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Availability of personal protective equipment and infection prevention supplies during the first month of the COVID-19 pandemic: A national study by the APIC COVID-19 task force

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Background: SARS-CoV-2, the virus that causes COVID-19 disease was first discovered in China in December, 2019. The disease quickly spread globally, with the first U.S. case identified in January, 2020; it was declared a pandemic on March 11, 2020. Soon after, anecdotal reports indicated that many US hospitals and healthcare facilities were running low on personal protective equipment (PPE) and supplies.

Methods: An online survey was administered to all Association for Professionals in Infection Control and Epidemiology members in March, 2020 to assess access to PPE, hand hygiene products, and disinfection supplies.

Results: In all, 1,201 infection preventionists participated. Participants reported running a bit low to almost being out of all PPE types. More had sufficient gloves (63.4%) compared to all other PPE types (\(p < .001\) for all). Face shields and N95 respirators were the least available (13.6% and 18.2% had sufficient supplies, respectively; \(p < .001\) for all). Many (66.9%) had sufficient hand soap, but far fewer had sufficient hand sanitizer (29.5%, \(X^2 = 211.1, p < .001\)). Less than half (45.4%, \(n = 545\)) had sufficient disinfection supplies.

Conclusions: Many US healthcare facilities had very low amounts of PPE, hand hygiene products, and disinfection supplies early on during the pandemic. A lack of these supplies can lead to occupational exposures and illness as well as healthcare-associated transmission of COVID-19 and other diseases.

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METHODS

This study consisted of a survey provided to all members of the Association for Professionals in Infection Control and Epidemiology (APIC; ie, a convenience sample) via Gravity Forms, an online survey software program. The survey was open from March 23 to 25, 2020. A single recruitment email and/or announcement was sent via an APIC newsletter. Members of the APIC COVID-19 Task Force developed the survey. The survey contained 14 questions plus demographic items. A Likert-type scale was used to assess participants’ current access to various types of PPE, including N95s, masks, face shields, goggles, gloves, isolation gowns, and hand hygiene and disinfection supplies. Answer options included have plenty, have sufficient amount, running a bit low, almost out, and have none. Participants were also asked a series of dichotomous questions regarding whether they had accessed supplemental PPE from outside sources, such as the Strategic National Stockpile (SNS), local or state resources, private donations, or do-it-yourself (DIY) efforts (0 = no; 1 = yes). The data was collected by APIC staff and then shared with the authors to conduct a secondary data analysis. The Saint Louis University Institutional Review Board determined that this was not human subjects research.

Data analysis

The Statistical Package for the Social Sciences (SPSS) 26.0 was used for all analyses. A dichotomous variable was calculated for each type of PPE and hand hygiene or disinfection supply, with running a bit low, almost out, and have none = 0/no, and have plenty and have sufficient amount = 1/yes. Descriptive statistics were computed for each question and used to describe the extent to which participants had access to PPE and/or hand hygiene and disinfection supplies. Chi square tests were used to compare all dichotomous groups, such as having access to each type of PPE and/or receiving supplemental PPE from different sources. A chi square goodness of fit test was used to compare regional response percentages by US census data. A p value of .05 was used for all analyses.

RESULTS

In total, 1,201 infection preventionists completed the survey. There were participants from all states and US territories. There were slightly more participants in the Midwest and slightly fewer in the West than would be expected compared to U.S. census data for those regions (X² = 48, P < .05; Table 1). The majority of respondents were infection preventionists (87.3%, n = 1,048) vs being a system Director or working for a corporate healthcare system (Table 1). Most (84%, n = 1,009) work at a single facility; 16% (n = 192) cover more than one healthcare facility type (Table 1). Over half (64.9%, n = 780) work in a hospital. About a third (34.0%, n = 408) worked at small-sized hospitals and/or facilities having 50 or fewer beds; 21.6% (n = 260) worked at one of the large-size hospitals and/or facilities with 301 or more beds (Table 1).

PERSONAL PROTECTIVE EQUIPMENT AVAILABILITY

Participants were asked about their current availability of various PPE types, including N95 respirators, masks, face shields, goggles, gloves, and isolation gowns; responses are outlined in Table 2. Participants reported running a bit low to almost being out of all types of PPE (Table 2). Participants were more likely to report having sufficient gloves (63.4% had sufficient amount) compared to all other PPE types (P < .001 for all comparisons; Table 2). Face shields and N95 respirators were the least available PPE types (only 13.6% and 18.2% had sufficient amounts, respectively; P < .001 for all comparisons; Table 2).

Participants were also asked whether they had received supplemental PPE from outside sources, such as local, regional, or federal sources, private donations, or DIY. Half 52.0%, (n = 624) reported receiving PPE from local or state sources, 44% (n = 528) from private donations, 30.7% (n = 369) DIY, and 22.2% (n = 267) from the SNS. Participants were significantly more likely to have received supplemental PPE from any source compared to receiving it from the SNS (P < .001 for all comparisons).

Availability of multiple PPE items was found to vary by facility type. Facilities consisting of 50 or fewer beds and ambulatory care facilities were significantly more likely to have sufficient N95 respirators compared to larger-sized facilities and those that do not have an ambulatory care facility (P < .01 for both). Critical access hospitals were more likely than other facilities to report having sufficient N95 respirators (33.1% vs 16.3%, X² = 22.7, P < .001). Hospitals, urgent care centers, and dialysis facilities were less likely to have sufficient masks (P < .01 for all). Critical access hospitals were more likely than other facilities to report having sufficient masks (28.7% vs 20.0%, X² = 5.5, P < .05). Hospitals and long-term care facilities were less likely than other agencies to have sufficient face shields (P < .05 for both). Hospitals were less likely than other facilities to report having sufficient goggles (20.5% vs 27.9%, X² = 8.8, P < .01). Home health agencies were significantly less likely than other healthcare agencies to report having sufficient gloves (28.6% vs 63.8%, X² = 7.4, P < .01). Gown availability did not vary by facility type.

AVAILABILITY OF HAND HYGIENE PRODUCTS AND DISINFECTION SUPPLIES

Participants were asked about their current availability of hand soap, hand sanitizer, and disinfection supplies; responses are outlined in Table 2. Participants reported running a bit low to almost having sufficient amounts of hand hygiene products (Table 2). Participants were significantly more likely to report having sufficient hand
many healthcare facilities without adequate PPE.15 It is notable that in this study, many US healthcare facilities had obtained supplemental PPE from outside sources yet still reported significant deficiencies in PPE availability. Although local, state, and federal stockpiles exist, they are intended to be supplemental and were not sufficient to aid in response to COVID-19. In early April, just 1 month into the pandemic, the SNS had deployed more than 90% of its stockpiled PPE.16 In this study, less than a quarter of the infection preventionists reported receiving PPE from the SNS, despite the very high number of facilities lacking PPE. Experts have recommended that the US invest in development and testing of PPE and replenishing of the SNS in order to meet the needs of US healthcare facilities during COVID-19 and future events.4 In addition, healthcare facilities should closely monitor their PPE stocks, use the CDC’s PPE burn rate calculator to estimate when supplies will run low, and implement PPE crisis standards of care sufficiently early to prevent depletion of supplies. When PPE crisis standards of care are not implemented, respirators, masks, and isolation gowns will be quickly depleted due to the high number of healthcare personnel who need to use them and the single-use nature of this PPE. However, even with crisis standards of care in place, PPE may be quickly depleted if huge healthcare surge and/or when supply chain disruptions occur.

Another critical finding in this study was that over half of participating healthcare facilities reported lacking sufficient disinfection supplies. Environmental disinfection is essential to prevent the spread of COVID-19, as there is a risk of transmission from contaminated sources.17 Research indicates the SARS-CoV-2 can survive on some environmental surfaces for hours to days; thus, disinfection is important to reduce contamination that might contribute to disease spread.18 In addition, healthcare environmental disinfection is critical to prevent the spread of multidrug resistant organisms and other pathogens that can be spread through contact transmission. A lack of disinfection supplies could contribute to increased rates of healthcare associated infections or occupational exposures to diseases and/or conditions beyond just COVID-19.

Table 2.
Access to personal protective equipment, hand hygiene products, and disinfection supplies

| N = 1,201 |
|---------------------------------------------------------------|
| Current amount available | Have none % (n) | Almost out % (n) | Running a bit low % (n) | have sufficient amount % (n) | Have plenty % (n) | Has sufficient amount (yes/no) % (n) |
|---------------------------------------------------------------|
| Personal protective equipment | | | | | | |
| Gloves | 2.7 (.72) | 0.2 (3) | 4.8 (58) | 31.6 (379) | 53.9 (647) | 9.5 (114) | 63.4 (761) |
| Isolation gowns | 2.1 (.84) | 1.4 (17) | 22.9 (275) | 44.0 (529) | 28.4 (341) | 3.2 (39) | 31.6 (380) |
| Masks | 1.9 (.78) | 1.0 (12) | 30.7 (369) | 47.3 (568) | 19.1 (229) | 1.9 (23) | 21.0 (252) |
| Goggles | 1.8 (.97) | 1.0 (12) | 28.1 (338) | 37.2 (447) | 22.0 (264) | 1.7 (21) | 23.7 (285) |
| N95 respirators | 1.5 (1.0) | 20.7 (249) | 27.7 (333) | 33.3 (400) | 17.3 (208) | 0.9 (11) | 18.2 (219) |
| Face shields | 1.5 (.90) | 12.7 (152) | 36.3 (436) | 37.5 (450) | 13.1 (157) | 0.5 (6) | 13.6 (163) |
| Hand hygiene & disinfection supplies | | | | | | |
| Hand soap | 2.7 (1.74) | 0.3 (4) | 5.0 (60) | 27.7 (333) | 55.9 (671) | 11.1 (133) | 66.9 (804) |
| Disinfection supplies | 2.3 (.82) | 0.6 (7) | 15.6 (187) | 38.5 (462) | 40.0 (480) | 5.4 (65) | 45.4 (545) |
| Hand sanitizer | 2.0 (.84) | 2.5 (24) | 25.1 (302) | 42.9 (515) | 27.5 (330) | 2.0 (24) | 29.5 (354) |

*0 = have none; 1 = almost out; 2 = running a bit low; 3 = have sufficient amount; 4 = have plenty
CONCLUSION

This study found that US healthcare facilities had very low amounts of PPE, hand hygiene products, and disinfection supplies just 1 month into the COVID-19 pandemic. This was partially due to healthcare surge as well as a lack of crisis standards of care for PPE and breaks in supply chain caused by the pandemic. PPE is worn by healthcare workers to prevent the transmission of healthcare acquired infections and protect against occupational exposures. When healthcare workers do not have PPE, the opportunity for transmission of healthcare acquired infections is increased, creating unsafe work environments and unsafe patient care. This study shed light on the critical lack of PPE in US healthcare facilities at a time when healthcare workers needed it most. These gaps in stockpiling and planning need to be addressed before the next major pandemic wave or event; failure to do so will result in excess healthcare associated infection and more occupational exposures and illness.

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A few limitations of this study must be noted. Limitations include the potential issue of responder bias. Non-responders may not have been interested in the survey if their facility was not experiencing patient surge challenges. Alternatively, infection preventionists whose facilities were experiencing overwhelming patient surges may not have had the time to complete the survey or even known that it had been distributed. Another limitation is that infection preventionists’ interpretation of “running a bit low” vs “have a sufficient amount” may have differed, though this is impossible to determine. This makes interpretation of the data somewhat challenging. One final limitation is that only APIC members were invited to participate. Therefore, the findings may not be representative of all healthcare facilities as ~ 65% of respondents worked in a hospital. More research is needed to determine PPE supply and sources for US outpatient care facilities, such as ambulatory care and long-term care facilities.

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