

Quality Control & Management of PPE within a Large Health Care Region

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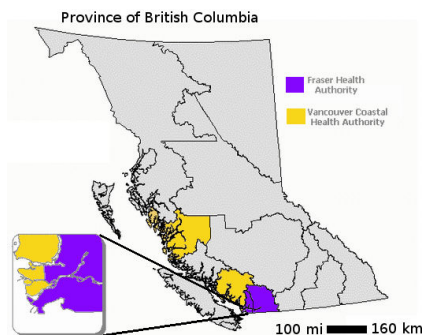
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Our Health Care Region

- British Columbia Lower Mainland
 - Population of ~ 2.6 mil (60% of the province)
 - 28 hospitals (rural -> primary trauma centres)
 - ~ 5000 pieces of PPE (thyroid, aprons, vest, skirts, gloves, etc.)



Accreditation Bodies & Standards

- Provincial accreditation body
 - Accredits medical imaging services at each hospital



Diagnostic Accreditation Program



Radiation Protection in
Radiology—Large Facilities
Safety Procedures for the Installation,
Use and Control of X-ray Equipment
in Large Medical Radiological Facilities
Safety Code 35



- Federal health care standard
 - Health Canada Safety Code 35



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Minimum PPE Requirements (DAP RS 4.3)

- 0.25 mm Pb equiv. $kVp_{max} \leq 100$
- 0.35 mm Pb equiv. $100 < kVp_{max} < 150$ kVp
- 0.5 mm Pb equiv. $kVp_{max} \geq 150$
- 0.5 mm Pb front / 0.25 mm Pb back recommended for interventional procedures
- Pb equiv. must be permanently marked on all PPE
- Challenge: numerous lead composite and non-lead PPE are offered by manufacturers



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Regular QC Requirements (DAP DES 3.10)

- Annual inspection for defects
 - Total defective area < 670 mm²
 - Defects < 5 mm diameter hole in area of thyroid / reproductive organs
- Challenge: hand written logs was a practice that often led to poor identification, inadequate tracking of PPE, and non-continuous records



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PPE QC and Management Program

- Evaluation of new PPE materials
 - Performed by Medical Physics
- Acceptance testing of newly ordered/received PPE
 - Performed by Quality Coordinators
- PPE Inventory system to facilitate annual QC and tracking
 - Performed by Radiology Technologists



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Evaluation of New PPE Materials

- Primary transmission fit to the Archer model¹ using a gen rad suite and 99.95% pure lead foil

$$B = \left[\left(1 + \frac{\beta}{\alpha} \right) e^{\alpha \gamma x} - \frac{\beta}{\alpha} \right]^{-\frac{1}{\gamma}}$$

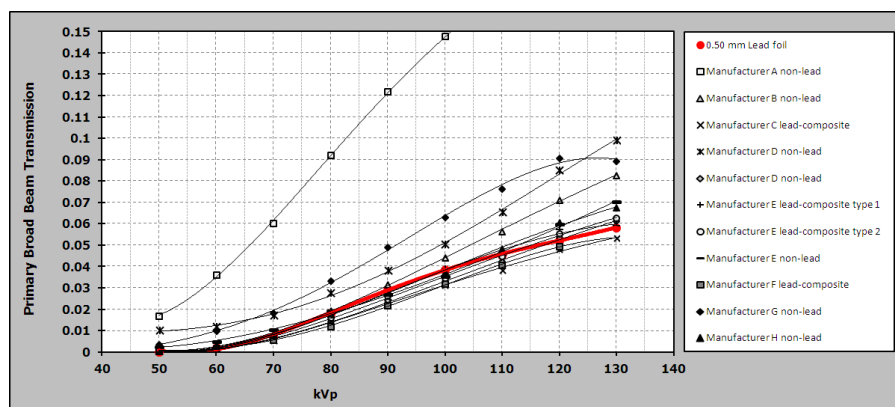
- Derived fitting parameters used to evaluate all new PPE materials offered by manufacturers
 - Build a preferred / approved materials list for the health region

¹ Archer, BR., et al., (1983). "Diagnostic x-ray shielding design based on an empirical model of photon attenuation," Health Phys. 44(5), 507-517



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PPE Primary Broad Beam Transmission

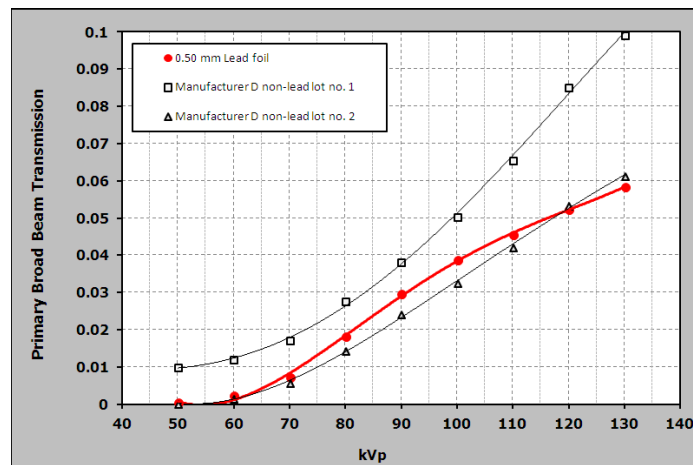


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Acceptance Testing

- Lead equivalency evaluation
 - Evaluate sub-sample of each shielding batch (lot #)
- Visual inspection
 - Ensures item matches order
 - Ensure PPE is properly labeled
- Fluoroscopic inspection
 - Ensure no defects in shielding

Manufacturing Deviation in PPE lots



Visual Inspection Example



- Multiple matching creases
- Manufacturer replaced lead free of charge
- \$600 value

Fluoroscopic Inspection

- Ensures no manufacture, repair, or shipping damage



Advantages of a Software PPE Inventory

- Standardization across hospital regions
 - Testing procedure
 - Identification system
- Web accessible database
 - Facilitates providing documentation for accreditation
 - Inventory continually updated as new items arrive
- More accurate records
 - Able to uniquely identify similar looking items
- Time savings during annual inspections



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Unique Barcode Identifiers

- 2D barcode buttons
 - Fasten onto PPE via rivet-like mechanism
 - Provide fast ID via a barcode scanner



13 mm



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PPE with Barcode Applied



PPE Inventory Interface

PPE Inventory System
Version: 1.1.2 Advanced User Mode

Add / Update Functions:

Scan Barcode ID:

Current status:

Hospital:

Department:

Area:

Manufacturer:

Manuf sale (mm/yr):

PPE article:

Size:

Colour:

Embroidery:

Other identifiers:

Shielding type:

Shielding lot No.:

Equivalent mm Pb:

Kv rating:

QC status:

Last inspected:

Inspected by:

QC Inspection:

Inspection Date:

Inspected By:

Shielding Integrity:

Buckles / Belts:

Stitching / Fabric:

Cleanliness:

Observed defects / comments (250 characters max):
No defects observed. Good condition.

Generate Report:

Scan Barcode ID:

Search Criteria

Current status:

QCStatus:

Hospital:

Department:

Area:

Generate Quick List:

Manufacturer:

PPE article:

Size:

Shielding type:

Shielding lot No.:

Features

- Tracking
 - In use, Out for repair, Removed from use
- History
 - Full history of all QC (and results) performed on the PPE throughout its lifetime
- Report generation
 - Individual reports or lists to facilitate accreditation
- Accessibility
 - Database is stored on a web-accessible collaboration platform (Microsoft Sharepoint)



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Example Report

Detailed Report on Personal Protective Equipment

Barcode ID: ST0001371
PPE Article: Apron - front only

Current Status: Pulled from use
Current QC Status: Fail

Hospital: Vancouver General
Department: Radiology
Area: GIGU

Manufacturer: Ryan Medical
Manufacture Date: 3/1/2012
Shielding Type: MinLite-X
Shielding Lot No.: 25146
Equivalent mm Pb: 0.5 at 130 kVp

Size: Female M
Colour: Dark Blue
Embroidery: GIGU 05
Other Identifiers: SN 2014-03-0014

Last QC Inspection Results

| Date | Inspector | QC Result | Shielding Integrity | Condition of Buckles / Belts | Condition of Straps / Folds | Cleanliness |
|------------|-----------|-----------|---------------------|------------------------------|-----------------------------|-------------|
| 10/16/2015 | JK | Fail | Unacceptable | Good | Good | Good |

Comments
 Tear has increased in size to 5 to 6 cm. Remove from use.

History

| Date | Status | Inspector | QC Result | Comments |
|-----------|-----------------|-----------|-----------|---|
| 3/23/2015 | Pulled from use | | | |
| 3/22/2015 | | JK | Fail | Tear has increased in size to 5 to 6 cm. Remove from use. |
| 3/15/2014 | | RJ | Pass | Pin hole has advanced into a tear. 2 cm long. OK. |
| 3/20/2013 | | JK | Pass | Small pin hole still there. No change in size. OK. |
| 3/17/2012 | | PS | Pass | Small pin hole defect observed near edge. OK. |
| 4/15/2011 | In use | | | |
| 4/15/2011 | | KH | Pass | Stitching has been repair. Ready for use. |
| 3/20/2011 | Out for repair | | | |
| 3/20/2011 | | KH | Repair | Stitching at bottom hem has let go. Must send out for repair. |
| 3/16/2010 | | PS | Pass | No defects. Good condition. |
| 3/16/2010 | In use | | | |



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PPE Inventory System

- Travel case, computer, barcode reader & ID supplies



Advantages of In-house Developed System

- Low cost
 - Competing systems offered by vendors can have large upfront costs, plus annual licensing fees
- Non biased
 - Some vendor's system are biased to work best with their own product
- Ownership and personalization
 - Data is owned by the health care system
 - System can be tailored (on the fly) to meet personal needs

The End

