those working in academia were intentionally excluded. Requests for participation made of leading North American safety

BLUE PLANET STUDIO/ISTOCK/GETTY IMAGES PLUS

TABLE 1

CONSOLIDATED PRACTICES REPORTED BY SURVEY RESPONDENTS

Health screenings	Human interaction	Barriers	Touch surfaces	Cleaning/disinfecting	Communication	Reporting and quarantine
•All entry points, all personnel •Contracted screening services •Temperature checks •Badge access linked to screenings •Infrared scanning, cameras, kiosks •Self-screening •Daily questionnaires •Developed company app •PCR testing •Offshore personnel prior to transport	•Staggering shifts and breaks, additional shifts •Visitor restriction •Work-from-home policies •Virtual meetings and trainings •Phased back-to-work plan •Work process redesign, delay of select projects •Removing chairs •Implemented Microsoft Teams •Adopted "telehealth" •No face-to-face meetings or trainings, if possible •No air travel or hotel stays allowed •Additional break areas •Elevators restricted to one person •Rented portable bathrooms •Provide free individually wrapped meals	•Physical barriers in eating areas •Face mask required unless stationary and social distancing can be maintained or when working alone •Social-distancing markers (e.g., where to stand, where chairs can be placed) •Face shields •Plexiglas partitions •Shower curtains when employees work next to each other in construction environment •Manufacture of own ASTM level 1 equivalent face masks	•Opening of all doors to reduce contact •Single-use packaging (e.g., ear plugs, sugar packets) •Installation of hands-free foot door pulls and other devices •Time clock changed to swipe system from key entry •Electronic form screening •Hands-free testing tablets	•Hiring of additional cleaning personnel •Hand sanitizer stations •Disinfectant wipes stations •Electrostatic cleaning •Ultraviolet lighting at high-traffic areas •Post-cleaning swab (ATP) testing •Portable disinfection misting devices	•Awareness training for all personnel prior to entry •Intensive employee communication efforts •Additional newsletters, brochures, postings, handouts •Leaders visible, available to answer questions •Signage describing precautions •Reinforcing a clear vision •Internal communications software •Daily blast emails •Cross-functional pandemic response team formed	•Procedures established •Self-quarantine and return-to-work rules published •Renegotiated union agreement specific to COVID-19 procedures •Mandatory leave if confirmed case or exposed to confirmed case •Mock COVID-19 drills to identify response gaps •Contact tracing procedures •Configuring badge system for use in contact tracing

foundations specifically for provision of select member data to maximize population size were either not answered or provided. Therefore, the survey instrument was distributed using the means immediately available to the researchers. This included supervisors of OSH student interns enrolled in Murray State University's OSH program, ASSP Region VI and VII members, and North Carolina Manufacturers Association members. A posting was additionally placed on the ASSP Community site to further solicit respondents. The researchers also forwarded the survey to OSH professionals directly or indirectly known to them. Recipients were further encouraged to share the survey link with other OSH professionals to maximize study participation. A study limitation, therefore, is that all statistical results provided herein are valid for the response population only. All respondents were asked to respond to all items and all responses were anonymous. No identifying email or other information was collected. Respondents were limited to one submission. This survey and study were approved by the Murray State University Institutional Review Board.

Descriptive statistics were utilized to characterize population proportions (Sullivan & Artino, 2013). Additional statistical tests included chi-square test of association and Kruskal-Wallis H test to determine significance of select survey data using an alpha level of .05 unless otherwise specified. All requisite assumptions were tested as commonly accepted (Lund & Lund, 2020).

Results

Demographics

Survey response was 113. Among the respondents, 40% work predominantly in manufacturing (n = 45), 24% construction (n = 27), 7% agriculture (n = 8), 4% (each) health services, mining and transportation (n = 5), and 3% utilities (n = 3). All other respondents represented industries comprising less than 1% of the total response population or otherwise did not identify with any of the industrial classification choices provided. Of the respondents, 46% are managers (n = 52), 23% directors (n = 26), 8% supervisors (n = 9), 6% technicians (n = 7), 4% (each) executive and consultant (n = 4), and 10% other (n = 11).

TABLE 2

RESPONDENT ORGANIZATIONS' RELATIVE OPERATIONAL SAFETY & HEALTH RISK

Level	Serious workplace incident likelihood vs. task performance	*n*	%
1	Likely only to affect those directly participating	31	27%
2	Could affect both those directly participating and those in the immediate area	39	35%
3	Capable of impacting the public	20	18%
4	Long-term and significant societal impact (e.g., environmental disaster potential)	17	15%
5	Unable to answer or not applicable	6	5%
	N	113	100%

Qualitative Data

Respondents were given the opportunity to freely describe best practices (e.g., technology, screening services, administrative controls) implemented as part of their COVID-19 response. A predefined list was not provided. Table 1 consolidates respondent input without regard to frequency of observation. Some, but not all, of the items listed by the respondents were coincidently evaluated as part of the complete survey and are further reported in the descriptive and statistical tests sections.

Descriptive Statistics

Table 2 illustrates how respondents judged their organization's relative operational OSH risk. The lowest risk level is associated with the lowest numeric level value. Table 3 (p. 34) provides the proportions for respondent organization pandemic planning before March 2020. Table 4 (p. 34) portrays respondent proportion for preshift health screenings by screening type confirmed.

Table 5 (p. 34) reports respondent perceptions of the impact of the COVID-19 pandemic on normal organization opera-

TABLE 3
PANDEMIC PLAN PREPARED

Plan status	*n*	%
Yes	51	45%
No	57	50%
Unable to answer	5	4%
N	113	100%

TABLE 4
PRESHIFT WORKFORCE SCREENINGS

Items	*n*	%
Not performed	13	12%
Questionnaire only	16	14%
Temperature or thermal scan only	20	18%
Questionnaire and temperature or thermal scan	63	56%
Pulse oximeter test only	0	0%
Unable to answer	1	1%
N	113	100%

TABLE 5
IMPACT UPON NORMAL OPERATIONS

Worker area	*n*	%	Sum
Very negative	16	14%	
Negative	37	33%	
Neither negative nor positive	42	37%	
Positive	14	12%	14%
Very positive	2	2%	
Unable to judge	2	2%	
N	113	100%	

TABLE 6
ADEQUATE WORKER PREVENTIVE EXPOSURE ACTIONS TAKEN

Confidence	*n*	%	Sum
Very unconfident	1	1%	
Unconfident	7	6%	
Neither unconfident nor confident	16	14%	
Confident	46	41%	78%
Very confident	42	37%	
Unable to judge	1	1%	
N	113	100%	

tions. Table 6 illustrates respondent confidence about efforts to adequately protect workers from COVID-19 infection in the workplace. Table 7 portrays the types of communication perceived as most effective for providing workers regular information updates. Figure 1 (p. 36) provides consolidated data in which respondents reported their level of agreement to:

- organizations' routine OSH program requirements being maintained,
- adequate PPE supplies being maintained,
- effective tracing procedures for possibly exposed workers being implemented,
- control of exposed or symptomatic workers,
- effective referral process for symptomatic or exposed workers being implemented, and
- social distancing implemented per then-current CDC guidelines.

Figure 2 (p. 36) consolidates data in which respondents report the degree that activities have been implemented in all work areas or for all workers, including:

- scheduling of workers to minimize their physical interaction,
- Adenosine Triphosphate (ATP) testing to confirm cleaning and disinfecting effectiveness,
- increased sanitation and cleaning,
- worker safe practices training, and
- face coverings per CDC guidelines.

Table 8 (p. 37) summarizes the reported early response improvement opportunities by frequency of comment.

Statistical Tests

Chi-Square Test of Association

A chi-square test of association was conducted to determine whether a significant relationship exists between the categorical variables of respondent organizations' relative OSH risk level (see Tables 2, p. 33, and 3, respectively) and respondent organization pandemic planning. A statistically significant association exists between organization risk level and pandemic planning: χ^2 (3) = 8.254, p = .041, Cramér's V = .284, p = .041. A review of cross-tabulation data demonstrates a positive correlation between higher-level risk organizations and the prevalence of pandemic planning. Lower-level risk organizations reflect pandemic planning below expected counts; level 3 risk level organizations completed pandemic planning in accordance with expected counts; and level 4 (highest risk) organizations completed pandemic planning above expected counts.

Kruskal-Wallis H Test

A Kruskal-Wallis H test is a rank-based nonparametric test that can be used to determine whether statistically significant differences exist between two or more groups (Lund & Lund, 2020). Two such tests were conducted. The first was to determine whether organization relative risk (Table 2, p. 33) results in significant differences in respondents' perception of the pandemic's impact to operations, availability of PPE, continuance of safety routines and confidence in worker protective measures. None were statistically significantly different between groups (i.e., there is no relationship found between organization risk level and the variables of impact to operations): χ^2 (4) = 6.277, p = .179; PPE availability: χ^2 (4) = 1.214, p = .876; safety routine continuance: χ^2 (4) = 4.354, p = .360; and confidence about worker protective measures: χ^2 (4) = 3.831, p = .429.

A second test was conducted to determine whether pandemic planning resulted in significant differences in respondents' perception of the pandemic's impact to operations, availability of PPE, continuance of safety routines and confidence in worker protective measures. There was no relationship found between the presence of pandemic planning and safety routine continuance: χ^2 (2) = .225, p = .894; or confidence about worker protective measures: χ^2 (2) = 1.850, p = .397. However, statistically significant relationships were demonstrated between the presence pandemic planning and lessened impact to operations: χ^2 (4) = 6.141, p = .046; and needed PPE actually being available: χ^2 (2) = 8.887, p = .012. A visual inspection of boxplots demonstrated that distributions of scores were similar for the impact to operations but

TABLE 7
COMMUNICATION METHODS MOST EFFECTIVELY USED TO REGULARLY UPDATE ALL EMPLOYEES

Method type	*n*	%
Video conferencing	26	23%
Common area postings or monitor messaging	19	17%
Email or texts	19	17%
Web page	17	15%
Social media	16	14%
Team meetings	6	5%
Supervisor individual contacts	5	4%
In-house e-learning	3	3%
Not answered	2	2%
N	113	100%

not for PPE availability. Thereafter, pairwise comparisons were performed using Dunn's 1964 procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented below for impact to operations and PPE availability criteria.

Impact to operations: Post hoc analysis revealed statistically significant differences between those who answered that no pandemic planning was conducted (*Mdn* = 2.0) and the unable to judge whether pandemic planning was performed (*Mdn* = 3.0) groups, but not between any other group combination. Statistical significance was accepted at the $p < .048$ level.

PPE availability: This post hoc analysis revealed statistically significant differences between the no (no pandemic planning was conducted) responses (Mean rank = 3.1404) and the yes (pandemic planning was conducted) groups (Mean rank = 3.7843). Statistical significance was accepted at the $p < .009$ level.

Discussion

Respondent organization relative risk was found to be significantly associated with organization pandemic planning. Higher risk organizations planned at greater-than-expected frequency versus lower risk organizations that planned at a lower-than-expected frequency. The tests completed for this study indicate that an important material benefit of higher risk organizations' planning efforts may have been demonstrated in the continued availability of required PPE. PPE shortages were especially dire in the early crisis weeks and necessarily caused considerable challenges to OSH professionals then and subsequently (Kamerow, 2020; Livingston et al., 2020). Note that pandemic planning was frequently identified by respondents as one of their greatest improvement opportunities, along with communication and the reliability of supplies. The latter two opportunities can be argued to be more likely to be achieved had adequate pandemic planning been undertaken. The importance of planning has generally been affirmed herein.

Respondents are broadly confident (agree or strongly agree responses > 80% of all responses) about their successes with:

- social distancing implementation,
- reliable referral of symptomatic or exposed workers,
- prevention of (known) exposed or symptomatic workers from reentering the workplace,
- COVID-19 safe work practices training for affected personnel, and
- increased sanitation and cleaning practices.

Not listed above but perhaps inferential to confidence about preventing sick or (known) exposed worker (re)entrance into the workplace is the reliance (56% of all respondents confirmed) upon both questionnaires and thermal scans. The utility of thermal screening has been challenged, however (Gostic et al., 2020; WHO, 2020b), and the increased recognition that "silent spreaders" may disproportionately propagate the COVID-19 virus (Apuzzo et al., 2020), if upheld, might significantly discount the utility of thermal checks. Related, many respondents report that their organizations have developed in-house web applications for employees to electronically complete wellness questionnaires, thus automating the process and eliminating additional touch hazards that exist when transacting paper forms. The phenomenon of "pencil-whipping," however, has been well described in an OSH context (Ludwig, 2014). Can we reliably trust the completed self-reported questionnaire data, day after day, week after week? There is inadequate peer-reviewed research at present to make conclusions on either point.

One item not adopted by a single respondent for preshift medical screening is that of pulse oximetry, which measures blood oxygen saturation (Bibuyck, 1989). Low-cost devices are widely available, and phone application-based systems have been shown to provide valid, reliable results (Losa-Iglesias et al., 2016); in addition, the benefits of pulse oximetry data are accepted (Fahy et al., 2018). The item was included in the survey instrument due to reports of emergency room physicians observing suspected COVID-19 patients to be in states of severe hypoxia (i.e., oxygen saturation levels less than 85% when 95% reflects normal oxygen saturation; Real First Aid, n.d.). These patients have presented asymptomatically, however, when significant distress should be expected (Couzin-Frankel, 2020). The term used to describe these patients is "happy-hypoxics." OSH professionals should at least be aware of the phenomenon, consult with their medical advisors and explore the utility of incorporating some form of related preshift screening, if indicated.

Respondents were less confident (agree or strongly agree responses > 40%, < 80% of all responses) about their successes with:

- the likelihood that enough is being done to adequately protect workers,
- face covering being used per CDC guidelines,
- capacity to effectively trace possibly exposed workers,
- affecting scheduling changes to minimize worker interaction, and
- maintaining adequate PPE supplies.

The benefit of face coverings continues to be debated (Bai, 2020; Brosseau & Sietsema, 2020). Studies will certainly be conducted for many post-pandemic years to derive the real benefit of their use for COVID-19 prevention. Known is that the spread of the disease is multimodal, but increasingly the mechanism of spread via respiratory droplets receives greatest import (CDC, 2020). Ensuring that face coverings are used per current guidelines will be a daily challenge for OSH professionals, but they may provide protection not otherwise probable. Moreover, minimizing worker interactions remains a higher leverage control deserving of continued creative focus.

Respondents were least confident (agree or strongly agree responses < 40% of all responses) about their successes with

FIGURE 1

RESPONDENT QUESTIONS: AGREEMENT PROPORTIONS

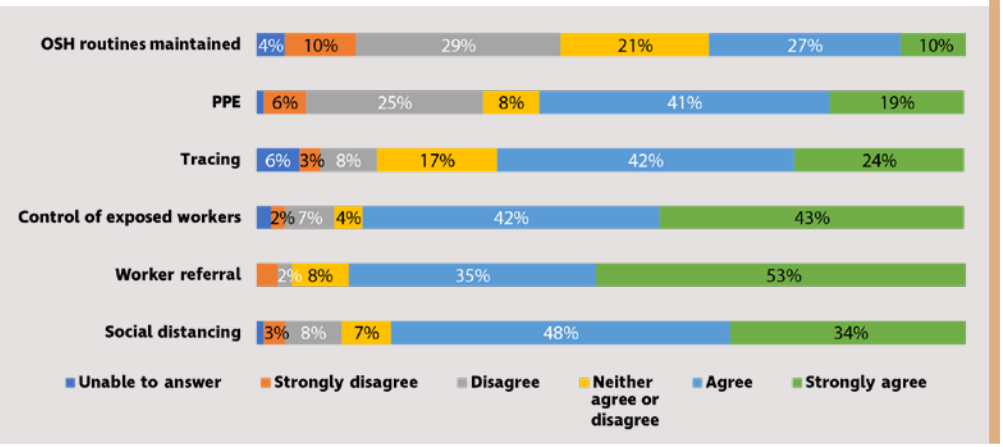
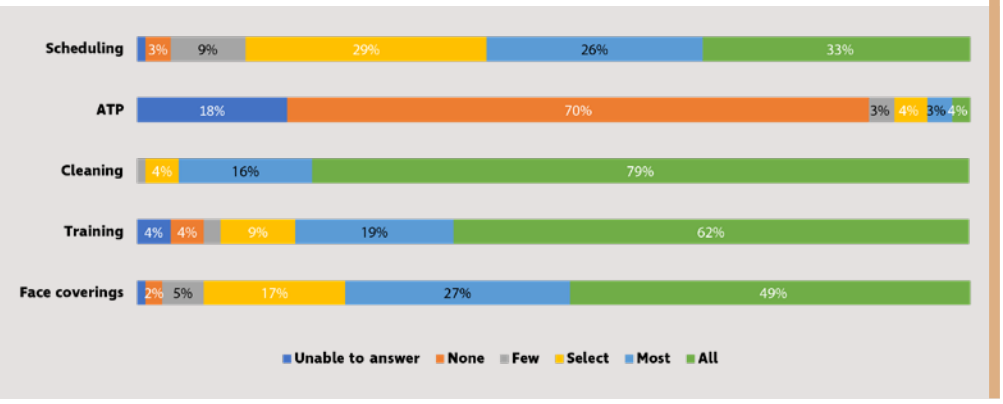


FIGURE 2

PROPORTION OF WORK AREAS OR WORKERS AFFECTED



routine OSH program requirements not being disrupted and the impact of the pandemic on normal operations.

It is difficult to imagine any facet of any organization's routine operations not having been significantly disrupted by this crisis. However, serious injury and fatality prevention can never be far from the OSH professional's sight. Its integrity is dependent upon the maintenance of critical procedures during high-risk activities (e.g., work at heights, confined space entry, energy control; Wilbanks, 2013), the hazards of which are indifferent to a concurrent pandemic. Regular audit of critical OSH routines is recommended to minimize drift from expected standards.

Among respondents, 95% are confident that increased cleaning activities have been implemented for most or all work areas. Yet the majority of respondents (86%) have not adopted ATP testing to confirm disinfecting effectiveness or were unable to judge whether it had been adopted. There is significant evidence of the usefulness of ATP testing to confirm the effectiveness of disinfecting activities (Boyce et al., 2009; Moore et al., 2010; Smith et al., 2014). Lillis (2015) writes that ATP "measures organic matter that may remain after a surface, device or piece of equipment is cleaned" (p. 5) and that:

> ATP is an enzyme that is present in all organic matter—living and once-living—including blood, saliva and bacteria. Essentially, the person conducting ATP monitoring swabs the surface to be tested and inserts that swab into a handheld unit called a luminometer. Results are available within seconds. (p. 5)

ATP testing provides an economical means to objectively test whether cleaning activities are, indeed, effective. Consideration of incorporating an ATP testing strategy may be indicated to justify OSH professionals' related confidence.

Conclusion

This study surveyed practicing OSH professionals who actively advised organizations in the early months of the COVID-19 pandemic. The goal met was to understand their first response efforts, the degree to which they were observed, their perceptions of their successes and improvement opportunities, and also to test for statistically significant relationships between responses. Larger and longer-term studies are required to determine whether the results reported herein are confidently generalizable to OSH state-of-the-art practice. Related, it is suggested that further research would be useful to specifically understand the methods used by higher risk organizations to facilitate pandemic planning and the relative benefits derived. It is also suggested that further study be conducted to determine whether this study's respondents' high confidence about the adequacy of worker exposure preventive actions was ultimately well-founded.

It is hoped this sharing of early experience allows the many who are still actively pioneering to more efficiently learn, adapt and adopt as the crisis continues to unfold. It is also hoped that it might minimally serve as an early lesson compendium, the utility of which will only be finally understood in a post-pandemic reality. **PSJ**

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TABLE 8

PERCEIVED GREATEST IMPROVEMENT OPPORTUNITIES

Opportunities	% of comments
Pandemic response planning	37%
Improved pandemic communication	20%
Reliable supplies (e.g., PPE)	19%
Screening and testing procedures	10%
Social/physical distancing	6%
Telework guidelines	6%
Disinfection procedures	2%
Total	100%

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