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Respiratory Protection Toolkit: Providing Guidance Without Changing Requirements. Can We Make an Impact?

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Abstract

International travel and infectious respiratory illnesses worldwide, place healthcare workers (HCWs) at increasing risk of respiratory exposures. To ensure the highest quality safety initiatives, one healthcare system used a quality improvement model of Plan-Do-Study-Act and guidance from Occupational Safety and Health Administration's (OSHA) May 2015 Hospital Respiratory Protection Program (RPP) Toolkit. The toolkit aided identification of opportunities for improvement within the well-designed RPP. One opportunity is the use of a respirator during aerosol-generating procedures for specific infectious illnesses. Observation data identified opportunities to mitigate controllable risk including strap placement, user seal check, and reuse of disposable N95 filtering facepiece respirators. Subsequent interdisciplinary collaboration developed ideas to decrease risks and increase protection from potentially infectious respiratory illnesses. The toolkit provided a comprehensive document to evaluate the program showing, while the OSHA standards have not changed, the addition of the toolkit can effect a positive change to protect HCWs.

Keywords

PDSA; quality improvement

Healthcare workers (HCWs) have the right to be protected from numerous respiratory health hazards while at work. The Occupational Safety and Health Administration (OSHA)

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laws include a standard specific to respiratory protection, 29 CFR 1910.134, in which the employer is required to have a written Respiratory Protection Program (RPP). The standard provides specific guidance as to the program components. Although the program has been mandated since 1998, HCW exposures to chemicals, microorganisms, and other newly recognized hazards, such as surgical plume, still occur annually. The purpose of this manuscript is to describe the assessment of the current RPP and practices within a large urban healthcare system, identification of gaps or opportunities for improvement, and the collaborative process used to develop practices to mitigate future controllable risks.

Background

Respiratory protection laws were developed to protect employees from potential occupational exposures when engineering and avoidance controls were not enough to mitigate risks of exposure. In healthcare, personal protective equipment (PPE) is used to care for patients known or suspected to have an infectious disease. The disposable filtering facemask respirator is one option to protect against airborne or aerosolized particles that may contain infectious or hazardous particles and will be the focus of this document. In addition to potential exposures for frontline staff, laboratory and research personnel are at risk for exposure when testing specimens for infection.

The infectious exposures employees could potentially be subjected to include airborne microorganisms expelled by infected patients while speaking or coughing. Microorganisms also become aerosolized during procedures such as bronchoscopies, electro cautery during surgery, open suctioning, and intubation (OSHA, 2015). These microorganisms could be any number of bacterium, viruses, or fungi suspended in the air and landing on the unprotected mucus membranes of HCWs potentially causing infection. Airborne particles are those particles small enough to stay suspended in the air for an increased amount of time. If these particles are infectious, they have the potential to cause infection to anyone entering the room without adequate protection or with poorly placed respiratory protection. The use of a respirator is recommended for HCWs providing care to patients when certain infectious organisms are either known or suspected (OSHA, 2015). Respirators come in many styles, disposable or non-disposable, that contain a filtering membrane and/or cartridge that captures specific contaminants from the air providing the user with clean air to breath. In order to effectively protect the HCW, the type of respiratory protection selected corresponds with the type of hazard encountered. Respirators available within the focus institution include a disposable N95 filtering facepiece respirator, full-face air purifying respirators with cartridges, and powered air-purifying respirators (PAPRs). Surgical facemasks are not respirators and should be used to protect HCWs' mucus membranes from body fluids that may be encountered by splashes or droplets, in addition to protecting the patient from droplets HCWs may be expelling. Surgical masks do not offer users protection from the inhalation of small inhalable particles.

While influenza is a frequently encountered respiratory infectious disease, increased international travel and lower vaccine rates are creating increased concerns for exposures to HCWs today. According to the Centers for Disease Control and Prevention (CDC), the range in the number of measles cases reported since 2000 was 37 cases in 2004 and increasing

to 667 cases in 2014 (2015). Three out of 100 persons who are fully vaccinated will still become infected with measles (CDC, 2015). Other concerning infectious diseases requiring respirator precautions include bacillus anthracis, aspergillosis, varicella, rubeola, monkey pox, severe acute respiratory syndrome (SARS), smallpox/variola virus, mycobacterium tuberculosis, Middle Eastern Respiratory Syndrome Coronavirus (MERS-CoV), and Ebola (OSHA, 2015). Each disease requires a specific type of respiratory protection based on the unique mode of transmission.

Problem

OSHA's (n.d.) standard 29 CFR 1910.134 requires employers whose workers have a potential for hazardous respiratory exposure to have a written RPP that includes a program administrator, policies and procedures, a medical evaluation, evaluation of hazard and selection of respirator, fit testing and record keeping, education to employees about hazardous potential exposures, as well as, proper PPE donning (placing) and doffing (removing), and regular program evaluation. While these requirements are stated and enforceable, how the standard is carried out within institutions can vary widely.

Disposable filtering face piece respirators, commonly referred to in healthcare as N95s, and PAPRs can be used to prevent these infections. When a respirator is placed and worn correctly, hazards to the employee are decreased; however, it has been shown that proper respirators are not always worn nor are they used correctly each time.

The National Institute for Occupational Safety and Health (NIOSH) conducted two research projects during the 2009–2010 H1N1 pandemic flu season. The Respirator Evaluation in Acute Care Hospital (REACH) study was conducted in two phases; however, several themes were consistent across studies. Within the REACH II study, the findings showed that while management was able to speak to the proper choice and appropriate use of the respirator, clinical staff was less likely to correctly state the recommendations and use of respirators. Donning and doffing of the N95 also was concerning as noted by improper strap placement in 46%, failure to perform a seal check in 85%, not using straps for doffing in 57%, and improper disposal of the respirator in 45% of observations (NIOSH, 2015). In response to these findings, OSHA (2015) published the 96-page *Hospital Respiratory Protection Program Toolkit* in May 2015 as a resource for institutions to develop and evaluate their current RPP. This document was used to evaluate the plan and practices within the project site while considering the potential for infectious hazardous exposures to employees.

Anecdotally, one common error that occurs, placing HCWs at increased exposure, is the lack of implementing respirator use for aerosol-generating procedures such as bronchoscopy, intubation, open suctioning, and administration of aerosolized medications. When patients are known or suspected of having seasonal flu, droplet isolation is required in which a surgical mask is worn to protect the user's mucus membranes from infectious droplets unless that patient is undergoing an aerosol-generating procedure, the CDC recommends the use of a respirator. This increased protection is necessary due to the increased number of aerosolized infectious particles created with aerosol-generating procedures that may be inhaled (OSHA, 2015).

Noti et al. (2012) studied the size of the influenza virus particle produced by a coughing mannequin and compared the ability of a non respirator loose fitting mask, poor fitting respirator, and a tight fitting respirator to protect a breathing mannequin. The results demonstrated a patient infected with influenza who is coughing is able to generate small particle aerosols and a tightly sealed filtering face piece provides greater protection than the poorly fitted filtering face piece and the loose fitting mask. The percentage of infectious influenza virus blocked by a tightly sealed respirator was 99.6%, a poorly fitted respirator was 66.5%, and a loose fitting mask was 56.6% (Noti et al., 2012). The occupational health significance of this is concerning as non-respirator masks are widely used to care for influenza patients and the findings reflect poor protection against infectious influenza particles. In addition, the REACH study showed poor adherence to properly placed N95 disposable face piece respirators (NIOSH, 2015). Both studies impress the idea that evaluation of user technique and effective education is imperative to protection of the HCWs from infectious illnesses.

Purpose

The purpose of the project was to review current RPP and practices within a large, pediatric, urban healthcare system; use of the RPP toolkit as a guide to identify gaps or areas for improvement within the program; assess staff knowledge and usage of the N95; and work collaboratively with occupational health practitioners and academicians to develop practices that may mitigate any identified controllable risk.

Methods

Project Design

The institution of focus has a strong culture of safety, as well as, an achievable goal to become a High Reliability Organization (HRO). This study used a quality improvement design with a single plan, do, study, and act (PDSA) cycle. The local Institutional Review Board determined the study to be “not human subjects research” and exempt from further review.

Sample

The study sample consisted of registered nurses, patient care assistants, and research imaging technologists. Respiratory therapists and physicians were unavailable to participate during the observation period.

Instrumentation

The OSHA (2015) *Hospital Respiratory Protection Program Toolkit* was used to evaluate the facility’s current Respiratory Protection Plan. The Modified N95 Observation Tool and 7-item survey were developed for the sole purpose of identifying user recall of N95 practices and knowledge with employees who previously completed online N95 training and underwent N95 fit testing.

Procedures

Plan.—The "Plan" phase consisted of identifying the study objective in collaboration with the study site practitioners, developing tools to meet the objective, and identifying documents to assess and staff to observe. The RPP toolkit was used as a guide to assess the current RPP and assure that all aspects required by OSHA are included in the plan as well as distinguishing any gold standard practices that are recommended.

Prior to development of the observation tool and survey questions, collaboration with the RPP administrator and Infection Control established the objective for the tools. Interdisciplinary role responsibilities within the respiratory protection program were identified. One concern identified was the continued practice to reuse the disposable filtering facepiece N95 mask. In 2015, the annual online education reflected the reuse of the N95 filtering face piece respirators was to be discontinued. The observation tool and survey questions assessed this practice. The units of interest to evaluate were identified.

Do.—The "Do" phase of the study consisted of assessing the RPP documents and education using the toolkit as a guide; observing staff compliance to the program details; and collecting surveys to measure staff knowledge of N95 use. The project was presented to the specific managers and permission was granted to access personnel for participation. At the time of data collection, a brief description of the project was described to each individual. The survey was provided to personnel to complete individually and returned directly to the observer. Questions not pertaining to specific HCWs responsibilities were marked as not applicable (N/A).

Observations of donning and doffing of the N95 filtering face piece respirator were limited to demonstration. The employee demonstrated the use of the N95 filtering face piece in addition to verbalizing the steps of the process. HCWs were asked to verbalize where they would be doing each step in relation to the patient. There were no HCWs utilizing an N95 filtering face piece respirator while caring for a patient at the time of observations, therefore observations were limited to demonstration only.

Study.—The "Study" phase consisted of identifying the strengths and opportunities within the current RPP as well as analyzing the data and summarizing what was learned from the observations and survey questions.

Act.—The "Act" phase embraced collaboration with the RPP administrator as well as the senior director of Occupational Safety and Environmental Health to identify and plan future changes to mitigate potential risk to employees.

Findings

Respiratory Protection Program

The RPP has gone through progressive changes over the past two years to meet the needs of the employees and the facility. One key enhancement was the ability to track and report the completion of online medical clearance and designated respirator education module, for either a N95 filtering face piece respirator or a powered air purifying respirator (PAPR),

whereby confirming the first two regulatory requirements for respirator use were met. A core group was pre-determined to be required to have annual fit testing. Those who did not have fit testing, were considered “just in time” ready and would be fit tested or given hands on PAPR training if an urgent need arose. The goal was to develop a sustainable fit testing program by decreasing the number of required fit tested employees from 1,700 to 700 annually.

In order to meet the sustainable needs of the large institution, 22 staff members are trained to perform fit testing. Multiple essential departments (respiratory, emergency, bronchoscopy, pulmonary, critical care units) needed to have personnel trained and available to perform fit testing for their personnel or staff from other departments on a scheduled or urgent basis. This planning will expedite a robust response by in house fit testers in the event there is a potential outbreak requiring numerous additional personnel to be fit tested to care for a large influx of infectious patients.

The healthcare system has developed a central respiratory protection intranet site providing staff and management access to a multitude of tools including instructions for N95 and PAPR use, as well as an algorithm to assist with decision making related to a potentially respiratory infectious patient that can be accessed at any time. Compliance documents for the Hospital Wide Medical Clearance, Hospital Wide Education Completion, and Hospital Wide Respiratory fit roster are accessible within the site and updated regularly. The fit test roster contains information of fit testing date and mask model in case the employee is unable to recall or locate the card received at the time of fit testing.

A safety call line was developed prior to this study for employees to report any injury or exposure to staff, patient, or visitor as well as any occurrences of near miss. A trained professional obtains a report of the occurrence and instructs employees on further care specific to the injury or exposure. In addition to reporting incidences, initiation of emergency fit testing can be requested by calling the safety line.

One substantial gap noted of the plan in comparison to the toolkit was related to increasing PPE to a respirator for aerosol-generating procedures on a patient with suspected or known seasonal influenza. “In 2010 the CDC issued new infection control guidance for seasonal influenza, a disease for which droplet precautions are recommended, stating that respiratory protection should be used when higher-risk, aerosol-generating procedures are performed on a patient suspected or confirmed with influenza” (OSHA, 2015, p. 10). Examples of aerosol-generating procedures referenced in the toolkit performed within the facility of focus were endotracheal intubation, open suctioning, tracheostomy care, cardiopulmonary resuscitation, induction of sputum, bronchoscopy, aerosolized medications, pulmonary function testing, autopsy and surgical procedures.

After assessment of the current RPP and RPP toolkit, all significant noted gaps or differences were documented and shared with the RPP administrator and the senior director.

Post Observations and Survey Questions

The Modified N95 Observation tool showed several noteworthy results (see Table 1). All persons verbalized placing the respirator outside of the patient room and all except one verbalized taking the mask off outside of the patient room. Of those observed, 57% failed to inspect the respirator for damage, 57% failed to place the straps correctly, 57% failed to perform a user seal check, 57% failed to remove the respirator handling the straps only, and 50% failed to dispose of the respirator properly. These persons verbalized re-use of the mask throughout the shift when caring for the same patient.

Of the 14 survey scenario questionnaires completed, 79% of staff reported following N95 Airborne precautions when a patient with symptoms of mycobacterium tuberculosis is admitted instead of waiting for the further workup of patient (see Table 2). 71% answered they would re-use the mask which was a practice also reflected during the observations. Two scenario questions were intended to assess the HCWs practice related to a patient undergoing a bronchoscopy however, bronchoscopy personnel were unavailable to participate during the time of observations. Negative pressure of the room and use of a respirator were reported to occur properly by those who answered the survey. Personnel outside of the bronchoscopy suite on an urgent basis can encounter these procedures; however, the frequency of this occurrence is unclear.

Discussion

The written RPP and education tools at the project site were comprehensive and methodical. The program was reflective of the OSHA (n.d.) 1910.134 standard and included a written RPP, an assigned RPP administrator, medical evaluations and clearance, education, and fit testing for use of tight fitting facepiece respirators prior to use. The respirator education was inclusive of proper inspection and use, limitations, how to handle an emergency such as a malfunctioning respirator, cleaning, and storage, and how to recognize medical symptoms contraindicated with the use of a respirator.

The addition of the central intranet location for all RPP resources and the safety line make exposures simple to report whereby providing knowledge of the hazard or potential hazard to the Occupational Safety and Environmental Health department. It is crucial for employers and employees to know the RPP is written and developed in accordance with the law in addition to providing HCWs additional tools for reminders and reporting of exposures, however, plan implementation within clinical care must be equally vital.

Observation and survey questions showed staff were knowledgeable in correctly identifying potentially infectious patients early in care, however, incorrect use and placement of a respirator offers poor protection against the exposure. By continuing the previous practice of re-using the disposable filtering facepiece N95 mask, HCWs are handling a potentially contaminated surface with each subsequent use.

High reliability organizations (HROs) are dedicated to providing an environment of safety for patients and employees to achieve the lowest injury rate possible. While this term and goal has not been at the forefront of healthcare’s awareness in the past, it is a rapidly

changing culture. The focus institution and leadership set a goal to become a HRO by establishing practices and systems supportive of a culture of safety. HROs have identified five core characteristics, which are preoccupation with failure, resistance to simplify incidence, sensitivity to operations, commitment to resilience, and deference to expertise (Chassin & Loeb, 2013). Leadership's dedication to safety was established in daily safety huddles, created ease of reporting through the safety line without retribution, and weekly interdisciplinary reviews of the safety line calls. Responses to identified injuries, hazards, and near misses involved leadership and frontline staff who were able to identify potential barriers whereby alleviating risk in the future.

Limitations

Data collection and analysis from the Modified REACH II observations and clinical scenario questionnaires were rudimentary. Although the observations and completed survey questions were limited to 14, the results were gathered from multiple departments including the complex pulmonary unit, imaging, Cardiac Intensive Care Unit, and included nurses, patient care assistants, and imaging research technologist. A small number of observations were an expected study limitation. Observations occurred as demonstration only. There were no caregivers utilizing an N95 for clinical care at the time of observations.

Implications for Practice

Strategies for Improvement

Strategies for improvement were reviewed and discussed in collaboration with frontline staff, clinical management, RPP administrator, and the Director of Occupational Safety and Environmental Health in order to alleviate risk of respiratory exposure to healthcare workers. Strategies were developed in response to the identified opportunities for improvement.

1. Remind staff and management that reuse of the disposable N95 filtering facepiece is no longer acceptable practice.
2. At the point of use, placement of a mirror and laminated tip sheet duplicating the well-designed slide currently in the RPP education for proper placement of the N95 respirator. This reflects the training during fit testing and prompts staff to visually check proper placement of straps.
3. Engage in-house fit testers to complete routine audits/observations to ensure fit testers and staff remain sharp with the proper usage of respirators and provide Occupational Safety and Environmental Health formal routine program evaluation.
4. Interdisciplinary review of the CDC documentation and activities that support increasing protection to a respirator to care for a patient suspected or known to have seasonal influenza who is undergoing an aerosol generating procedure.
5. Automated monthly reminder from Occupational Safety and Environmental Health to clinical management to review the Respiratory Protection Homepage to ensure staff compliance of Hospital Wide Medical Clearance, Hospital Wide Education Completion, and Hospital Wide Respiratory fit roster. This

emphasizes the importance of assuring only qualified staff care for patients within regulation standards.

Collaboration with Infection Control, Occupational Safety and Environmental Health, and Employee Health will be integral to identifying ongoing exposure concerns, non-adherence to standards of practice, opportunities for improvement within the policy, and practices to mitigate any risk of exposure.

Implications for Nursing Practice

The results of this specific healthcare facility study, as well as the REACH I/II study, provides impetus for those responsible for RPPs to develop more robust program evaluation at the level of clinical care. This assessment identified great strengths of a well-designed and educated RPP as well as a leadership dedicated to a culture of safety. Program evaluation is required by the OSHA standard, however, in order to protect the HCW, areas for opportunity must be identified and the toolkit provided a framework to assess all RPPs.

The implications specifically for occupational health nursing are related to health promotion and disease prevention. The occupational health professional must plan, implement, and evaluate the RPP on a continual basis in order to identify any areas that may place employees at risk. The continual assessment and reassessment was reflected within this study using the PDSA model. The next step will be to “Act” on those recognized opportunities by adjusting the implementation of the plan in clinical care. Through leadership and staff collaboration, the effectiveness of the well-designed program can be enhanced to overcome barriers to proper use of respirators and decreasing the risk of potential exposure to infectious respiratory diseases.

Conclusion

The PDSA quality improvement design along with OSHA’s *Hospital Respiratory Protection Program Toolkit* proved effective for identifying opportunities for growth for one urban acute care facility. Ongoing training and readiness will be imperative to protect HCWs in the event of an outbreak such as a novel or pandemic influenza, measles, or SARS like illness, which would require staff and management to be prepared with respiratory protection to safely care for those patients. While some patients with suspected infectious respiratory illnesses end up not having an identified pathogen, the lessons learned when procedures fail, offer insight into opportunities to better prepare those assigning care and those caring for the potentially infectious patients. For organizations to achieve the status of being a HRO, it is necessary for ongoing program evaluation, recognizing opportunities for enhancement of a program, and reinforcement of skills and best practice.

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Table 1.

Modified N95 Observational Tool

14 observations completed	**Yes**	**No**	**N/A**[b]
Does the employee have any facial hair at the sealing surface of the respirator?	0	14 (100%)	0
Did they wash/sanitize their hands prior to donning (putting on) the respirator?[a]	8 (57%)	6 (43%)	0
Was the respirator donned (put on) outside of the room?[a]	14 (100%)	0	0
Did they inspect the respirator for damage (straps, wet, crumbled)?	6 (43%)	8 (57%)	0
Was the respirator correctly donned (put on) per the manufacturer's instructions? (Top strap placed at crown of head, bottom strap placed at the base of neck under any hair)	6 (43%)	8 (57%)	0
Was the respirator properly formed to the nose?	10 (71%)	4 (29%)	0
Was a user seal check performed?	6 (43%)	8 (57%)	0
Was the respirator properly removed, using the straps only?	6 (43%)	8 (57%)	0
Was the respirator doffed (taken off) outside the patient room?[a]	13 (93%)	1 (7%)	0
Did they wash/sanitize hands after doffing (taking off) the respirator?[a]	8 (57%)	6 (43%)	0
Was the respirator properly disposed of in the usual waste? (If soiled by blood or body fluid, placed in red bag waste)[a]	7 (50%)	7 (50%)	0

[a] Item verbalized during demonstration by health care worker

[b] N/A = not applicable

Table 2.

Survey Scenario Tool

14 completed	**Yes**	**No**	**N/A**[b]
A patient is admitted to your unit with complaints of cough lasting 3 or more weeks, fever, and fatigue. No other information is available prior to your first contact with the patient.			
Do you follow N95 airborne precautions? (hand hygiene, respirator use, proper isolation room with door closed, and removal of PPE[c] after leaving the room)	11 (79%)	3 (21%)	0
Do you wait for further work up to initiate N95 airborne precautions?	4 (29%)	10 (71%)	0
When caring for a patient with suspected or confirmed seasonal influenza, do you put on a droplet facemask for bronchoscopy, suctioning, intubation, or resuscitation?	14 (100%)	0	0
When caring for a patient suspected of having TB who is having a bronchoscopy, is negative pressure in the room established and verified?	11 (100%)	0	3[a]
When caring for a patient suspected of having TB who is having a bronchoscopy is a respirator (N95 or PAPR[d]) put on?	12 (100%)	0	2[a]
When caring for a patient in N95 airborne precautions, when is it acceptable to reuse an N95 mask?	Correct	Incorrect	
When the mask is used for caring for the same patient When the mask is not contaminated with blood or body fluids When the mask is not crumpled, wet, or damaged (X) An N95 mask is never reused[a]	4 (29%)	10 (71%)	
Who is responsible for placing a patient confirmed or suspected of having an infectious respiratory illness in droplet/airborne/N95 airborne precautions? Infection control Physician Patient care nurse (X) Any of the above[a]	Correct 8 (57%)	Incorrect 6 (43%)	

(X) Indicates correct answer

[a] N/A to job duties, therefore not counted into the percentage.

[b] N/A = not applicable

[c] PPE = personal protective equipment

[d] PAPR = powered air-purifying respirator