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Co-60 Sterilization of PPE

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What are we doing?

We are assessing the efficacy and integrity of Personal Protective Equipment (PPE) after irradiating the PPE with gamma radiation over a three-week sprint (report should be available before April 17th)

PPE selected based on conversations with University of New Mexico Hospital (UNMH) on what PPE they believe will run out first

- N95 Masks (UNM masks are 3M 1870+; we only have 3M 1860 models)
- Surgical Masks
- Face Shields
- Tyvek Suits

Doses selected are determined by literature

- 0.0 Mrad (control)
- 0.5 Mrad [5]
- 1.0 Mrad [5, dose that led to a kill for 2002 SARS coronavirus]
- 2.5 Mrad (industry typical)
- 5.0 Mrad (allows for up to 4 reuses above the 1 Mrad irradiation, with 20% dose margin)

Status

Collected samples of all recommended PPE and delivered to Gamma Irradiation Facility (GIF)

Portacount test available to measure fit factor and provide quantitative measure of mask efficacy

Mechanical tests prepared to quantify strap degradation

No planned quantitative tests for non-N95 PPE, just qualitative assessment

Gamma Irradiation Facility Information [4]

Large Co-60 gamma source that can irradiation objects as large as an M1 Abrams tank

Dose rates up to 10^3 rad/second

However, dose rates for the volume of material we would test are 50–80 rad/s

It would take <6 hours to get to 1 Mrad (sterilization dose) for fairly large volumes

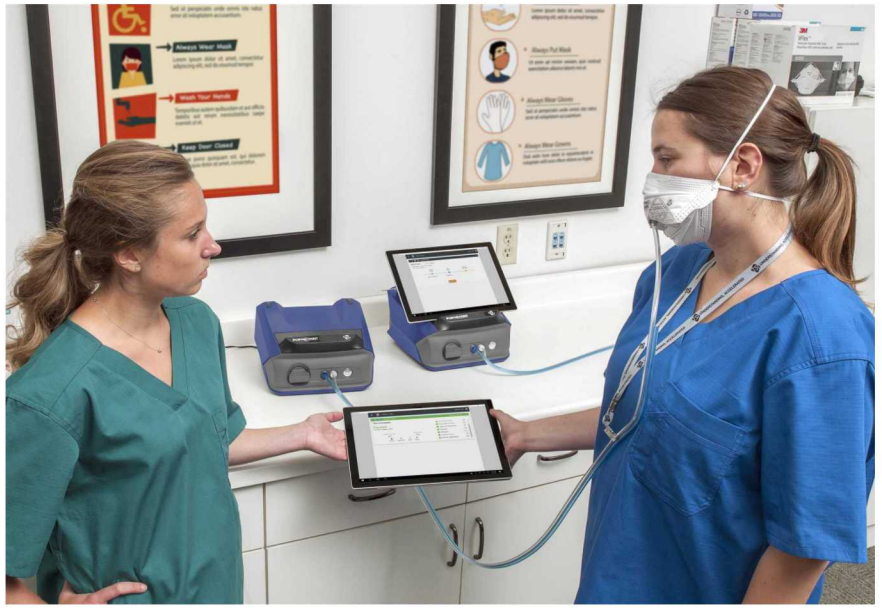
Don Hanson and Maryla Wasiolek are the main contacts for the facility

Post irradiation tests

Portacount test is a CDC's NIOSH classification scheme for particulate air-purifying respirators for N95 [11]

Mechanical tests include measuring change in elasticity and force required for strap failure

Dosimetry will be performed by using alanine dosimeters and confirmed using a ionization chamber



Future Work

- Use Sandia's aerosol measurement facilities to measure penetration vs particle size for irradiated N95 masks

- Confirm the dose for sure kill on COVID-19

- Use radiation transport to calculate dose as a function of position in cell within packed boxes

- Develop concept of operations for large throughput of PPE sterilization at GIF

References

(1) CDC guidelines on N95 reuse: https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html

(2) Impact of multiple reuse of masks: https://www.sciencedirect.com/science/article/pii/S019665531100770X

(3) Past CDC recommendations for reuse (including recommendation of reuse during SARS): https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4610368/

(4) SNL Gamma Irradiation Facility: https://www.sandia.gov/research/facilities/gamma_irradiation_facility.html

Gamma inactivation of viruses:

(5) Includes SARS, another coronavirus: http://www.ajtmh.org/content/journals/10.4269/ajtmh.18-0937#html_fulltext

(6) https://www.sciencedirect.com/science/article/pii/S1045105611000649

(7) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3432196/

(8) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4974539/

(9) https://aem.asm.org/content/aem/22/1/61.full.pdf

(10) https://www.cdc.gov/niosh/npptl/hospresptoolkit/fittesting.html

(11) https://www.cdc.gov/mmwr/preview/mmwrhtml/00055954.htm