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Brief Report

Frequent and unexpected deviations from personal protective equipment guidelines increase contamination risks

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Personal protective equipment (PPE) training aims to reinforce the Centers for Disease Control and Prevention guidelines for donning and doffing; however, many health care and ancillary personnel use non-guideline methods to don and doff their PPE gowns and gloves. We found that hospital personnel commonly deviated from the guidelines, increasing the likelihood of self-contamination. Furthermore, securing the gown ties inappropriately was an especially common problem that consequently increased doffing missteps.

BACKGROUND

The Centers for Disease Control and Prevention (CDC) provides guidelines on the proper sequences and techniques for both donning and doffing of personal protective equipment (PPE), and these are often reinforced during training of hospital employees.[1] These guidelines were developed to minimize the spread of pathogens. Here, we set out to determine how well CDC doffing guidelines were being adhered to in a hospital setting. Observations of hospital personnel across multiple hospital units showed that lapses in PPE use guidelines were commonplace and sometimes occurred through unexpected means. Additional interventions beyond training in PPE use, such a redesigning and simplifying the gown tie closure, may be necessary to further limit protocol violations.

METHODS

This institutional review board-approved study was carried out in the western United States at an oncology hospital and at a large tertiary hospital. Health care personnel receive PPE training during new employee orientation followed by annual online training; however, the stringency of training may vary among individuals, as each department is responsible for training its own staff. Online training videos present the recommended step-by-step techniques for donning and doffing and advise against behaviors that increase the risk of self-contamination. These risks include touching the outside of the gloves or gown with bare hands or putting gloved hands behind the back. Over the course of 2 weeks, a trained observer conducted structured observations in 7 different units (1 medical, 1 surgical, 3 intensive, and 2 specialty care). The 48 subjects included nurses (n = 13), health care assistants (n = 12), doctors (n = 2), nutrition services (n = 5), respiratory therapists (n = 3), a speech therapist (n = 1), a dialysis technician (n = 1), environmental services workers (n = 2), an electrocardiogram technician (n = 1), phlebotomists (n = 3), and other health care workers (n = 5). Personnel were observed from outside of contact precaution patient rooms, in plain view from the hallway. Doffing was evaluated by the observer based on guidelines recommended by the CDC and dictated by hospital policy.[1]

All observed hospital workers used a common single-use, disposable, universal-size film gown. The gowns are intended to be donned with the opening in the back. Each gown has a breakable neck strap with perforations located over the left and right shoulders, thumb loops that are worn beneath gloves, and 2 36-inch ties that extend from each side of the gown at the waist and are meant to be secured in the back. Doffing was considered adherent to policy if the personnel pulled the front of the gown, rolled up the gown, and removed the gloves without overtly touching the exterior surfaces of the gown or gloves with bare hands, touching their clothing with gloved hands, or reaching around to their back. Non-adherence with these

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Table 1
Observed doffing practices (N = 48 hospital personnel)

Practices	N (%)
Gown tying location	
Tying gown in the back*	20 (41.7)
Tying gown in the front	17 (35.4)
Did not tie the gown	7 (14.6)
Gown tie closure unknown	4 (8.3)
Gown disposal	
Rolling into a ball*	20 (41.7)
Swirling over arm	1 (2.1)
Left loose	27 (56.3)
Gown sleeve and glove removal	
Gown and gloves, with both sleeves together*	42 (87.5)
One sleeve and glove at a time	6 (12.5)
Gown removal sequence	
Gown and glove together*	43 (89.6)
Gown first, then gloves	5 (10.4)

*Indicates adherence to Centers for Disease Control and Prevention guidelines and hospital doffing guidelines.

guidelines was documented during the observations along with incidents of potential self-contamination. For statistical analyses, *P* values were calculated using Fisher exact tests.

RESULTS

Doffing of PPE by 48 randomly chosen personnel was observed in patient care areas across 7 different hospital units. Observed doffing deviations included untying the ties, breaking the ties as a separate step rather than while pulling the gown off, reaching behind the back to release ties, allowing gloved hands to touch clothing, lifting the neck strap over the head, breaking the neck strap by pulling near the neck opening rather than from the hips, rolling up the gown with bare hands, not rolling up the gown during removal, removing one glove and sleeve at a time, swirling the gown around the arm, and removing gloves prior to removal of the gown. From observations of the doffing process, errors in donning could be inferred. These included tying the gown in the front, not tying the gown at all, and not using the gown thumb loops under but instead over the gloves. Additional PPE-associated problems included PPE trash cans with contents overflowing onto the floor, disposal of PPE outside of the room, gown fragments clinging to personnel after doffing, doffing while holding a tablet, doffing while wearing a medical arm brace, and wearing a winter coat under the isolation gown.

Few personnel followed the CDC and hospital guidelines for donning and doffing entirely, and only 23% (n = 11) of the individuals avoided overt actions that are associated with self-contamination (Table 1). Nearly half of the personnel (48%, n = 23) potentially self-contaminated during the doffing process, and 42% (n = 28) did not follow the hospital-specified techniques for rolling up the PPE gown prior to disposal. Only 18 out of 48 (38%) of the observed personnel tied their gowns in the back and subsequently broke the ties as intended. Individuals who tied their gowns in the front, against CDC and hospital guidelines, were also more likely to incorrectly release the ties (Table 2).

Table 2
Relationship between tie location and gown tie removal (N = 36 observations)

	Tied in back	Tied in front
Breaking tie	18	8
Untying	1	9

Gowns should be secured in back and ties broken during doffing, according to Centers for Disease Control and Prevention and hospital guidelines. *P* = .002 by Fisher exact test.

DISCUSSION

We found that personnel often employ non-guideline-based strategies for donning and doffing isolation gowns. Self-contamination is a frequent problem associated with improper doffing of PPE and likely contributes to the spread of nosocomial infections.[2] The most common PPE-associated errors observed in our study were inconsistent use of gown ties and failing to roll up the gown prior to disposal. The former is especially problematic, because, during donning, ties that are not secured in the back as indicated by the guidelines are more likely to come into contact with potentially contaminated surfaces. Ideally, the 36-inch ties for the gowns used by personnel in this study are secured in a bow in the back. Use of a knot, rather than a bow, or securing the ties in front of the gown can leave the ties streaming and more exposed to potential contaminants.

Although we were limited by a relatively small number of observations, our findings are consistent with results from other recent studies providing evidence that hospital personnel often fail to follow proper donning and doffing procedures.[2-4] The high rates of deviation from approved guidelines suggest that alternative approaches for training personnel should be explored, including training that does not rely mainly on online instruction but instead also fosters hands-on skill development. In addition, changes to gown design can reduce accidental exposure to contaminants,[5] and applying human factors engineering has the potential to improve performance, as well.[6] Our observations suggest that simplifying the gown closure process may be especially useful for limiting contamination of personnel.

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