Infection Prevention in Practice 6 (2024) 100369

Available online at www.sciencedirect.com

Infection Prevention in Practice

journal homepage: www.elsevier.com/locate/ipip

Adherence to Personal Protective Equipment practices during the COVID-19 pandemic: A pilot study

Taryn B. Amos [a], Cameron Griffin [b], Joshua K. Schaffzin [c,d], Andrea Ankrum [b], Felicia Scaggs Huang [c,d,*]

[a] Department of Psychology, Old Dominion University, Norfolk, USA
[b] Infection Prevention & Control Program, Cincinnati Children's Hospital, Cincinnati, USA
[c] Division of Infectious Diseases, Cincinnati Children's Hospital, Cincinnati, USA
[d] Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, USA

ARTICLE INFO

Article history:
Received 14 December 2023
Accepted 17 April 2024

Keywords:
Personal protective equipment
PPE adherence
COVID-19 pandemic
Healthcare worker

SUMMARY

A direct observational pilot project of healthcare personnel (HCP) was conducted to validate a tool that measures personal protective equipment (PPE) adherence at a large pediatric institution. Overall unit PPE adherence for all moments ranged from 50–61%. Masking was the most adhered to PPE moment (100%); hand hygiene prior to donning PPE had the lowest adherence (13%). Using data from this standardized tool, researchers can evolve PPE standards to maximize their adherence, effectiveness, and ease of utilization.

Background

Current standards for optimal PPE utilization for transmission based precautions (TBP) in healthcare in a post-pandemic environment are inadequate. Facilities have long struggled to balance its financial burden, contribution to environmental waste, and effectiveness. The changing landscape in healthcare, such as with the emergence of the novel pathogen, SARS-COV-2 introduced more complexity in the system [1–4]. Healthcare personnel (HCP) choices and beliefs are core drivers of PPE use. New policies affect recommendations for PPE but may not be followed if deemed impractical by HCP who are end users. We conducted a pilot project to validate a novel observation tool and scoring scheme of HCP PPE adherence, as a first step to ultimately address these issues.

Methods

This pilot observational study was performed in three Intensive Care Units (pediatric, neonatal, and cardiac) and a Bone Marrow Transplant (BMT) unit at a large quaternary pediatric hospital from June 7 – July 27, 2022. HCP caring for patients in transmission-based precautions (TBP), identified using the electronic medical record (EMR), were observed. We defined adequate hand hygiene (HH) as per the World Health

* Corresponding author. Address: 3333 Burnet Ave MLC 5019, Cincinnati, OH, 45229, USA. Tel.: +1 513 636-0108; fax: +1 513 636-7658.
E-mail address: felicia.scaggshuang@cchmc.org (F. Scaggs Huang).

https://doi.org/10.1016/j.infpip.2024.100369
2590-0889/

Table I
Transmission-based precaution (TBP) types and their PPE requirements

	Contact	Contact Enteric*	Strict Contact	Droplet	Strict Droplet**
Hand Hygiene Prior to Donning PPE	+	+	+	+	+
Face Mask	+	+	+	+	+
Gown	+	+	+	−	−
Gloves	+	+	+	−	−
Proper Eye Protection	−	−	−	+	+
Hand Hygiene Upon Room Exit	+	+	+	+	+
Mask Changed Upon Room Exit	−	−	−	+	+

A "+" designates a requirement while "-" designates not a requirement. *Hand washing with soap and water required upon exit.

**N-95 respirator required for aerosol generating procedures. SP: Standard Precautions (7).

Table II
Percent adherence of PPE moments observed

Moment	NICU n = 57	PICU n = 58	CICU n = 55	BMT n = 56
Room Entry	**13%**	**3%**	**24%**	**37%**
HH performed prior to donning PPE	13%	3%	24%	37%
Within Room	**76%**	**67%**	**73%**	**77%**
Face mask worn properly	100%	100%	100%	100%
Gown worn properly	61%	70%	70%	76%
Eye Protection worn properly	50%	18%	20%	16%
PPE doffed prior to exiting the room	63%	61%	66%	76%
Room Exit	**44%**	**29%**	**33%**	**30%**
HH performed upon exit	41%	36%	44%	34%
Mask Changed upon exit	100%	17%	14%	21%
Total	**59%**	**51%**	**57%**	**61%**

Note: Percent adherence of PPE moments were based on isolation type requirements.

Organizations five moments [5,6], and Contact and Droplet isolation requirements by the Centers for Disease Control and Prevention guidelines [6].

We collected observations using Power Apps® (Microsoft Corporation, Redmond, WA) with trained anonymous research personnel. The application was developed so multiple concurrent isolation types could be evaluated based on the minimum appropriate 'PPE moments' for the highest level of protection. The 'PPE moments' including HH prior to room entry; proper face mask, gown, glove, or eye protection use as per CDC definitions; doffing PPE in the patient room; and HH when exiting the room (Table I). For droplet precautions, because universal masking was in place during the study period, we scored changing the face mask upon room exit.

The scored data was visualized with PowerBI® (Microsoft Corporation, Redmond, WA) via a scoring matrix so adherence could be calculated for individual isolation types as well as for all concurrent isolation types (e.g., strict droplet and contact isolation for a single patient). When summarizing data for a given TBP, only elements applicable to that isolation type were included in the calculation, even if a patient had multiple isolation types ordered. We performed descriptive statistics by calculating percent adherence by all observed PPE moments, observations with complete adherence (defined as 100% adherence for all observed moments), and individual PPE moments. We also stratified the data by HCP role, isolation type and unit. PPE moments were considered "N/A" and not included in the percent adherence calculation if they were not

Table III

Percentage of complete PPE adherence by HCP and TBP

Observations	NICU	PICU	CICU	BMT
HCP Type	**Total HCP Observed (n = 57)**	**Total HCP Observed (n = 56)**	**Total HCP Observed (n = 56)**	**Total HCP Observed (n = 55)**
Registered Nurse (RN)	16% (n = 32)	9% (n = 34)	22% (n = 36)	16% (n = 32)
Nurse Practioner (NP)	100% (n = 1)	0% (n = 1)	0% (n = 0)	0% (n = 0)
Physician	0% (n = 3)	0% (n = 5)	0% (n = 1)	100% (n = 2)
Direct Patient Care Staff (PCA, OTPT, Transporter, Pharmacist, Pharmacy Technican) **	0% (n = 1)	0% (n = 1)	50% (n = 2)	29% (n = 7)
Clinical Support Staff (Child Life, HUC, EVS)**	0% (n = 2)	33% (n = 3)	0% (n = 1)	0% (n = 3)
Patient Care Therapist (Speech Therapist, Respiratory Therapist)	50% (n = 2)	0% (n = 1)	0% (n = 0)	0% (n = 1)
Other *	31% (n = 16)	30% (n = 10)	19% (n = 6)	50% (n = 10)
Isolation Type	**Total Observed Isolation Type (n = 57)**	**Total Observed Isolation Type (n = 56)**	**Total Observed Isolation Type (n = 56)**	**Total Observed Isolation Type (n = 55)**
Droplet	0% (n = 0)	9% (n = 23)	0% (n = 20)	0% (n = 16)
Contact	21% (n = 57)	15% (n = 53)	24% (n = 51)	39% (n = 23)
Contact Enteric	0% (n = 7)	0% (n = 3)	0% (n = 7)	22% (n = 36)
Strict Droplet	67% (n = 3)	14% (n = 14)	17% (n = 6)	0% (n = 3)
Strict Contact	0% (n = 0)	0% (n = 0)	0% (n = 0)	40% (n = 10)

Note: "complete" is defined as defined as 100% adherence for all observed moments. *Other classifies HCP positions that could not be identified. **Patient Care Assistant (PCA), Environmental Services (EVS), Health Unit Coordinator (HUC), Occupational Therapy and Physical Therapy (OTPT). Note: Patients could be under multiple isolation precautions simultaneously.

observed directly as not all moments needed to be scored for the observation to be submitted. Patients that were under multiple isolation precautions were scored separately for each isolation type.

Results

Overall, proper face mask use was the most adhered-to moment (Table II). HH prior to donning PPE in NICU (13%) and PICU (3%), mask changed when exiting in CICU (14%), and proper eye protection in BMT (16%) were least adhered-to. For all observed PPE moments, PICU (51%) and BMT (61%) had the lowest and highest adherence, respectively (Table III).

Registered nurses (RNs) comprised 60% of observed HCP (n = 134) and had the lowest total adherence of all PPE moments (16%). HCP classified as 'Other' comprised 24% of observed (n = 52) and had the highest total adherence (31%).

Contact isolation was most frequently observed (184, 55% of observations) followed by contact enteric (59, 18%), droplet (53, 16%), strict droplet (26, 8%), and strict contact (10, 3%). Strict contact isolation had the highest adherence (40%).

Discussion

We developed an observation tool to measure adherence to TBP policies by HCP across different units. Our observations revealed low PPE adherence regardless of unit, HCP or isolation type. This held true for patients with COVID-19, who might be expected to have higher adherence based on published data for dedicated COVID-19 units compared to the mixed-diagnosis units in our study [7,8]. It is possible that local efforts before and during the COVID-19 pandemic to increase adherence (such as monitoring programs, real-time feedback on non-adherence and using a buddy system) waned over time, despite required annual HH and PPE use training for clinical HCP [3,4,7,9,10]. Although other studies evaluated electronic and paper audit systems for PPE adherence, the instruments themselves were not shared in the publications and PPE monitoring has not become integrated into the routine work of Infection Prevention and Control programs [11–14]. Our transparent and standardized tool can be utilized to further understand HCP PPE use.

Our observed low adherence may be explained by several factors. Pandemic-related burnout has been cited as a driver of HCP's failure to follow institutional standards [15]. Burnout experienced by our workforce is prevalent due to abnormally high patient volumes and acuity, staffing shortages and elevated staff turnover. An influx of new providers coupled with a lack of PPE education and expectations may also contribute. Additionally, our institution's low healthcare associated infection rate may falsely assure staff that current suboptimal PPE use is sufficient.

This study was limited by a small sample size and short duration, which limits results generalizability. However, since our observation tool is based on CDC guidance and our site serves a diverse local and international patient population, it may still be applicable to others' experiences. Observations were performed during, and were likely influenced by, the COVID-19 pandemic. Future additional assessments should examine PPE adherence independent of pandemic-related factors.

Conclusion

We utilized a standardized scoring scheme to validate a tool that measures PPE adherence, which is an initial step to understanding current post-pandemic PPE practices. We observed low PPE adherence for patients in TBP in three ICUs and a BMT unit at a large pediatric hospital. Future studies should explore HCP's barriers and motivations for PPE use, to maximize their adherence, effectiveness, and ease of use beyond the COVID-19 pandemic.

Ethical statement

This study was performed in compliance with all local relevant laws and institutional guidelines. As this work was quality improvement-related, an institutional review board approval was not required. Informed consent was not required as no experimentation with human subjects was performed.

Funding

This study was funded internally by the Cincinnati Children's Hospital Medical Center Infection Prevention & Control Program. This project was financially assisted by The John Hauck Foundation, Fifth Third Bank and John W. Hauck, Co-Trustees.

Credit author statement

Taryn Amos: I assisted with methodology, software, and validation. I was involved in the analysis. I performed the investigation and the data visualization. I was responsible for writing of the original draft as well as the review and editing of the manuscript. I am willing to publish this manuscript. The work was supported by internal funding through the Infection Prevention & Control Program of Cincinnati Children's Hospital Medical Center.

Andrea Ankrum, MS: I conceptualized and designed the study. I assisted with methodology, software, and validation. I was involved in the analysis. I performed the investigation. FSH provided the resources. I was involved in the review and editing of the manuscript. I administered the project. I am willing to publish the manuscript. The work was supported by internal funding through the Infection Prevention & Control Program of Cincinnati Children's Hospital Medical Center.

Felicia Scaggs Huang, MD, MSc: I conceptualized and designed the study. I assisted with methodology, software, and validation. I was involved in the analysis. I provided the resources. I was responsible for writing of the original draft of the manuscript and was involved in the review and editing of the manuscript. I supervised the study and administered the project. I am willing to publish the manuscript. The work was supported by internal funding through the Infection Prevention & Control Program of Cincinnati Children's Hospital Medical Center.

Joshua K Schaffzin, MD, PhD: I conceptualized and designed the study. I was involved in the analysis. I was involved in the review and editing of the manuscript. I supervised the study. I am willing to publish this manuscript. The work was supported by internal funding through the Infection Prevention & Control Program of Cincinnati Children's Hospital Medical Center.

Cameron Griffin: I assisted with methodology, software, and validation. I was involved in the analysis. I managed data curation and performed data visualization. I was responsible for writing of the original draft of the manuscript and was involved in the review and editing of the manuscript. I am willing to publish the manuscript. The work was supported by internal funding through the Infection Prevention & Control Program of Cincinnati Children's Hospital Medical Center.

Conflict of interest statement

All authors report no relevant conflicts of interest.

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