DOUBLE-GLOVING

ARE YOU EXPOSED?
CONTINUING NURSING AND ALLIED HEALTH EDUCATION PROVIDER
Paula is the Director of the Department of Surgery at Inova Fairfax Medical Campus. She has been a perioperative nurse for over 30 years with the Inova Health System. Paula served on the Board of the Association of periOperative Registered Nurses (AORN) and as National President from 2006-2007. She is a 2013 Fellow of the American Academy of Nursing. Paula received her BSN and her MSN from George Mason University and a Doctorate of Nursing Practice with a focus on patient safety at Johns Hopkins University.
LEARNER OBJECTIVES

PARTICIPANTS WILL BE ABLE TO:

• Understand the risk factors associated with glove perforations
• Discuss the impact of occupational exposure on healthcare workers today
• Review the role of gloves in patient safety and impact on surgical site infections (SSIs)
• Summarize literature that supports the use of double-gloving for protecting patients and healthcare workers
• Uncover barriers and challenges to adoption of double glove technique
• Discuss recommendations and strategies increasing double-gloving practice
• Surgical team members are exposed to percutaneous, infectious materials (including blood/bodily fluids) in as many as 50% of surgical procedures.  

• Blood-to-hand contact occurs in at least half of these exposures.

Reference:
1 Childs T. Use of double gloving to reduce surgical personnel’s risk of exposure to bloodborne pathogens: an integrative review. AORN. 2013;98(6):585-596.
WHY DO YOU GLOVE?

TWO MAIN ROLES FOR GLOVES

Prevent gross contamination of healthcare workers from:
- Blood
- Body fluids
- Secretions

Reduce risk of contamination of patients:
- Excretions
- Mucous membranes
- Non-intact skin

GLOVES PROVIDE PHYSICAL, CHEMICAL, AND BIOLOGICAL PROTECTION

References:
EVOLUTION OF GLOVES:
FROM PROTECTING YOU TO PROTECTING YOUR PATIENTS

• Gloves entered healthcare practices more than 250 years ago \(^1\)

1758
- Johann Walbaum, Germany
  - Material: Sheep cecum
  - Purpose: Mechanical protection of the healthcare worker when performing gynecological examinations

End of 1700s
- Joseph Plenk, Australia
  - Purpose: Protect midwives from contracting syphilis from infected patients

1889
- William Halsted, Johns Hopkins Hospital
  - Material: Rubber
  - Purpose: Chemical protection of scrub nurse from disinfecting agent

1914
- World War I
  - Purpose: Widespread adoption

1890
- Joseph Colt Bloodgood, Johns Hopkins Hospital
  - Purpose: Noted reduction in infections after hernia surgery

Reference:
GLOVE PERFORATIONS:

THE STARK TRUTH
GLOVE PERFORATIONS ARE MORE COMMON THAN YOU MAY THINK

• Gloves can be torn, perforated or weakened ¹

• **1 in 10** chance of perforating single layer glove during low-risk surgical procedure ²
  - Frequency of perforations can range from **3%** to **12%** ³,⁴

References:
BEWARE OF COMMON CULPRITS¹-³

NEARLY 3 OUT OF 4 BLOOD/BODY FLUID EXPOSURES OCCUR DUE TO PERCUTANEOUS INJURY⁴

- Needles
- Scalpel
- Bone fragments

- Sharp surfaces of complex instruments

- Chemicals
- Natural wear and tear

- Glove defects

References:
INCREASING THE LIKELIHOOD FOR GLOVE PERFORATION

- Type of surgery
  - Bone vs. soft tissue
  - Emergency vs. scheduled
  - Manual tissue retraction
  - Restricted field
  - Laparoscopic vs. open
- Length of surgery
- Complexity of instrumentation
- Number of instruments used during procedure
- Role of healthcare personnel
- Healthcare personnel experience
- Human fatigue
- Improper fitting gloves

References:
ALL SURGICAL PROCEDURES RISK PERFORATIONS

RANGE OF PERFORATIONS BY PROCEDURE $^{1-3}$

- **7%** Urological Surgery
- **18%** Average for all types of procedures $^1$
- **65%** Cardiac Surgery

- Highest rates: $^2$
  - Orthopedic, trauma, and thoracic
- Laparoscopic procedures have rate of perforations $\sim20\%$ $^1$

ALL SPECIALTIES HAVE CONSIDERABLE RISK OF PERFORATION

References:
• Glove puncture rates AND bacterial counts increase with increasing operation times ¹

• Mean perforation time was 70 minutes after initiating operation ²

• Glove perforation risk increases 1.115 times for every 10 minutes of surgical time ³

• Perforation rates significantly lower when gloves were changed at 20 minute intervals ¹

References:
Gloves from different manufacturers have high level of variability

Failure rate of surgical gloves can vary by brand
- One study found failure rates from 1% to nearly 6% depending on the glove manufacturer (a 3.5 times difference)

Impact of in-use failure
- Increase risk of exposure to pathogens
- Cost and time needed to replace gloves

References:
1. MHC study #G09-005

FDA ALLOWS 2.5% OF NEW UNUSED STERILE GLOVES TO FAIL STANDARDIZED QUALITY CONTROL TESTING
PERFORATIONS GO UNRECOGNIZED BY THE NAKED EYE

UP TO 96% OF GLOVE PERFORATIONS MAY GO UNRECOGNIZED

Single glove perforation may go unnoticed since less force is needed to perforate the glove barrier.

Bacterial migration discovered in **over half** of micro-perforations

- *Ex. Micrococcus luterus*, *Enterococci*, and *E. coli*

References:
SHARPS INJURY
Overall occurrence of sharps injuries: 44.32 per 100 occupied beds per year in teaching hospitals (16.88 per 100 in non-teaching hospitals) 1

99% of all surgeons have experienced a needle stick injury at some point according to a large survey 2
  - Average number of instances was 8 times over 5 year span 2
  - More common in emergency settings than elective 3

Despite high number, only ½ actually reported their injuries 2
  - Underreporting due to inconvenience, unnecessary, or considered “part of the job” 4

Instruments with infectious material and the quantity of pathogens present will determine risk of pathogen transmission 2

600,000-800,000 PERCUTANEOUS INJURIES OCCUR IN U.S. EACH YEAR AMOUNTING TO $500 MILLION IN DIRECT MEDICAL COSTS 5

References:
1 Nassiry A. Adherence to the American College of Surgery (ACS) recommendation on double gloving, free zone and blunt suture needle use among Surgeon ranks. VCU Theses and Dissertations. Paper 2221.
FACTORS ASSOCIATED WITH RISK OF PERCUTANEOUS INJURY

CAUSES OF PERCUTANEOUS INJURY

1. Types of devices and procedures
2. Lack of access to or sub-optimal use of protective equipment
3. Professional inexperience
4. Subjective perception of risk
5. Improper management of sharps

• High workload, fatigue, mental pressure
• Working alternate shifts

16% of sharps injuries occur during the passing of sharp instruments

References:
NURSES AT HIGHEST RISK OF SHARPS INJURIES

61% of sharps injuries are classified as preventable.¹

Percent of sharps injuries by occupation:¹
- Technicians: 18%
- Physicians: 25%
- Nurses: 41%

Percent of sharps injuries by work location:¹
- Inpatient wards: 36%
- ICUs: 28%
- Outpatient: 7%
- ED: 7%
- Other: 13%

References:
NEEDLESTICK MOST COMMON SHARPS INJURIES

DEVICES INVOLVED IN PERCUTANEOUS INJURIES
(N=13,731)

- Hollow-bore needle, 59%
- Suture Needle, 19%
- Scalpel, 7%
- Other, 8%
- Glass, 2%
- Other/unknown, 6%

MECHANISMS OF INJURIES

- Manipulating the needle in a patient
- During sharps disposal
- Improper disposal
- During clean-up
- Colliding with worker or sharp
- During recapping
- When accessing an IV line
- When transferring or processing specimens
- While handling or passing equipment
- In transit to disposal

SPECIFICALLY IN THE OR, SUTURE NEEDLES ARE THE MOST COMMON CAUSE OF PERCUTANEOUS INJURY (UP TO 43%)

References:
1 Center for Disease Control and Prevention. Sharps Injury Prevention Workbook.
COMMON LOCATIONS OF NEEDLESTICK INJURIES

MOST OCCUR IN NON-DOMINANT HAND $^{1,2}$

References:
SHARPS STRATEGIES AND AWARENESS PROGRAMS

SHARPS SAFETY AGENDA

- Blunt-tip suture needles
- Alternatives to using needles
- Safety-engineered devices
- Hands-free technique
- Neutral passing zone
- Double-gloving
- Multidisciplinary support
- Education
- Adequate staff-to-patient ratio
- Sharps injury log

(43%) surveyed perioperative staff nurses and unit directors on surgical sharps safety report lack/unaware of sharps education plan

2 out of 5

References:
EXPOSING THE HEALTHCARE WORKER
PERSONAL PROTECTIVE EQUIPMENT:

PROTECTING YOU, YOUR FAMILY, AND SOCIETY

• Caring for patients with communicable diseases places healthcare workers at risk for exposure

• Healthcare workers can further spread infectious agents to other healthcare workers, their families, or other patients

• Personal protective equipment protects healthcare worker’s mucous membranes, airways, skin, and clothing from infectious materials
  • Personal protective equipment includes gloves, gowns, eye protection, masks and respirators

Reference:
TRANSMISSION OF INFECTION TO HEALTHCARE WORKERS

- Sharps injuries increase risk of both bacterial and viral cross infection \(^1\)
  - For example, as many as 18,900 *S aureus* bacteria could pass through a single needle hole in a gloved finger in 20 minutes \(^1\)
- Cuts/grazes in the skin also increases infection risk \(^2\)
  - Skin integration disrupting lesions detected in 13% of surgical teams prior to surgery \(^2\)

References:
• Reports of at least 60 different blood-borne pathogens can be transmitted to healthcare workers due to accidental exposures
  - 26 viruses, 18 bacteria/rickettsia, 13 parasites, and 3 yeasts
• ~1% of Americans carry at least one type of blood borne infection

References:
**ARE YOU PREPARED FOR LONG-TERM CONSEQUENCES?**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Consequences of the disease</th>
<th>Transmission of virus</th>
<th>Number of cases due to percutaneous injuries (2004)</th>
<th>Risk of infection with sharps injury</th>
<th>Blood and bodily fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEPATITIS B (HBV)</strong></td>
<td>100-200 healthcare workers die each year from HBV(^1); can cause prolonged illness, cirrhosis, liver cancer, and/or death (^2)</td>
<td>(^2)</td>
<td>66,000</td>
<td>(^6),(^7)</td>
<td>Blood and bodily fluids</td>
</tr>
<tr>
<td><strong>HEPATITIS C (HCV)</strong></td>
<td>80% progress to chronic hepatitis; can cause cirrhosis, liver cancer, and/or death (^2)</td>
<td>(^5)</td>
<td>16,000</td>
<td>(^8)</td>
<td>Blood</td>
</tr>
<tr>
<td><strong>HIV</strong></td>
<td>1 in 8 Americans with HIV are unaware they are infected; (^3) progresses to AIDS within 10 years if not treated (^4)</td>
<td>(^6)</td>
<td>1,000</td>
<td>(^9)</td>
<td>Blood and bodily fluids</td>
</tr>
</tbody>
</table>

**References:**
ECONOMIC IMPACT OF HEALTHCARE WORKER EXPOSURE

• $188.5 million in combined medical and work productivity in 2004
  • Direct and indirect costs associated with sharps injuries can range from hundreds to thousands of dollars per exposure

• Impact on: Morbidity, Mortality, Productivity
  • Lost time from work
  • Quality of life
  • Emotional
  • Litigation
  • Drug toxicity
  • Further virus spread

• Economic burden on hospitals to manage occupational exposure (blood tests, treatments, outpatient visits, lost working hours)
  • Occupational exposure management alone can be up to $5,000 per case

References:
1. Nassiry A. Adherence to the American College of Surgery (ACS) recommendation on double gloving, free zone and blunt suture needle use among Surgeon ranks. VCU Theses and Dissertations. Paper 2221.
EXPOSING THE PATIENT
HOW SAFE ARE YOUR PATIENTS?

- Over half of surgical procedures are contaminated at the end of procedure
  - 42% of these incidents were not due to patient’s flora
  - 33% of devices that cause injuries come in contact with the patient after injury to the healthcare worker

References:
SURGICAL SITE INFECTIONS POSE SEVERE CONSEQUENCES

• **1 in 20** surgical patients will suffer from an SSI

• **Impact of SSIs**
  - **60%** more likely to be admitted to ICU
  - Up to **6x** higher risk for 30-day readmission
  - Longer hospital stays and higher risk of mortality
  - Nearly **$100,000** per patient in direct and indirect costs

• SSIs are directly correlated to wound contamination from patient, surgical team, and surgical intervention factors

• Approximately **60%** of SSIs are preventable amounting to up to **$6 billion** in potential cost savings

References:
GLOVE PERFORATIONS RE-CLASSIFY WOUND STATUS

Class IV
Dirty or infected
- Old trauma wounds with retained devitalized tissue
- Existing clinical infection or perforated viscera

Class III
Contaminated
- Open, fresh accidental wounds
- Major breaks in sterile technique or gross spillage from GI tract
- Acute, non-purulent inflammation is encountered

Class II
Clean-contaminated
- No infection or major break in technique
- Respiratory, alimentary, genital, or urinary tract are entered under control conditions without unusual contamination

Class I
Clean
- Not infection/inflammation, no entry into respiratory, alimentary, genital, or urinary tract
- Closed and drained with closed drainage, if necessary

Reference:
ELEVATED RISK OF SSIs WITH GLOVE PERFORATION

GLOVE PERFORATIONS AND SSIs

• Glove leakage occurred in **16.3%** of all cases

• Glove perforations increased risk of SSI by **2x** overall, and over **4x** when antibiotic prophylaxis is not administered

Reference:
ELEVATED RISK OF SSIs WITH GLOVE PERFORATION

4.5%
OVERALL SSI RATE
(188/4,147 PROCEDURES)

3.9%
SSI RATE WITH NO GLOVE PERFORATIONS

7.5%
SSI RATE IN PROCEDURES WITH GLOVE PERFORATIONS

NO ANTIBIOTIC PROPHYLAXIS

2.9%
SSI RATE WITH NO GLOVE PERFORATIONS

12.7%
SSI RATE IN PROCEDURES WITH GLOVE PERFORATIONS

Reference:
CASE STUDY: SURGEON INFECTS CARDIAC PATIENTS

CEDARS SINAI MEDICAL CENTER

- Surgeon infected 5 patients during valve replacement due to tears in surgical gloves

IMPACT ON PATIENTS
4 out of 5 required second valve replacement

IMPACT ON HOSPITAL
Hospital covered total cost of care of affected patients

- Hospital-wide changes were implemented
  - Change gloves more frequently and use of double gloves

Reference:
The Affordable Care Act (ACA) initiative is to align payment with healthcare quality

As of October 2008, CMS will not reimburse hospitals for the additional expenses of treating certain hospital acquired infections (HAIs), including SSIs

Currently, all acute care hospitals must report SSI data for selected surgical procedures to receive full annual reimbursement

In 2016, CMS instituted a 1% payment reduction on hospitals in lowest 25% rank for SSIs compared to national standards

References:

SSIs ≠ REIMBURSEMENT
DOUBLE-GLOVING:

COVERING YOU AND YOUR PATIENTS
DOUBLE GLOVES SIGNIFICANTLY REDUCES RISK OF PERFORATION

**Perforation Rates**

- Single Glove: 9%
- Double Glove: 2%

2006 meta-analysis of 14 low-risk surgical trials utilizing total of 8,885 gloves

**Odds Ratio**

- Single Glove: 1
- Double Glove: 0.25

4x LOWER RISK OF PERFORATIONS WITH DOUBLE GLOVES

2006 meta-analysis of 14 low-risk surgical trials utilizing total of 8,885 gloves

**Risk Reduction**

- When using double gloves vs. single gloves
- Healthcare worker risk is significantly decreased by 71%
- 2014 meta-analysis of 12 surgical trials including 3,437 patient procedures

CUMULATIVE EVIDENCE SUPPORTS THE PRACTICE OF ‘DOUBLE-GLOVING’

References:

DOUBLE GLOVES LOWERS PASSAGE OF BLOOD/BODILY FLUID

- Double layers of gloves wipe off substantial amount of blood/bodily fluid that may reside on penetrating object ¹
- Double gloves reduced risk of blood exposure by 85% when outer glove was punctured ²

DOUBLE GLOVES REDUCE VIRAL LOAD IN THE EVENT THAT INNER AND OUTER GLOVE PERFORATIONS OCCUR

References:
DOUBLE-GLOVING DECREASE VIRUS TRANSFER WITH GLOVE REMOVAL

**FREQUENCY OF VIRUS TRANSFER**

Single-gloves significantly transferred virus more frequently to participants’ hands during protective equipment removal than double gloves (78% vs. 23%)

**AMOUNT OF VIRUS TRANSFER**

Single gloves significantly transferred more virus to participants’ hands than with double-gloving

**CDC RECOMMENDS DOUBLE-GLOVING FOR HANDLING CONFIRMED AND SUSPECTED CASES OF EBOLA**

Reference:
DOUBLE-GLOVING MAY INFLUENCE CAUTIOUS BEHAVIOR

- 2014 Cochrane meta-analysis\(^1\)
  - Double gloves reduced the number of reported needlestick injuries by **42%** in two studies
  - Overall outer glove perforation rate did not significantly differ between single versus double gloves

References:
CASE STUDY:

DOUBLE-GLOVING SUBSTANTIALLY REDUCES SHUNT INFECTIONS

- 2006 retrospective study Vanderbilt University Medical Center
  - Purpose: determine effect of double-gloving on cerebrospinal fluid (CSF) shunt infections
  - Overall infection rate: **11.8%** (102/863 shunts)
  - **2.3x greater risk** of shunt infection when single gloves are used compared to double gloves

Reference:
CASE STUDY:

• 2007 prospective, cohort study at University of Florida College of Medicine OB/GYN Department

  • Purpose: compare frequency of glove perforations in double vs. single glove
  • Tested 1000 sets of gloves (675 sets were double glove and 325 sets were single glove)

RESULTS

• No difference in total perforation rate of outer gloves (10% double-glove vs 11% single glove)

• Potential for blood-skin exposure was significantly greater for single gloves (p<.01)
  • 11% of single gloves vs. 2% of double gloves with both inner and outer perforations

Reference:
• Use of indicator glove allows punctures to outer glove to be more visually revealed when they occur\textsuperscript{1,2}

References:
### EARLIER IDENTIFICATION WITH INDICATOR GLOVES

#### RAPID IDENTIFICATION

<table>
<thead>
<tr>
<th>Glove Type</th>
<th>Detection Rate</th>
<th>Time to Detect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latex Indicator Glove</td>
<td>84%</td>
<td>22 seconds</td>
</tr>
<tr>
<td>Latex Standard Glove</td>
<td>8%</td>
<td>47 seconds</td>
</tr>
<tr>
<td>Synthetic Indicator Glove</td>
<td>56%</td>
<td>42 seconds</td>
</tr>
<tr>
<td>Synthetic Standard Glove</td>
<td>12%</td>
<td>67 seconds</td>
</tr>
</tbody>
</table>

Evidence supports use of color indicator system for detecting perforations when double-gloving.

References:
UNCLEAR EFFECTS OF OTHER GLOVE BEHAVIORS

**THICKER GLOVES**
- Significantly less fluid was transmitted and more force was required to puncture with double, thin glove layer compared with single thick layer

**TRIPLE GLOVES**
- May further reduce risk, but more research is necessary

**SPECIAL MATERIAL GLOVES**
- May further reduce risk, but more research is necessary

Researchers concluded that "prevention of percutaneous exposure incidents can be successfully achieved with an increase in the number of glove layers, rather than by increasing the thickness of gloves".

References:
A RECOMMENDED PRACTICE ACROSS SOCIETIES
DOUBLE GLOVE ADOPTION IS LOW DESPITE SUPPORTIVE DATA

- Fewer than 1/3 of surgeons report using double-gloving in >75% of cases

<table>
<thead>
<tr>
<th></th>
<th>ATTENDINGS</th>
<th>RESIDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use double-gloving in &gt;75% of the time</td>
<td>29%</td>
<td>36%</td>
</tr>
<tr>
<td>Aware of ACS guideline for double-gloving</td>
<td>68%</td>
<td>58%</td>
</tr>
<tr>
<td>Agree double-gloving reduces injuries</td>
<td>55%</td>
<td>62%</td>
</tr>
</tbody>
</table>

Reference:
WHY HEALTHCARE WORKERS CHOOSE NOT TO DOUBLE GLOVE

- Discomfort and/or too tight \(^1\-^3\)
- Perceived restriction of dexterity \(^2,^3\)
- Habit of not using \(^1\)
- Impaired sensation of touch/tingling \(^2,^3\)
- Uninformed about consequences of blood and body fluid contamination \(^4\)

ONE STUDY FOUND OVER 50% OF HEALTHCARE RESPONDENTS DON’T BELIEVE DOUBLE-GLOVING PROVIDES ADDDED PROTECTION\(^1\)

References:
BAD HABITS CAN BE BROKEN

• One study showed 88% of study participants accepted wearing double gloves when asked \(^1\)

• Double-gloving becomes instinctive to those exposed in the beginning their training \(^2\)

References:
TACTILE SENSITIVITY IS PERCEIVED BUT UNSUBSTANTIATED

- Several studies concluded double-gloving has similar tactile sensitivity to single gloves as shown by: 1-4
  - Similar dexterity performance scores  
  - Ability to tie surgical knots  
  - "Dice test"  
  - 2-point discrimination test compared to single gloves

- Overall outer glove perforation rate did not significantly differ between single versus double gloves 5

- One study reported 88% of the study participants who reported double gloves as acceptable did not perceive any decrease in tactile sensitivity 6

- Double-gloving also does not impede with "feeling" a needlestick 7

References:
IMPLEMENTING A DOUBLE GLOVE PROTOCOL
KNOW THE BARRIERS TO CHANGE

- A 2015 study found that risk perception and healthcare culture are more influential in determining gloving practice rather than personal characteristics¹
  - Knowledge and training gaps ²
  - Misperception of risk ²,³
  - Concerns of decreased tactile sensation ²
  - Lack of promotion by leadership ²
  - Hospital/healthcare culture ²,³
  - Availability and access to supplies ³

References:
SUCCESSFULLY IMPLEMENTING DOUBLE GLOVE PROTOCOL

CHECKLIST 1,2

- Obtain “buy-in” from leadership
- Provide education on rationale for change (i.e. risks, consequences)
- Promotion of relevant literature to disprove misconceptions (i.e. tactile sensitivity)
- Train on safety techniques and proper glove selection
- Preoperative checklist
- Ensure gloving resources are available
- Institutional policy change, mandating adoption
- Monitor personnel compliance and implement quality improvement strategies when needed

NEED MULTIMODAL APPROACH TO ENHANCE AND PROMOTE CHANGE

References:
ENCOURAGEMENT IN GLOVE SELECTION

• Choosing the right glove
  • Primary factors: strength, durability, and glove thickness
• Try different combinations to find what feels right
  • Study found wearing larger glove on outside was more comfortable than wearing the larger glove on inside; however, some prefer the reverse

References:
BEST PRACTICES TO CONSIDER

- Regard all patients as potentially infections and implement standard precautions with every patient
- Protect both patients and yourself from risk of cross infection
- Nurses play a key role in implementation of evidence-based practices
- Provide effective care that is current and of best practice
- Wear properly sized gloves
- If perforations occur, prudent to change both inner and outer gloves as soon as possible once noted
- Change gloves frequently
- Employ good hand hygiene both pre- and post-operative
- Implement sharps safety practices

References:
SUMMARY

- Glove perforations can lead to direct contact between healthcare workers and patients resulting in transmission of infection.
- Both healthcare workers and patients are at risk of detrimental effects that glove perforation can impose.
- Double-gloving protects both the health care provider and patient.
- Double-gloving is the simplest, most effective, and cost-beneficial method of reducing risk of infection.
- Evidence supports the use of color indicator system for detecting perforations when double-gloving.

References:
Following the Q & A session, the webinar will adjourn, and you will be directed to the course evaluation and printable certificate
Thank you for attending this continuing education presentation.