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The Effects of Modified Personal Protective Equipment (PPE) Protocols on Healthcare Personnel Providing Patient Care During the COVID-19 Pandemic: A Qualitative Assessment

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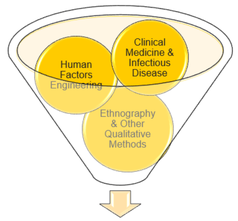
Introduction

- Healthcare personnel (HCP) must use personal protective equipment (PPE) appropriately (e.g., donning, doffing) to prevent pathogen transmission.[1]
- HCP often commit donning/doffing errors and self-contaminate during patient care.[2-4]
- The COVID-19 pandemic led to modified PPE protocols, supply shortages, introduction of novel PPE designs, and added PPE items (e.g., face shields).
- We built on our prior human factors engineering (HFE) and ethnographic observations of HCP's PPE doffing in simulated settings[5] to develop and pilot protocols for observing PPE use in patient care during the COVID-19 pandemic.



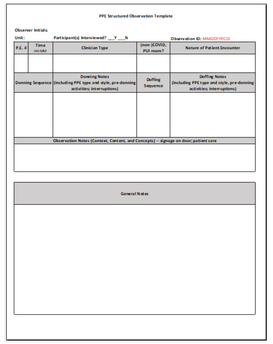
Our Interdisciplinary Approach

Research Aim

To qualitatively assess and compare PPE use for COVID-19 and non-COVID-19 rooms on acute and intensive care units to identify 1) deviations from recommended guidelines for PPE use, 2) barriers and facilitators to PPE use, and 3) HCP feedback and concerns regarding PPE.

Methods

- Observed HCP PPE use in 1 acute, 1 intermediate, and 1 intensive care unit at a large Midwestern academic hospital from December 2020-January 2021.
- Employed additional ethnographic techniques such as mapping barriers/facilitators to PPE use (e.g., unit layouts, signage) and conducting mini-interviews with a subset of participants to clarify observed behavior and identify PPE-related concerns.
- Collected data in a structured template supplemented with unstructured field notes, then imported notes into MAXQDA qualitative software.
- Used an iterative, team-based approach to thematic analysis incorporating both inductive and a priori codes (informed by our prior work and the literature).
- Applied supplementary HFE techniques such as usability design and a cognitive processing framework to a comparative analysis of facility protocols with CDC and WHO guidelines.
- Observers included qualitative (EC, KD, DJ) and HFE (JPS) researchers.
- The University of Iowa Internal Review Board approved all study activities (#202005603).


PPE Structured Observation Template

Observer Initials:

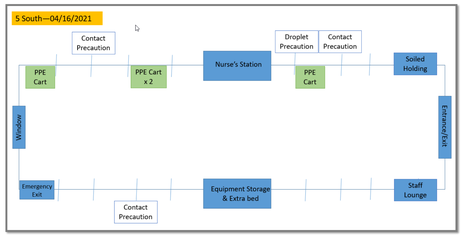
Unit: Participant(s) Interviewed? ___Y ___N Observation ID: MAXQDA PICK

P.E. #	Time on/off	Clinician Type	(nom (COVID-, PUI room?-	Nature of Patient Encounter

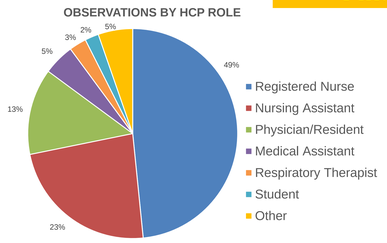
Donning Sequence	Donning Notes (including PPE type and style, pre-donning activities, interruptions)	Doffing Sequence	Doffing Notes (including PPE type and style, pre-donning activities, interruptions)

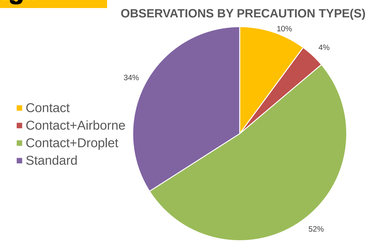
Observation Notes (Context, Content, and Concepts) – signage on door; patient care

General Notes

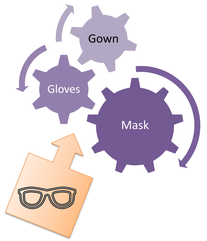


Findings





CHANGES TO PROTOCOLS & RECOMMENDED PRACTICES



- Facility pandemic guidelines for standard and contact precautions included:
  - Masks or respirators throughout the study period
  - Eye protection (e.g., face shields, safety glasses) from April-May 2021
- Protocol changes had the greatest impact on donning given added eye protection; e.g., HCP wearing bulky face shields had 3 options when a gown was required:
  - Pull gown over head and shield (could tear the gown's perforated neck)
  - Hold shield in one hand while donning (potentially challenging)
  - Set the shield on a nearby clean surface (not always available)

BARRIERS & FACILITATORS TO PPE USE

Frequently changing protocols	PPE fit (e.g., size)	PPE comfort	Communication with masks	Lack of surfaces to set down supplies	Facilitators
Time-intensive protocols	PPE items added to donning/doffing process	Gown tearing	Unclear signage	Carrying items	Preferred PPE designs
Protocol communication	Unfamiliar PPE	Eye protection fogging/glare	Inconvenient PPE storage/cleaning stations	Lack of signage for "clean"/ "dirty" surfaces	Clear signage
					Size availability
					Extended PPE use
					Ability to purchase own
					Enhanced mask use

PROTOCOL DEVIATIONS & ADAPTATIONS

- Leaving gown belt untied
- Exposed wrists due to arm length/gown size
- Placing thumb loops over gloves (vs. under)
- Attaching masks to headbands or extenders
- Twisting mask earloops for a tighter fit
- Layering masks (or masks and N95s)
- Wearing unapproved (or no) eye protection
- Placing "dirty" PPE on designated "clean" surfaces
- Pre-tearing gown neck to fit over face shields
- "Batching" tasks to reduce room entries

Highlights & Lessons Learned

- **HIGHLIGHTS**
  - Pandemic-related protocol changes were not always communicated clearly and affected donning and doffing practices, with a greater impact on the former due to the addition of eye protection.
  - HCPs adjusted in various ways to new more time-intensive protocols (e.g., "batching" tasks); some adjustments were not in line with recommended practices.
  - HCP perceived changes to allow PPE extended (re)use, and to provide more PPE design options, as facilitators.
  - Unfamiliar PPE were not always intuitive or comfortable to use.
  - Some HCPs expressed a desire to incorporate aspects of recommended pandemic-era practices into their routine practice (e.g., expanded mask usage).
  - Barriers identified in our prior simulations persisted during the pandemic (e.g., gown malfunctions, PPE fit, non-preferred designs).
  - We observed new barriers (e.g., PPE storage locations, unclear signage, lack of places to set supplies while donning/doffing) in patient care practice.
- **PILOT LESSONS LEARNED**
  - Building rapport with HCP facilitated data collection and mitigated Hawthorne effect.
  - Iterative data collection and analysis identified issues for template usability and cross-observer note consistency.
  - Interdisciplinary teams may require cross-training to ensure shared definitions (e.g., terminology, jargon) and consistent data collection.
  - A combined HFE/ethnographic approach allowed for both the identification of significant observation barriers *and* potential solutions through triangulation (i.e., use of multiple methods for data collection).

Conclusions

This pilot study:

- Confirmed barriers to PPE doffing identified in our simulation studies—PPE fit, unfamiliar PPE, and design issues (e.g., gown tearing).
- Identified additional barriers in real-world practice (e.g., donning/doffing while carrying items) and the COVID-19 pandemic (e.g., enhanced eye protection).
- Highlighted HCP feedback that some modified protocols facilitated PPE use (e.g., extended PPE use) and lowered perceived risk of self-contamination (e.g., increased mask use).

Healthcare facilities should consider the implications of these findings for PPE use both during routine care and for future respiratory pathogen outbreaks.

LIMITATIONS

- HCP were aware that we were observing them, thus Hawthorne Effect may have been a factor.
- Not all shifts or HCP roles were included since our goal was to develop and assess the feasibility of the methodology.
- Data collection processes varied across observers and units.
- Given our experience, we refined our data collection protocols in the next stages of our research.

ACKNOWLEDGEMENTS & DISCLOSURES

We thank the HCP who participated in this study for their time and insights. This work was supported by the Centers for Disease Control and Prevention (CDC) Epicenter program. LH has unrelated funding from PDI Healthcare, CDC, and the Agency for Healthcare Research and Quality. 3M provides products for one of LH's unrelated studies. Image credits: JPS (photograph) and DJ (map).

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