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## PPE Compliance and Knowledge Among Healthcare Staff

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### Abstract

**Problem:** One of the most important steps in infection prevention is the use of personal protective equipment (PPE) to protect patients and staff from infectious agents; yet, research indicates that PPE compliance remains suboptimal in many healthcare institutions.

**Purpose:** To identify the effect of a multidisciplinary education campaign on PPE compliance and knowledge among healthcare workers (HCWs) on a rehabilitation unit of a large, midwestern teaching hospital.

**Methods:** This project utilized pre-intervention observational audits and a survey to determine baseline PPE compliance and knowledge on the piloted units. A post-intervention survey was sent to HCW to assess for a change in knowledge.

**Interventions:** Educational material regarding proper PPE usage and knowledge gaps gathered from the pre-intervention survey was sent to all staff virtually. Educational materials were also posted throughout the unit and discussed during team huddles.

**Results:** Pre-intervention observational audits showed 21.64% (n=97) correctly donned and doffed PPE according to the institution's policy. Comparison of pre- to post-survey data showed no significant change in all four knowledge-based questions (p=0.45, p=1.00, p=0.69, p=1.00).

**Conclusion:** Staff showed knowledge regarding proper PPE use prior to the intervention. However, compliance was suboptimal. This data indicates

that despite staff being knowledgeable on proper use, other barriers exist that lead to a lack of compliance with PPE policies.

**Key Words: PPE, compliance, Personal Protective Equipment, multidiscipline, education**



23 A review of the literature was completed to define the problem. Current  
24 articles in a selection of journals describe studies to indicate that PPE compliance  
25 is suboptimal in a variety of healthcare settings, including in-patient facilities. The  
26 research also strongly supports the importance of PPE in preventing infection. A  
27 literature review was conducted searching the databases CINAHL, PubMed, and  
28 ScienceDirect. The inclusion criteria were: articles published in English,  
29 published in the last ten years, from a peer-reviewed journal, and focused on PPE  
30 compliance and knowledge among HCWs. Exclusion criteria were articles not  
31 related to PPE compliance and knowledge, older than ten years, and articles  
32 without an English version available. One study by Larson (2004) was used  
33 despite being older than ten years old as it was determined to be of high-quality  
34 and contained an established survey tool that was modified and used to gather  
35 data in this project.

36 Overall, the literature showed that PPE compliance remains less than  
37 optimal across many healthcare institutions and remains an area for improvement  
38 at the piloted facility. Following review of the literature, it can be concluded that  
39 identifying barriers to PPE compliance is a key step in developing and  
40 implementing an effective intervention (Allen & Cronin, 2012; Alsmeyer, 2014;  
41 Andonian, et al., 2019; Baloh, et al., 2019; Bruce, 2013; Harrod et al., 2019; Jain,  
42 et al., 2013; Larkin et al., 2017). It was also found that PPE compliance is  
43 suboptimal among a variety of disciplines, and favored a multidisciplinary  
44 approach (Beam, et al., 2011; Doll, et al., 2017; Harrod, et al., 2019; Jain, et al.,  
45 2013; & Larkin, et al., 2017). Interventions studied within the research include

46 audits, education in a variety of forms, visual aids, or a combination of  
47 interventions (Allen & Cronin, 2012; Alsmeyer, 2014; Andonian, et al., 2019;  
48 Beam, et al., 2011; Bruce, 2013; Larkin, et al., 2017; Mauger, et al., 2014; Tomas,  
49 et al., 2015). The interventions implemented within the research review were all  
50 suggested to be effective in improving PPE compliance and/or knowledge  
51 (Larkin, et al., 2017; Mauger, et al., 2014; Tomas, et al., 2015). However, many  
52 studies noted that further research to analyze the long-term effects of the  
53 interventions would be beneficial in determining long-term effectiveness.

54 In summary, the literature review indicated that a combination of  
55 education, visual aids, and audits with feedback have shown to be successful in  
56 increasing appropriate PPE compliance and staff knowledge. Additionally, the  
57 research supports a multidisciplinary approach to improve compliance as  
58 compliance was shown to be suboptimal among all HCWs. A majority of the  
59 research used audits or surveys to determine the intervention to be implemented  
60 and are recommended as an effective measurement tool for PPE use.

#### 61 **Rationale**

62 The *Change Theory* by Kurt Lewin was utilized as the theoretical basis for  
63 this project (Petiprin, 2016). The *Change Theory* is a three-stage process that  
64 requires an individual to reject prior learning. The three stages in Lewin's theory  
65 are unfreezing, change, and refreezing (Petiprin, 2016). Unfreezing involves a  
66 process of letting go of the old pattern of practice or knowledge that is  
67 counterproductive. The second stage involves the changing of counterproductive

68 thoughts and behaviors. Finally, the refreezing stage involves making new  
69 thoughts and behaviors into a habit (Petiprin, 2016).

70 Lewin's theory guided this project. The behavior that was identified by the  
71 projects institutional leadership as counterproductive was low compliance of staff  
72 utilizing PPE correctly. The first step was to inform staff of this behavior and  
73 educate them on the consequences associated with noncompliance. During  
74 the first stage, investigators identified which knowledge and behaviors  
75 had become a pattern in order to address them, which was the rationale for the  
76 pre-intervention survey and audits. Additionally, Lewin's theory states that it is  
77 vital to overcome individual resistance and group conformity in this stage  
78 (Petiprin, 2016). Next, the implementation of a multidisciplinary  
79 educational intervention was used to change the behaviors and patterns of staff to  
80 increase PPE compliance. In this stage, staff were provided with education to  
81 support productive behavior change. Lastly, the investigators and team  
82 guided staff to establish new knowledge and practices as habits in the refreezing  
83 stage. Ideally, the staff will utilize their new knowledge and change their practice  
84 as guided through these three stages of Lewin's *Change Theory*.

85 Additionally, the *Iowa Model of Evidence-Based Practice to Promote*  
86 *Quality Care* (Titler, et al., 2001) was utilized as the framework for this project.  
87 The *Iowa Model* provides a guideline for decision making related to clinical and  
88 administrative practices that affect patient outcomes. It assists healthcare  
89 providers in translating quality research findings into clinical practice to improve  
90 patient outcomes, which is the goal of this project (Brown, 2014). The *Iowa*

91 *Model* is a multiphase model and was chosen to be the framework for this project  
92 as it is a streamlined change process that applied to the clinical question being  
93 explored. Additionally, the *Iowa Model* puts focus on organization collaboration  
94 as it incorporates the conduct and use of research as the guiding method for  
95 intervention protocol (Doody & Doody, 2011). Because the institution identified  
96 PPE compliance as a priority and there was a sufficient literature on possible  
97 interventions, it was identified that the change was appropriate for adoption  
98 into practice. These qualities aligned with the guiding principles of  
99 the *Iowa Model*.

#### 100 **Aims**

101 Infection prevention is a top priority at many healthcare facilities.  
102 The institution identified infection prevention as a crucial area for  
103 improvement on the piloted units (S. Johnson, personal communication,  
104 November 26, 2019). Many approaches to increase staff knowledge and  
105 compliance have been explored. Evidence supports use of a variety of  
106 interventions including education, regular auditing, and visual aids (Allen &  
107 Cronin, 2012; Alsmeyer, 2014; Doll, et al., 2017; Larkin, et al., 2017). It also  
108 shows that the need for improvement lies within all disciplines (Mitchell, et al.,  
109 2013). Therefore, this project aimed to identify gaps in knowledge regarding PPE  
110 among HCWs, and barriers to PPE compliance. Furthermore, the goal was  
111 to develop and implement an educational intervention to study the effect it has on  
112 these variables. The clinical question for this project was: For healthcare  
113 professionals in the rehabilitation setting of a teaching hospital, how does a

114 multidisciplinary educational infection prevention campaign affect PPE  
115 compliance and staff knowledge?

## 116 **Methods**

### 117 **Context**

118 The project was implemented on two inpatient rehabilitation units at a  
119 large, midwestern teaching hospital. The two units have a total of 58 beds. Patient  
120 population on these units include patients rehabilitating from surgery, strokes,  
121 traumatic brain injuries, and other complications requiring additional care and  
122 therapy. The units are staffed with nurses, nursing assistants, physical therapists,  
123 occupational therapists, speech therapists, and clinicians. The staff from these  
124 disciplines have been trained to the piloted unit's "Transmission-based  
125 Precautions (Isolation)" policy and were the population of this study. Inclusion  
126 criteria included any of the staff in a role mentioned above that entered a contact  
127 or enteric isolation room on the piloted units. Exclusion criteria for participants  
128 included environmental services and dietary staff.

129 There were many key stakeholders involved in this project. Stakeholders  
130 included both patients and any staff on the unit. The infection prevention team,  
131 nurse educators, and the unit's leadership team are also key stakeholders. Project  
132 members included: investigators, nurse managers, a clinical nurse specialist,  
133 infection prevention manager, unit practice council members, and a  
134 statistician. Leadership played an active role throughout the project and were  
135 supportive of project implementation.

### 136 **Interventions**

137            Modifications to the initial intervention were made due  
138 to a pandemic that occurred during the study period. The piloted unit's response  
139 measures restricted any in-person education. Therefore,  
140 the intervention was implemented virtually. The intervention was a virtual, multi-  
141 disciplinary education program. Content distributed in the virtual education  
142 program was determined based on data gathered in the pre-intervention phase and  
143 the needs of the staff as determined by management and the facility's  
144 infection prevention manager. All the material was approved by nurse  
145 managers, the infection prevention team, and the clinical nurse specialist before  
146 being sent to staff. Educational material was sent to all staff participating  
147 in the project from the pilot units (nurses, nursing assistants, providers, physical  
148 therapists, occupational therapists, and speech therapists).

149            The educational material was sent out twice during the two-  
150 week intervention period. The first time it was sent to the staff. The second time it  
151 was sent to the unit manager one week after staff received the material. The  
152 material sent to staff contained an explanation of why the intervention was being  
153 implemented virtually, facts on the importance of PPE policy compliance, and  
154 statistics from the observational audits collected during the pre-intervention stage.  
155 Additionally, the material included instructions on how staff can access their  
156 facility's PPE policy and who to contact for questions, barriers identified in the  
157 surveys and audits to proper PPE donning and doffing, a link to a visual aid  
158 for proper donning and doffing technique, and a video demonstration of how to  
159 properly don and doff PPE per the facility's policy. Finally, the material

160 contained contact information of the investigators and management, and staff  
161 were encouraged to reach out to them with any additional questions. After reading  
162 through the educational material and watching the video demonstration, staff were  
163 asked to complete a post-intervention survey to assess PPE knowledge.

#### 164 **Study of the Interventions**

165         The evaluation measures that were used to evaluate the success of  
166 implementing this intervention were audits performed by trained investigators and  
167 a survey. Observational audits were completed to measure baseline PPE  
168 compliance rates and surveys measured staff knowledge and perception of PPE  
169 use. The audit tool utilized was adapted from a tool by Telford, et al.  
170 (2018). Permission for use was granted and modifications were made based on the  
171 institutions “Transmission-based precaution (Isolation)” policy and with  
172 recommendations from a leader of the institution’s infection prevention team.

173         The survey tool utilized was adapted from a tool by Larson (2004) and  
174 was shown to have a test-retest reliability coefficient of 0.86 and a standardized  
175 alpha coefficient in item analysis of 0.80. Permission for use of the survey tool  
176 was obtained. The survey contained four Likert scale questions, one open-ended  
177 question, and four multiple-choice questions. Likert scale questions were utilized  
178 for statistical analysis to compare pre- and post-intervention PPE knowledge. The  
179 open-ended and multiple-choice questions were utilized to identify gaps in PPE  
180 knowledge among staff. The areas identified for improvement guided the  
181 education included in the intervention.

#### 182 **Measures**

183           Much of the research suggested that observational audits and  
184 surveys are an effective measurement tool for PPE use. As a result, an established  
185 audit and survey were modified and utilized as tools in this study to  
186 measure PPE compliance and knowledge. The goal for this project was  
187 to complete the observational audits pre- and post-intervention. Pre-intervention  
188 audits served as baseline data and showed investigators that PPE compliance was  
189 suboptimal on the piloted units. Unfortunately, due to the COVID-19  
190 pandemic and the response measures at the facility, investigators were unable to  
191 perform post-intervention audits to determine if there was a change in  
192 compliance following the educational intervention. The same survey tool was  
193 given to staff both pre- and post-intervention to assess for change in  
194 knowledge. Staff were able to complete the survey via a virtual link. Staff were  
195 ensured that the survey was confidential.

196           The project team determined that based on research, and the inability to  
197 complete post-intervention audits, that it would  
198 be beneficial to continue auditing after the original study period to monitor  
199 compliance long-term. The suggestion of continued audits was communicated to  
200 leadership on the unit. The initial cost for this project to the investigators was  
201 minimal, as investigators completed all the audits. However, there would be a  
202 cost associated with the continued assessment of compliance if the institution had  
203 to pay individuals for their time to complete audits.

204           To improve the value of the audits, inter-rater reliability was tested  
205 between auditors. This was done by completing three audits independently on the

206 same observation and comparing the results of these audits. The audits were the  
207 same between both investigators, thus ensuring interrater reliability. At times,  
208 investigators were unable to complete full audits. If parts of the audits were  
209 missed, they were marked “not visualized” and the incomplete data was excluded  
210 from the results. All the surveys were fully completed.

### 211 **Analysis**

212 The initial plan was for the investigators to perform audits prior to the  
213 implementation of the intervention for baseline data on PPE compliance that  
214 could be compared to audits obtained following the intervention. However, due to  
215 the pandemic, only baseline audits were obtained and no  
216 statistical analysis between pre- and post-intervention audits were done.  
217 Instead, data gathered from the baseline audits were calculated to provide staff  
218 with baseline compliance statistics and details on where breaks in compliance  
219 most often occurred. Therefore, instead of using the audits to examine the  
220 effectiveness of the intervention, the audits were utilized to better understand  
221 current compliance within the units, and trends in PPE  
222 practices using percentages.

223 A survey to assess PPE knowledge was sent to staff before the  
224 implementation of the intervention that gathered data that was compared to the  
225 data obtained from the survey sent out after the intervention. The  
226 same survey was sent both pre- and post-intervention and was compromised  
227 of multiple-choice, sequence, and Likert-scale questions. The Likert-scale  
228 questions were compared across the pre- and post-intervention groups with a two-

229 sample t-test. The rate at which the multiple-choice and sequence questions were  
230 answered correctly was compared across these groups with Fisher's exact test.

### 231 **Ethical Considerations**

232 The investigators did not identify any conflicts of interest or need for  
233 formal ethics review. All staff received the same education on proper PPE  
234 usage. Additionally, all staff had adequate resources to locate the policy and had  
235 the opportunity for any questions to be answered. The project was submitted and  
236 received approval from both the piloted institution and the University's  
237 Institutional Review Boards (IRBs).

## 238 **Results**

### 239 **Data**

240 The data analyzed from the survey are responses from 48 nurses prior to  
241 and 36 nurses following an educational intervention on personal protective  
242 equipment (PPE). The assessment tool consisted of four six-point Likert-scale  
243 items (Questions 1-4). For three of the four items, a "Strongly agree" was coded  
244 as 6 and "Strongly disagree" as 1. One of the items ("I don't have time to stay  
245 informed about available guidelines and guideline updates") was reverse-  
246 coded such that a "Strongly disagree" was coded as 6. The average across all four  
247 questions was computed for each nurse and compared across the pre- and post-  
248 intervention groups. In addition to the four Likert-scale items, four knowledge  
249 questions (Questions 6-9) were asked. These were answered either correctly or  
250 incorrectly, resulting in a binary response for each nurse.

251           The audit data reviewed was split up into four sections: setup, donning  
252 PPE, doffing PPE, and use of PPE. Auditors either marked “yes” “no” or “not  
253 visualized” for each point. Setup was further broken down into: door signage  
254 visible, isolation cart within reach, and correct signage on the  
255 door. The donning and doffing PPE sections were further broken down based on  
256 the correct steps as per the institution’s policy. The correct steps for donning PPE  
257 are: hand hygiene performed before gathering supplies, staff donned gown first,  
258 staff donned gloves second, the gown was secured correctly (closed and tied), and  
259 gloves and gown were donned outside of the room. The correct steps for doffing  
260 PPE are: staff doffs gown and gloves in one motion (or gown first), staff disposes  
261 PPE in the trash in patients’ room, staff doffed PPE without visible contamination  
262 to themselves, staff performs hand hygiene after doffing. The final section was  
263 use of PPE and had one aspect: PPE was only worn inside the isolation room.

#### 264 **Methods**

265           For the survey data, the average to Questions 1-4 was compared across the  
266 pre- and post-intervention groups with a two-sample t-test. The rate at which the  
267 knowledge questions were answered correctly was compared across these groups  
268 with Fisher’s exact test.

269           For audit data, only baseline data was obtained. Thus, percentages were  
270 calculated to show baseline compliance rates.

#### 271 **Results**

272           Table 1 shows the mean (standard error mean) for the average of  
273 Questions 1-4. Additionally, it shows the count (percent) of correct answers for

274 each of the four knowledge questions. The average response on the Likert-scale  
275 questions was very similar (and positive) across the two groups: 5.1 in the pre-  
276 intervention responses and 5.2 in the post-intervention responses on a 6-point  
277 scale. Similarly, the percent correct on each of the four knowledge questions were  
278 similar from pre-to-post. The percent of nurses answering correctly was highest  
279 for Questions six, eight, and nine, with a notably lower correct response rate for  
280 Question seven. None of the statistical tests performed resulted in statistically  
281 significant differences across the two groups.

282         Audit data indicated that all four sections (setup, donning PPE, doffing  
283 PPE, and Use of PPE) were completed correctly 21.6% (n=97) of the  
284 time. Staff entered contact or enteric isolation rooms without utilizing any  
285 PPE 21.6% (n=30) of the time. These observations were not included in the  
286 subsequent calculations. Table 2 breaks down each section of the audit and shows  
287 percentages of visualized observations that were done correctly per section. If  
288 aspects of the section were “not visualized,” or if staff did not wear PPE during  
289 the encounter, the audits were excluded from data analysis.

290         A few additional percentages were calculated to further understand the  
291 data. The most common step missed when donning PPE was hand hygiene.  
292 Twenty percent (n=97) of the time staff did every other aspect of the audit  
293 correctly except hand hygiene prior to putting on PPE. Donning was completed in  
294 the incorrect order 22% (n=97) of the time, most frequently donning gloves  
295 before gown.

296

## Discussion

**297 Summary**

298           The first key finding of this project was that PPE compliance was  
299 suboptimal. PPE was worn correctly only 21.6% of the encounters that were  
300 audited. This finding confirmed the need for an intervention to help address PPE  
301 compliance on the piloted units. Survey results indicated high PPE  
302 knowledge both pre- and post-intervention. This indicates that the staff  
303 knows how to properly utilize PPE, but not translating into practice. Thus, it is  
304 important to identify what barriers to proper PPE usage exist to implement  
305 strategies that address barriers and improve compliance.

306           Additionally, findings from the audits indicated that staff doffed PPE  
307 correctly (72.1%) more consistently than donned PPE correctly (34.6%). This is  
308 contradictory to the literature review conducted, as many of the studies reviewed  
309 for this project indicated that doffing is often the area of concern (Antonian, et al.,  
310 2019; Baloh, et al., 2019; Beam, et al., 2011; Doll, et al., 2017; Mitchel, et al.,  
311 2013; Okamoto, et al., 2019; & Tomas, et al., 2015). This finding supports  
312 the implementation of pre-intervention audits and surveys to help identify the  
313 areas for improvement specific to the institution.

314           One key aspect of the audits that was consistently done well was room set  
315 up. If a patient was on contact or enteric precautions, the room had the correct  
316 signage visible and the isolation cart within reach for 99.3% of encounters. The  
317 literature search completed for this project identified visual aids have shown to be  
318 an effective intervention (Allen & Cronin, 2012; Alsmeyer, 2014; Doll, et al.,  
319 2017; Larkin, et al., 2017). However, investigators did not implement visual aids,

320 as the findings from the audits indicated this was already successfully being  
321 implemented at the institution.

322         There were no statistically significant changes in the data analyzed from  
323 the survey results. This was likely due to high scores on the pre-intervention  
324 survey. Staff knowledge did not decrease post-intervention, but also did not have  
325 much room to improve given the high score on the pre intervention survey. One  
326 question was added to the post-intervention survey that was not on the pre-  
327 intervention survey and that was “did you find this information helpful?” Staff  
328 were asked to answer this “yes/no” question. 94.3% (n=35) staff members  
329 indicated that the educational intervention was helpful.

### 330 **Interpretation**

331         Suboptimal PPE compliance was reported in much of the literature review  
332 completed for this project (Allen & Cronin, 2012; Jain, Dogra, Mishra, Thakur, &  
333 Loomba, 2013; Larkin, et al., 2017). This was consistent with the findings from  
334 this project. Many of the studies reviewed for this project implemented  
335 an educational intervention utilizing audits and surveys revealing a variety of  
336 results. This project implemented a multidisciplinary virtual education campaign  
337 to address low PPE compliance. Due to the COVID-19 pandemic, post-  
338 intervention audits could not be obtained to identify if the intervention affected  
339 PPE compliance. However, since the survey was completely online, results were  
340 obtained pre- and post-intervention. Survey results indicated that a  
341 multidisciplinary education campaign did not show statistically significant

342 improvement in PPE knowledge among staff members. This was consistent with  
343 some of the studies reviewed in the literature.

344         The biggest reason investigators believe there was a difference between  
345 observed and anticipated outcomes was due to the COVID-19 pandemic. Post-  
346 intervention audits were not able to be completed, which was one of  
347 the measurements to identify intervention effectiveness. While the survey  
348 provided useful information, staff performed well on the pre-intervention survey,  
349 and thus the intervention would not have allowed for much improvement. The  
350 audit data would have been beneficial in determining the effectiveness of this  
351 intervention. It can be inferred that because PPE knowledge was high pre-  
352 intervention and compliance was low, barriers other than lack of PPE knowledge  
353 exist that influence PPE compliance.

354         Another variation made to this project due to the pandemic was the  
355 delivery method of the intervention. The initial plan was to deliver short, in-  
356 person education sessions that would have included interactive education, such as  
357 the use of glow germ, as this has shown some effectiveness in past studies (Allen  
358 & Cronin, 2012; Andonian, et al., 2019; Beam, et al., 2011; Bruce, 2013; Larkin,  
359 et al., 2017; & Tomas, et al., 2015). Following COVID-19 precautions, in person  
360 educational sessions were not possible. Therefore, education was delivered  
361 virtually and may have impacted project outcomes. One could argue that virtual  
362 education would not be as effective, as staff could skim through or disregard  
363 the education material. Additionally, virtual education misses the opportunity  
364 to do any hands-on interaction. Interestingly, the survey asked staff what form of

365 communication is most beneficial to them, and the most common answer was e-  
366 mail or online (23%), supporting the use of a virtual intervention. It is also cost-  
367 effective, can be accessed at the user's convenience, repeated as needed, easily  
368 replicated, and provides a safe learning environment, which is required during a  
369 pandemic. Ultimately, more research needs to be done on the most effective  
370 education delivery method.

371 Despite the lack of clinically significant data, staff reported that the  
372 education intervention was helpful. Additionally, the intervention was  
373 inexpensive and required minimal resources other than time. Because staff felt the  
374 intervention was useful, it is worth considering as a cost-effective intervention to  
375 improve PPE knowledge and compliance. Further research is needed on effective  
376 delivery method for an intervention addressing PPE.

### 377 **Limitations**

378 One key aspect of this project was obtaining baseline information to  
379 understand current gaps in knowledge and barriers to PPE usage for staff. This  
380 allowed the intervention to the specific needs of the piloted units. However, this  
381 limits the generalizability of the project.

382 One limitation noted was the Hawthorne effect. Investigators introduced  
383 themselves and the project to the unit before implementation. They also checked  
384 in with the charge nurses daily during the auditing period to identify which  
385 patients were on contact or enteric precautions. Thus, the staff could identify  
386 the investigators and their purpose for being there. This could have altered the

387 results for audit compliance, as investigators' presence may have influenced the  
388 staff's PPE decisions knowing they were being audited.

389 Another limitation was that staff often doffed  
390 PPE in the patient's room with the door closed. This limited the ability for  
391 investigators to fully see the doffing process. If investigators were not able to  
392 view the doffing process in full, it was marked "not visualized" and this data  
393 was excluded from the final percentages.

#### 394 **Conclusion**

395 Use of PPE is a standard practice in healthcare institutions across the  
396 United States in preventing the spread of HAIs. HAIs are not only costly but  
397 potentially fatal. Proper use of PPE is one of the best ways to protect patients and  
398 healthcare workers from HAIs (Wisconsin Department of Health Services,  
399 2018). Despite this knowledge, research has indicated that compliance rates for  
400 proper PPE usage are suboptimal, thereby, putting patients and staff at risk for  
401 developing HAIs. This project sought to identify current compliance rates for  
402 proper PPE usage, gaps in knowledge and barriers for consistent usage, and  
403 an effective intervention to improve staff knowledge and compliance. The main  
404 finding of this project was that while knowledge on the proper use of PPE was  
405 adequate, compliance rates were very low.

406 While this project could be easily implemented in a variety of settings to  
407 improve PPE compliance and knowledge, adjustments would need to be made to  
408 improve the effectiveness of the intervention. Further research is recommended to  
409 identify why adequate staff knowledge of PPE is not being implemented into

410 practice. Methods to overcome barriers is also recommended. Finally, if an  
411 educational intervention is going to be explored to address the identified barriers,  
412 research should be done to determine the most effective form of education  
413 delivery method.

## References

- AHRQ. (2019). AHRQ's healthcare-associated infections program. Retrieved from <https://www.ahrq.gov/hai/index.html>
- Allen, S. & Cronin, S. (2012). Improving staff compliance with isolation precautions through use of an educational intervention and behavioral contract. *Dimensions of Critical Care Nursing, 31*(5), 290-293. doi:10.1097/DCC.0b013e31826199e8.
- Alsmeyer, Megan. (2014). *Increasing compliance of personal protective equipment selection and use of isolation precautions among RNs and NAs on med-surg unit* (Unpublished master's thesis). University of San Francisco, California.
- Andonian, J., Kazi, S., Therkorn, J., Benishek, L., Billman, C., Schiffhauer, M., & Maragakis, L. (2019). Effect of an intervention package and teamwork training to prevent healthcare personnel self-contamination during personal protective equipment doffing. *Clinical Infectious Diseases, 69*, S248–S255. doi:10.1093/cid/ciz618
- Baloh, J., Reisinger, H. S., Dukes, K., Silva, J. P. da, Salehi, H. P., Ward, M., & Herwaldt, L. (2019). Healthcare workers' strategies for doffing personal protective equipment. *Clinical Infectious Diseases, 69*, S192–S198. doi:10.1093/cid/ciz613
- Beam, E., Gibbs, S., Boulter, K., Beckerdite, M., & Smith, P. (2011). A method for evaluating health care workers' personal protective equipment

technique. *American Journal of Infection Prevention* 39(5), 415-420. doi:10.1016/j.ajic.2010.07.009

Brown, C. G. (2014) The Iowa model of evidence-based practice to promote quality care: An illustrated example in oncology nursing. *Clinical Journal of Oncology Nursing*, 18(2), 157-159. doi: 10.1188/14.CJON.157-159.

Bruce, N. (2013). *Improving compliance with healthcare associated infection (HAI) practice guidelines to reduce the acquisition of HAIs* (Unpublished doctoral dissertation). University of Massachusetts Amherst, Massachusetts.

Doll, M., Feldman, M., Hartigan, S., Sanogo, K., Stevens, M., McReynolds, M., & Bearman, G. (2017). Acceptability and necessity of training for optimal personal protective equipment use. *Infection Control & Hospital Epidemiology*, 38(2), 226–229. doi:10.1017/ice.2016.252

Doody, C. & Doody, O. (2011). Introducing evidence into nursing practice: Using the IOWA model. *British Journal of Nursing*, 20(11), 661-664. doi: 10.12968/bjon.2011.20.11.661

Fairview Health Services. Transmission-based precautions (isolation). Updated March 2017.

Retrieved

from [http://intranet.fairview.org/policies/category/infectionpreventioncontrol/s\\_140010](http://intranet.fairview.org/policies/category/infectionpreventioncontrol/s_140010)

- Jain, M., Dogra, V., Mishra, B., Thakur, A., & Loomba, P.S. (2013). Factors limiting the usage of personal protective equipment in a tertiary-care hospital. *The Canadian Journal of Infection Control*, 28(2), 105-110.
- Larkin, J., Lee, D., Kruegelback, G., Maxwell, T., Burroughs, R., Emery, C., & Salamone, D. (2017). Target-improving personal protective equipment (PPE) compliance: A three year study. *American Journal of Infection Control*, 45(6), S62. doi:10.1016/j.ajic.2017.04.100
- Larson E. (2004). A tool to assess barriers to adherence to hand hygiene guideline. *American Journal of Infection Control*, 32(1), 48–51.
- Mitchell, R., Roth, V., Gravel, D., Astrakianakis, G., Bryce, E., Forgie, S., Johnston, L., Taylor, G., & Vearncombe, M. (2013). Are health care workers protected? An observational study of selection and removal of personal protective equipment in Canadian acute care hospitals. *American Journal of Infection Control*, 41(3), 240-244. doi:10.1016/j.ajic.2012.04.332
- Office of Disease Prevention and Health Promotion. (2019). Health-care associated infections. Retrieved from <https://health.gov/hcq/prevent-hai.asp>
- Okamoto, K., Rhee, Y., Schoeny, M., Lolans, K., Cheng, J., Reddy, S., & Popovich, K. J. (2019). Impact of doffing errors on healthcare worker self-contamination when caring for patients on contact precautions. *Infection Control & Hospital Epidemiology*, 40(5), 559–565. doi:10.1017/ice.2019.33

- Stone P. W. (2009). Economic burden of healthcare-associated infections: An American perspective. *Expert review of pharmacoeconomics & outcomes research*, 9(5), 417–422. doi:10.1586/erp.09.53
- Telford, B., Healy, R., Flynn, E., Moore, E., Ravi, A., & Geary, U. (2019). Survey of isolation room equipment and resources in an academic hospital. *International Journal of Health Care Quality Assurance*, 32(6), 991–1003. doi:10.1108/IJHCQA-10-2018-0254
- Titler, M., Kleiber, C., Steelman, V., Rakel, B., Budreau, G., Everett, L., Buckwalter, K., Tripp-Reimer, T., & Goode, C. (2001). The Iowa model of evidence-based practice to promote quality care. *Critical Care Nursing Clinical North America*, 13(4), 497-509.
- Tomas M. E, Kundrapu S., Thota P., Sunkesula, V. C., Cadnum, J., Mana, T., Jencson, A., O'Donnell, M., Zabarsky, T. F., Hecker, M. T., Ray, A. J., Wilson, B. M., & Donskey, C. J. (2015). Contamination of health care personnel during removal of personal protective equipment. *Journal of the American Medical Association Internal Medicine*, 175(12):1904–1910. doi:10.1001/jamainternmed.2015.4535
- Wisconsin Department of Health Services. (2018). *Infection control and prevention- personal protective equipment (PPE)*. Retrieved from <https://www.dhs.wisconsin.gov/ic/ppe.htm>

Table 1

*Survey Results*

	<b>Avg Q1-Q4</b>	<b>% correct Q6</b>	<b>% correct Q7</b>	<b>% correct Q8</b>	<b>% correct Q9</b>
<b>Pre</b>	5.1 (0.1)	45 (94)	28 (58)	43 (90)	48 (100)
<b>Post</b>	5.2 (0.1)	31 (89)	20 (59)	34 (94)	36 (100)
<b>p-value</b>	0.34	0.45	1.00	0.69	1.00

Table 2

*Audit Results*

	<b>Yes</b>	<b>No</b>	<b>Not Visualized</b>	<b>Did not utilize PPE for encounter</b>	<b>Visualized observations done correctly per section (%)</b>
<b>Setup</b>	138	1	0	0	99.3%
<b>Don PPE</b>	37	70	2	30	34.6%
<b>Doff PPE</b>	49	19	41	30	72.1%
<b>Use of PPE</b>	96	5	8	30	95%