

INVESTIGATING INFECTION CONTROL BEHAVIORS IN NURSES

Elizabeth L. Beam, PhD, RN
 HEROES Project Coordinator & NBU Educator
 ebeam@unmc.edu




Who is Beth Beam?

- Instructor (HEROES Project Coordinator) since 2005
- Educator (Nebraska Biocontainment Unit) since 2007
- Education:
 - UNMC CON Omaha
 - BSN 2000
 - MSN 2004
 - Started MSIA program for PhD in 2009
 - Graduated with PhD in December 2014




Objectives of this talk...

- By the end of this presentation, the participants will be able to:
 - Explain the different types of isolation and coordinating protective gear.
 - List at least two common errors in the use of personal protective equipment (PPE).
 - Discuss research studies that examine the use of PPE and apply the research findings to practice in many types of nursing care settings and infectious diseases.

Purpose

- The purpose of this study is to better understand the infection control behaviors that nurses demonstrate in practice.
- The project will describe nursing behaviors related to basic airborne and contact precautions using personal protective equipment (PPE) in a simulated care environment.
- Expands on previous pilot study (new study more mobile):
 - Beam, E., Gibbs, S., Boulter, K., Beckerdite, M., & Smith, P. (2011). A method for evaluating personal protective equipment technique by healthcare workers. *American Journal of Infection Control*, 39, 415-420.



Types of isolation

- Contact
 - Gowns, gloves.
- Droplet
 - Standard patient care mask is worn.
- Airborne
 - N95 (filtering face piece) respirator is worn.
- Note: eye protection should be used any time a splash risk is present.



Available Guidance...Challenges.



Review of the Literature

- Healthcare workers frequently demonstrate inconsistent or inadequate infection control behaviors and personal protective equipment (PPE) use.
 - Disease epidemiology studies
 - Observation studies and quality improvement
 - Reviews and Discussion Articles
 - Simulation studies
 - Current events



ROL: Disease Epidemiology Studies

- SARS
 - Ofner-Agostini, M., Gravel, D., McDonald, L. C., Lem, M., Sarwal, S., McGeer, A., et al. (2006). Cluster of cases of severe acute respiratory syndrome among Toronto healthcare workers after implementation of infection control precautions: A case series. *Infection Control and Hospital Epidemiology*, 27(5), 473-478.
 - Record review and phone interviews. Inconsistent PPE use, lack of infection control training.
 - Shigayeva, A., Green, K., Raboud, J. M., Henry, B., Simor, A. E., Vearncombe, M., et al. (2007). Factors associated with critical-care healthcare workers' adherence to recommended barrier precautions during the Toronto severe acute respiratory syndrome outbreak. *Infection Control and Hospital Epidemiology*, 28(11), 1275-1283.
 - Healthcare worker interviews. Knowledge deficits about self-protection.
- H1N1
 - Jaeger, J. L., Patel, M., Dharan, N., Hancock, K., Meites, E., Mattson, C., et al. (2011). Transmission of 2009 pandemic influenza A (H1N1) virus among healthcare personnel—Southern California, 2009. *Infection Control and Hospital Epidemiology*, 32(12), 1149-1157.
 - Baseline and follow up questionnaires and serum testing in two hospital and one outpatient clinic. Adherence to PPE use was inadequate. Mask and respirator use was associated with being seronegative.



ROL: Observation studies and Quality Improvement

- CPR and basic infection control
 - Chiang, W., Wang, H., Chen, S., Chen, L., Yao, Y., Wu, G., et al. (2008). Lack of compliance with basic infection control measures during cardiopulmonary resuscitation: Are we ready for another pandemic? *Resuscitation*, 77, 356-362.
 - Video scoring used, PPE use unsatisfactory, contamination events common among nurses.
- Care for Febrile Respiratory Illness patients
 - Mitchell, R., Roth, V., Gravel, D., Astrakianakis, G., Bryce, E., Forgie, S., et al. (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: 240-244.
 - Large Canadian study, 11 hospitals. Appropriate PPE use was modest, interventions should focus on recommended precautions, pediatric care, sequence, and hand hygiene.
- Contact precautions implementation
 - Mawdsley, E. L., Garcia-Houchins, S., & Weber, S. G. (2010). Back to basics: Four years of sustained improvement in implementation of contact precautions at a university hospital. *Joint Commission Journal on Quality and Patient Safety* 36(9), 418-423.
 - Performance improvement showed that surveillance can improve proper use of contact precautions. No direct observation of provider behavior at bedside.



ROL: Reviews and Discussion Articles

- Hand Hygiene Compliance
 - Erasmus, V., Daha, T. J., Brug, H., Richardus, J. H., Behrendt, M. D., Vos, M. C., et al. (2010). Systematic review of studies on compliance with hand hygiene guidelines in hospital care. *Infection Control and Hospital Epidemiology* 31(3), 283-294.
 - Median compliance rate of 40%. Poor study methods and reporting. Universal problem which needs standardized research methods and monitoring.
 - Larson, E. (2013). Monitoring hand hygiene: Meaningless, harmful, or helpful? *American Journal of Infection Control*, 41, S42-S45.
 - Discusses best mechanisms for performance improvement in hand hygiene.
- Contact Precautions?
 - Zastrow, R. L. (2011). Emerging infections: The contact precautions controversy. *American Journal of Nursing*, 111(3), 47-53.
 - Controversy will continue due to lack of solid research in the area.



ROL: Simulation Studies



- Whyte, J., Cormier, E., & Pickett-Hauber, R. (2010). Cognitions associated with nurse performance: A comparison of concurrent and retrospective verbal reports of nurse performance in a simulated task. *International Journal of Nursing Studies*, 47, 446-451.
 - Simulation to study nurses caring for acute congestive heart failure patients.
 - Uses Think Aloud (both concurrent and retrospective).
- Watson, C. M., Duval-Arnould, J. M., McCrory, M. C., Froz, S., Connors, C., Perl, T. M., & Hunt, E. A. (2011). Simulated pediatric resuscitation use for personal protective equipment adherence measurement and training during the 2009 influenza (H1N1) pandemic. *The Joint Commission Journal on Quality and Patient Safety*, 37(11), 515-523.
 - In situ simulations to measure PPE adherence, PPE confidence, elapsed time to resuscitation, and deviation from AHA guidelines.
 - Measured with surveys and video scoring.

ROL: Current Events



- Ebola 2014:
 - August: Transmission to healthcare workers providing care in countries of epidemic. Need for Biocontainment Care realized.
 - October: Transmission to healthcare workers providing care to Ebola patient in the United States. Need for increased PPE guidelines realized (<http://www.cdc.gov/vhf/ebola/hcp/procedures-for-ppe.html>).
 - Links to UNMC CON HEROES website for examples.
- Ebola Virus:
 - Primarily a contact disease, droplet precautions
 - High risk of transmission with aerosol generating events and procedures
 - High mortality rate, fear factor

“So what?”

- The biggest and best research question.
- Healthcare associated infection remains a significant challenge internationally. Suboptimal infection control behaviors play a large role.
- A study of infection control behaviors in nurses was needed.



Project Funding

- Donated:
 - Existing equipment (Cameras, Laptops, Clamps, Batteries)
 - Time
- Budget: Expenses less than \$1,000.00
 - Purchased one additional GoPro Camera, some SD cards and batteries.
 - PPE Equipment, was able to use isolation cart at no cost.
 - Paid participants the IRB approved amount for study participation in cafeteria meal tickets (\$12.50 per hour).



Identifying nurses and recruiting...



- UNMC IRB approved study #450-12
- Inclusion Criteria: Participants must be employed at least 0.5 FTE in work where they provide direct patient care as a registered nurse in Nebraska.
- Exclusion Criteria: Nurses who participated in the 2009 pilot work will be excluded from this study.
- IRB approved email message sent to nurses via nurse managers.
- Later a flyer was developed to boost recruitment and it was shared in person at management meetings in hospital. Direct contact with managers also helped with recruitment.

Methods



- Patient room had a portable video recording system.
- One performance of a simulation with a live standardized patient. The patient required airborne and contact precautions (Similar to Beam, et al., 2011 study).
- Nurses were to conduct the health assessment and give an intravenous pain medication.
- Nurses viewed their performance immediately following the experience on a computer and discussed their performance (using Think aloud concept, Ericsson & Simon, 1993).

Study process (with time estimation):

- Consent, orient to simulation room and equipment (10 minutes)
- Simulation experience (15-20 minutes)
- Debriefing/Think Aloud (15-20 minutes)
- Demographic survey (5 minutes)
- Range of motion to camera (5 minutes)
- At one month, emailed survey (5-10 minutes)



Entering the room...



Room Set Up



Study Sample (n=24)

Age		
Mean		33.5 years of age
Range		24 to 61 years of age
Degree		
Masters of Science in Nursing		1
Bachelors of Science in Nursing		21
Associates Degree		1
Diploma Program		1
Years in Nursing		
< 5		13
5 to 10		6
11 to 15		1
16 to 20		1
> 20		3
History of Bloodborne Pathogen Exposure		
Yes		10
No		14
Gender		
Male		3
Female		21

Video Scoring Experience

- Scoring sheet developed from CDC Guideline (2007).
- What is it like?
 - Hospital PPE – Not quite right
 - <https://www.youtube.com/playlist?list=PL4St4k9FHU3oq0W3TrnHnD1xTyCy8P->

Qualitative Data Review

- Transcribed all audio recordings from the debriefings.
 - Two main parts to debriefing:
 - Video Review – comments while their performance played on screen.
 - Participant was cued about use of COW.
 - CDC Guideline Review – Comments while looking over CDC Guidelines (2007).
- Using three main headings, coded all comments.
 - Donning issues
 - In room issues
 - Doffing issues



Hypotheses Review

- The expected quantitative findings were: *poor fit-check of the N95 in donning, not securing the gown at both the neck and waist, removing contaminated items from the room, doffing items out of order, and poor hand hygiene compliance.*
- The expected qualitative findings were: *nurses would recognize the need for self-protection, nurses would copy behaviors of their peers and superiors, compliance would be prioritized over safety, and nurses would feel that strict infection control behaviors were unnecessary because they were already colonized.*





Manuscript Overview

- #1: Methods Paper
- #2: COW Use
- #3: Variations in Practice

Manuscript #1 (Published in AJIC)



- REFERENCE: Beam, E. L., Gibbs, S. G., Hewlett, A. L., Iwen, P. C., Nuss, S. L., & Smith, P. W. (2014). Method for investigating nursing behaviors related to isolation care. *American Journal of Infection Control*, 42, 1152-1156.
- Purpose: Methods paper, study overview
- Contribution to the literature:
 - Expands on pilot work: larger sample, single population
 - Describes the inexpensive, portable video scoring system used in the study
 - Shares qualitative data from participating nurses
 - Outlines knowledge deficits and educational needs
 - Key issues: gowns, respirator use, eye protection
 - Forecasts future study designs to include examining behavior change over time as well as different types of providers and settings

Example: Video Scoring Data

Quality of Donning	MET	NOT MET
1) Perform hand washing	21	3
2) Gown right side out	14	10
3) Tie gown at neck and waist	6	18
4) Ties done in bow (secure but easy to untie)	8	16
5) Don N95 Respirator	24	0
6) Seal N95 Respirator (fit snug to face and below chin)	10	14
7) Fit-check the N95 Respirator	0	24
8) Respirator straps positioned correctly (placed behind head and at base of neck)	12	12
9) Don eye protection	2	22
10) Don gloves with gown cuffs under the glove covering wrist of isolation gown	16	8



Manuscript #1



- Interesting findings
 - Poor use of gown ties, eye protection
 - No fit-check of respirator (10 of 24 nurses performed an intentional seal of respirator), poor strap placement half of the time
 - Poor gown control on doffing
 - Poor execution of respirator removal
- Remaining questions?
 - What is the best standard for eye protection use and cleaning?
 - Can we standardize education for nurses on respirator use?
 - Emphasize differences for men vs. women
 - How different is performance in a high stress situation, fatigue?

Manuscript #2 (Submitted to CIN)



- REFERENCE: Beam, E. L., Gibbs, S. G., Hewlett, A. L., Iwen, P. C., Nuss, S. L., & Smith, P. W. (Submitted). Evaluating isolation behaviors by nurses utilizing computer workstations at the bedside. *Computers, Informatics, Nursing*.
- Purpose: Focus on computers on wheels (COW) use challenges in isolation care
- Contribution to the literature:
 - Examines infection control behaviors related to COW use.
 - Identified contamination events and decontamination issues upon leaving the patient room.
 - Shared the lived experience of nurses who use COWs in patient care with isolation patients.
 - A doffing process including a COW which follows the current infection control guidance is shared.



Manuscript #2

- Interesting findings in the 18 nurses:
 - Two nurses did not disinfect the COW at all.
 - Four nurses used gloves from the isolation cart to disinfect the COW, reaching in with potentially contaminated hands.
- Remaining questions?
 - Should COWs be stationed permanently in isolation rooms? What are the current nationwide COW to patient ratios?
 - What is the best process for leaving an isolation room with a COW?
 - How do we overcome COW disinfection challenges? Who should perform the cleaning? How should it be done? Do we need better technology?



Manuscript #3 (Published in AJN)

- REFERENCE: Beam, E. L., Gibbs, S. G., Hewlett, A. L., Iwen, P. C., Nuss, S. L., & Smith, P. W. (Submitted). Clinical Challenges in Isolation Care: Safe Practices for Nurses at the Bedside. *American Journal of Nursing*.
- Purpose: To share safe practices in infection control based upon clinical challenges identified in our study.
- Contribution to the literature:
 - Discusses importance of sequencing in safe infection control processes.
 - Discusses the variations in practice seen in the study.
 - Specific concerns with gowns and gloves, respiratory protection, and protective eyewear are addressed.



Example of sequencing data...

Participant Number	Doffing Order, n = 24 nurses
1	Gown, Gloves, N95 in room, HH
2	Unties bottom tie of gown, Gloves, Gown, N95 out of room, HH
3	Gloves, HH, Gown, N95 in room
4	Gown and one glove removed together, N95 in room with ungloved hand, Second glove, HH
5	Gloves, Gown, HH, N95 out of room, HH
6	Gloves, Eye protection, N95 in room, Gown, HH
7	Gloves, HH, Gown, HH, N95 out of room
8	Gloves, Gown, HH, N95 out of room, HH
9	Gloves, HH, Gown, N95 out of room, New gloves from isolation cart to clean equipment, Gloves, HH
10	Gloves, Gown, New gloves applied in room to clean equipment, Gloves, N95 out of room, HH



Hypotheses Realized...

- The expected quantitative findings were: **poor fit-check of the N95 in donning, not securing the gown at both the neck and waist, removing contaminated items from the room, doffing items out of order, and poor hand hygiene compliance.**
- The expected qualitative findings were: **nurses would recognize the need for self-protection, nurses would copy behaviors of their peers and superiors, compliance would be prioritized over safety, and nurses would feel that strict infection control behaviors were unnecessary because they were already colonized.**



Overall Discussion of Findings

- SA #1: Behaviors
 - Future scoring documents will be based upon WHO donning and doffing guidelines (see Guidelines Comparison – next slide).
 - Isolation signage should include images to remind nurses about the need for eye protection when splash risk is present.
 - More eyewear guidance is needed in hospitals for clinical caregivers.



Guidelines Comparison

	Centers for Disease Control (2007)	Public Health Agency of Canada (2011)	World Health Organization (2008)
Donning			
1.	Gown	Hand Hygiene	Gown
2.	Mask or Respirator	Gown	Face shield OR Mask and Eye Protection
3.	Goggles or Face Shield	Mask/N95 Respirator	Gloves
4.	Gloves	Protective Eyewear	N/A
5.	N/A	Gloves	N/A
Doffing			
1.	Gloves	Gloves	Gloves and Gown
2.	Goggles or Face Shield	Gown	Hand Hygiene
3.	Gown	Hand Hygiene	Face shield OR Eye Protection, then Mask
4.	Mask or Respirator	Eye Protection	Hand Hygiene
5.	Hand Hygiene	Mask/ N95 Respirator	N/A
6.	N/A	Hand Hygiene	N/A

Overall Discussion of Findings

- SA #2: Rationales
 - Reemphasized concerns related to:
 - Respirator safety
 - Eye protection
 - Gown fit
 - Nurses need to be empowered to address their safety concerns and seek out the necessary accommodations.
- SA #3: Timing of changes
 - Very open and simple part of the study.
 - Results supported future designs which use a rapid test-retest design to look at behavior change.

Overall Study Limitations

- Sample size/recruitment
 - Target 30, but achieved saturation at 24.
- Only one discipline
- Lack of an interactive EMR
- Hawthorne effect (Video Recording)



Other potential manuscripts...



- In depth analysis of behaviors related to the respirator (clinical challenges with respiratory protection in patient care)...particularly regarding adjustments in the room, impacts of eyewear, how strap placement impacts in room activities, one strap users (we had two), removal, etc.
- Primarily qualitative data paper. Focus on intentional errors vs. unintentional errors.
- If x, then how often did y occur? X=poor donning, Y=consequence/contaminating behavior

Potential Future Research



- Use the study method to evaluate other clinical behaviors:
 - Chemotherapy administration
 - Urinary Catheterization
 - Tx of Highly infectious patients
- Expanded testing of the consequences of certain donning errors:
 - Respirator strap placement
 - Poor gown securing
- Behavioral intervention studies
 - Lecture vs. Online/Interactive Learning Modules

Potential Future Research



- Factors that impact performance
 - Fatigue
 - Day shift vs. Night shift
 - Alcohol consumption/Impaired clinician
- Going beyond healthcare workers, infection control behaviors
 - Hospital visitors
 - Family caregivers

Potential Future Research

- Smaller project ideas:
 - Can small particles of *Mycobacterium Tuberculosis* be captured in gloves from an aerosol? Determine the risk for re-aerosolization when gloves are removed.
 - How much splash is created during certain routine patient care tasks at the bedside? Establish high splash risk activities to help nurses prioritize when cleaning of protective eyewear is needed.



Future directions...

- Continue to support response to the current Ebola outbreak and the understanding of appropriate infection control processes in US and international hospitals for isolation as part of the Nebraska Biocontainment Unit Leadership Team.
- These types of studies may have value to safety organizations as well as device manufacturers. May lead to improvement in device specifications and instructions for end users.



List of Conspirators



- | | |
|------------------|--------------------|
| • Shawn Gibbs | • Nedra Marion |
| • Philip Smith | • Jarrod Carley |
| • Pete Iwen | • Jill Hallgren |
| • Sue Nuss | • John Sherlock |
| • Eleanor Rogan | • Kevin Epperson |
| • Andrew Jameton | • Karen Schumacher |
| • Angela Hewlett | • Julia Houfek |
| • Stephen Smith | • Marlene Cohen |
| • Andrea Gaydoss | |

List of Supporters



- Connie Miller
- Carol Pullen
- Shelly Schwedhelm
- Kate Boulter
- Tiffany Moore
- Family and friends
- All of the nurses who participated in the study.

Thank you

- Questions?
- Contact info:
UNMC College of Nursing
Elizabeth L. Beam
(402) 559-6547
ebeam@unmc.edu


