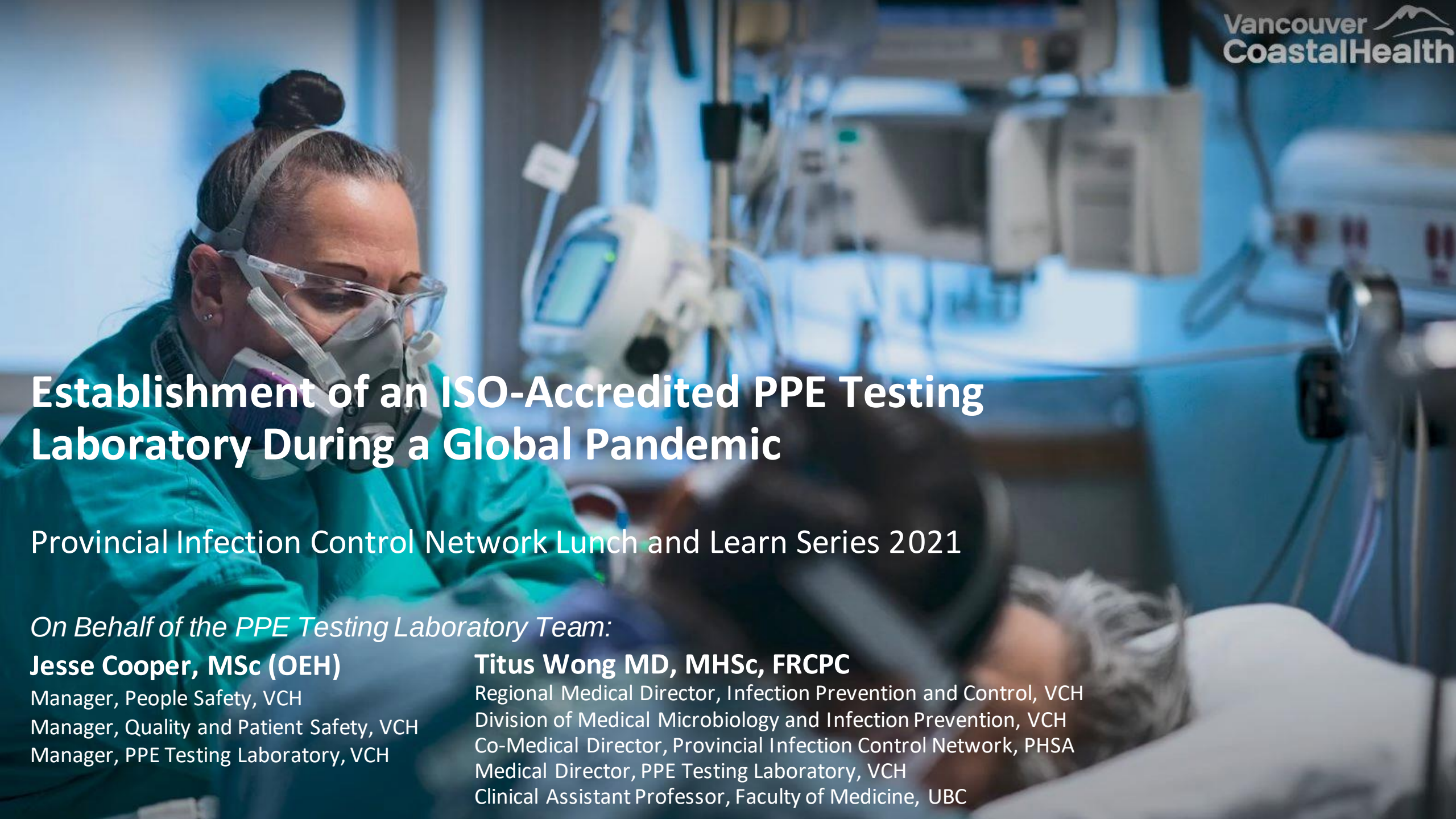

Establishment of an ISO-Accredited PPE Testing Laboratory During a Global Pandemic

Provincial Infection Control Network Lunch and Learn Series 2021

On Behalf of the PPE Testing Laboratory Team:

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Disclosures

JC no disclosures

TW has research and speaking disclosures not relevant to this presentation:

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- **Patents: N/A**
- **Other: N/A**

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- **Standards Council of Canada** – Elias Rafoul and the SCC accreditation team
- **Health Canada** – David Boudreau


Be Kind
Be Calm
Be Safe
Dr. Bonnie Henry

PPE Supply Chain Is Important

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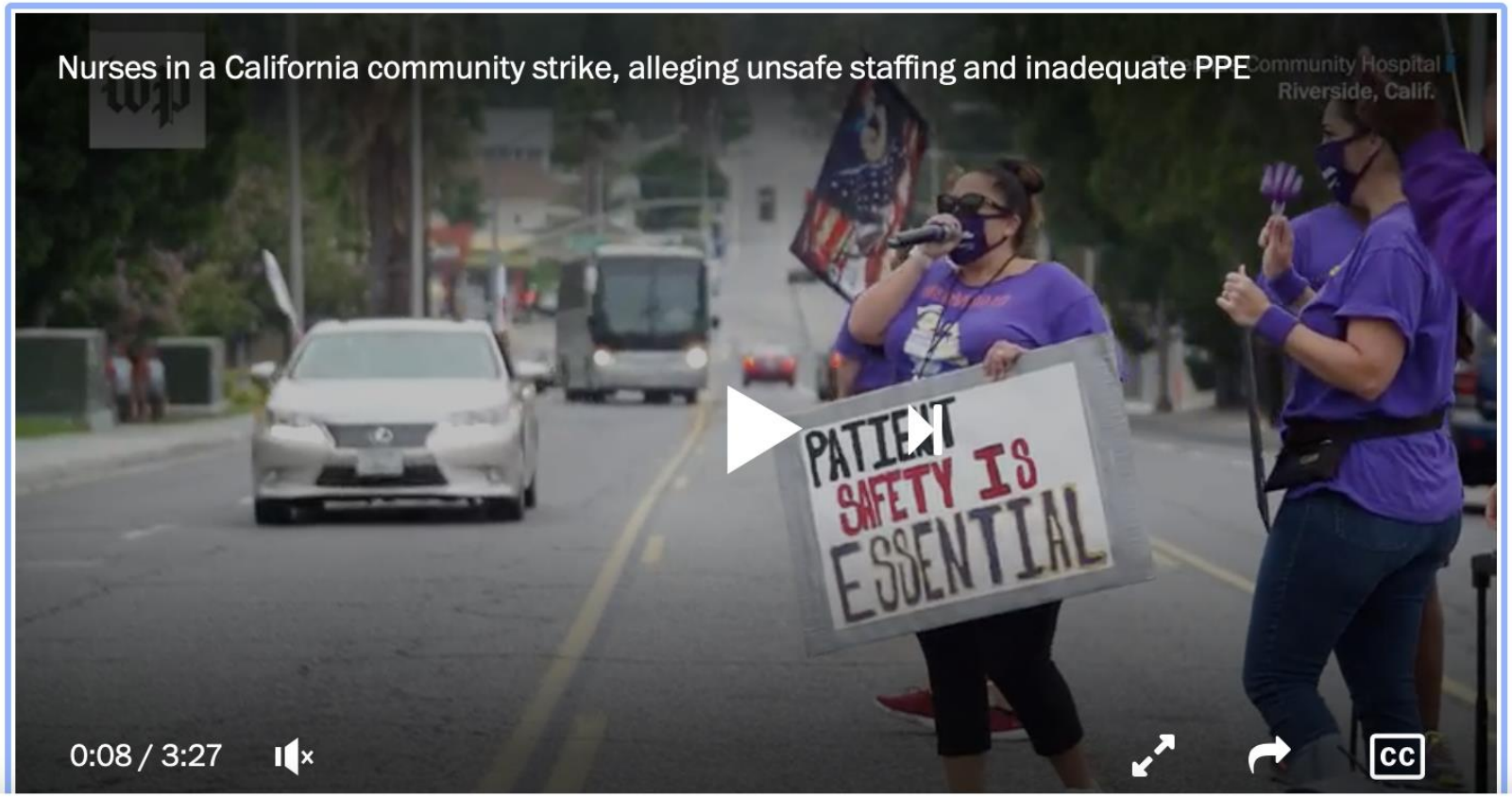
Health

America is running short on masks, gowns and gloves. Again.

Health-care workers are scrambling for supplies and reusing equipment as the coronavirus pandemic surges



Collaborative PPE Assessment and Testing

Factors Contributing to PPE Shortage

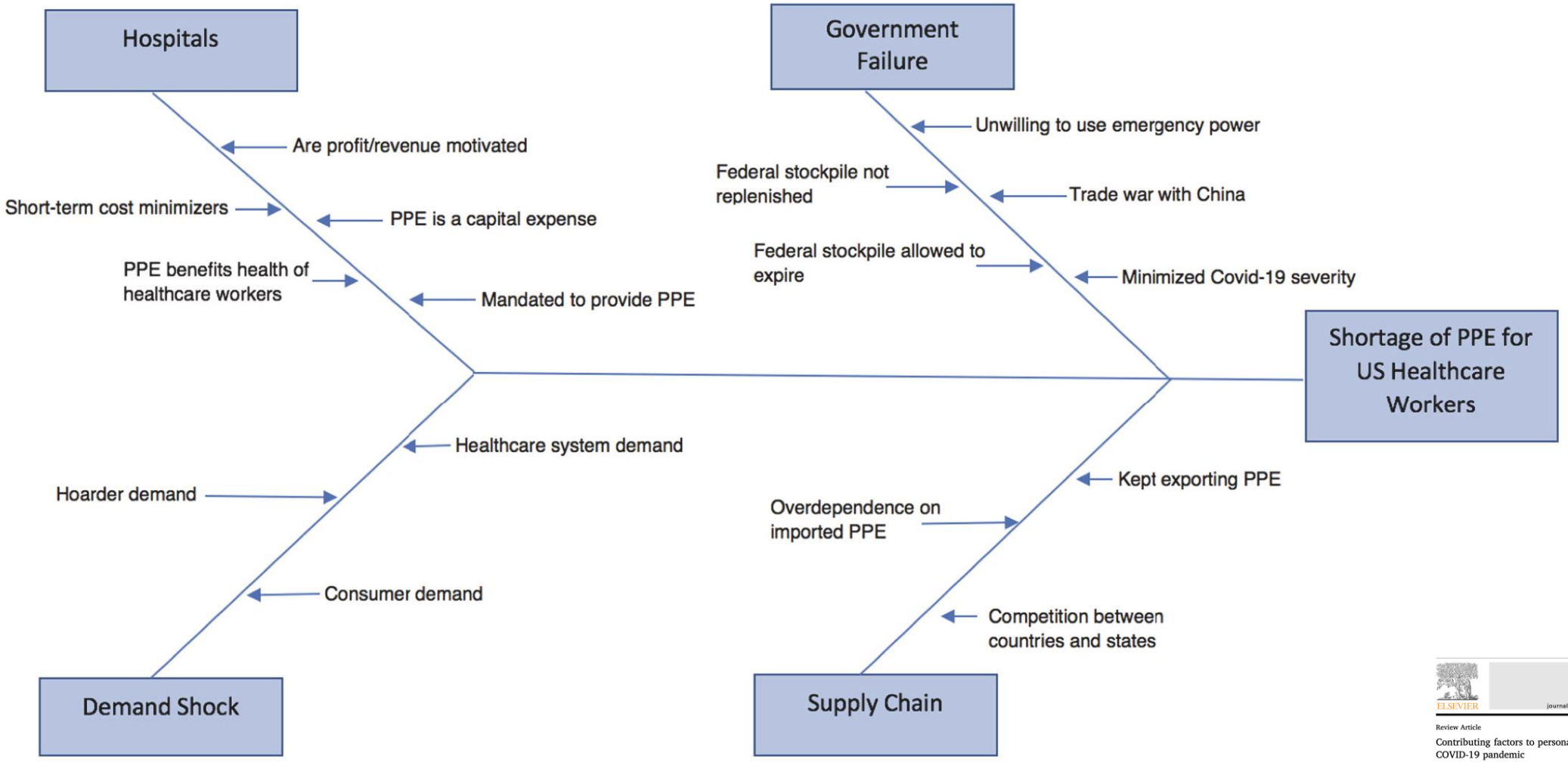
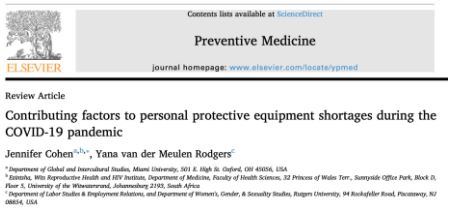


Fig. 2. Factors contributing PPE shortage.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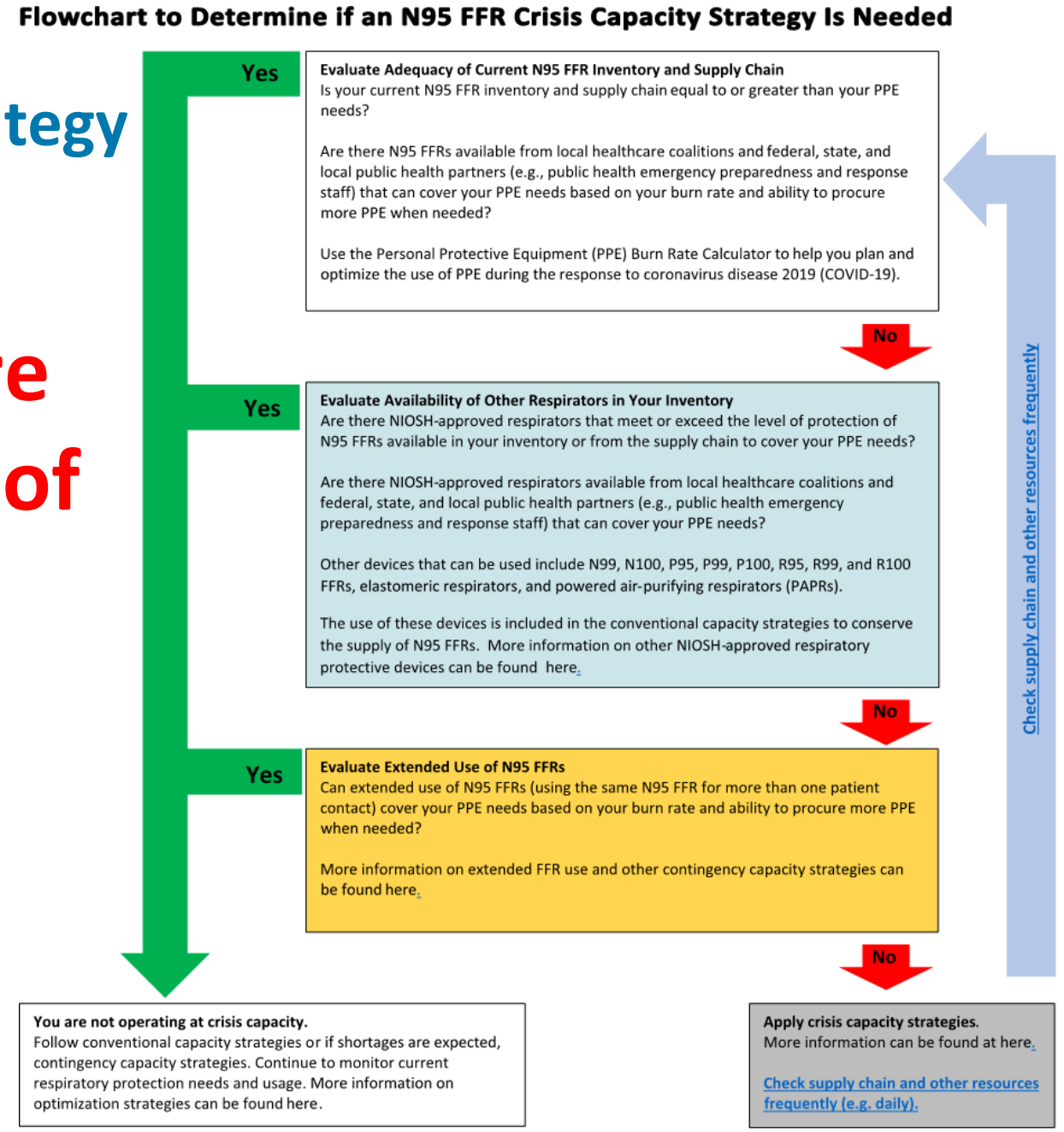
Review Article

Contributing factors to personal protective equipment shortages during the COVID-19 pandemic

Jennifer Cohen[a,b,*], Yana van der Meulen Rodgers[c]

PPE Crisis Capacity Strategy

How do we ensure we don't run out of a PPE item?



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State of the Science Review

Safety in the practice of decontaminating filtering facepiece respirators: A systematic review

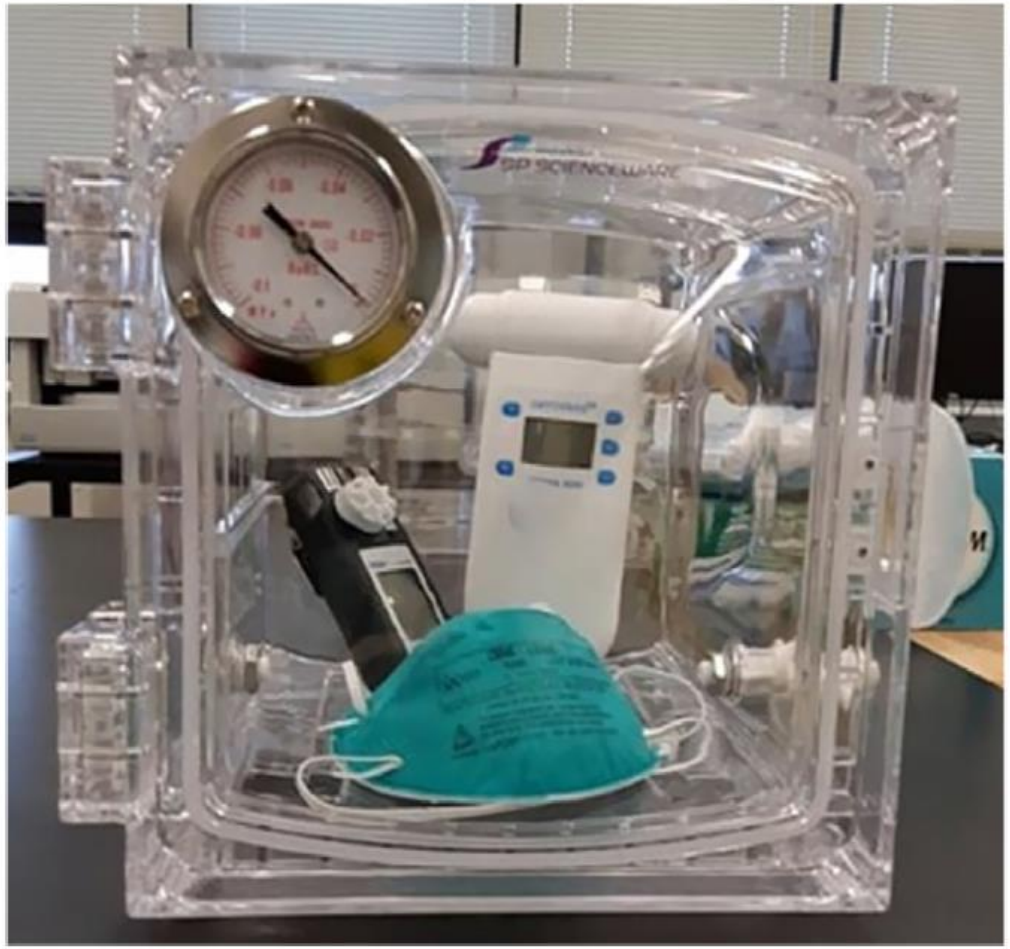
Juliana Rizzo Gnatta PhD [a,*], Rafael Queiroz de Souza PhD [a], Cassiane de Santana Lemos PhD [a], Ramon Antônio Oliveira PhD [a], Lisiane Ruchinsque Martins PhD Student [b], Giovana Abrahão de Araújo Moriya PhD [c], Vanessa de Brito Poveda PhD [a]

Moist Heat, Microwave-generated steam &UV-C and Vaporized Hydrogen Peroxide most effective

Provincial N95 Reprocessing Project – A Contingency Plan

Over 150,000 N95 FFRs reprocessed at 38 healthcare facilities across BC

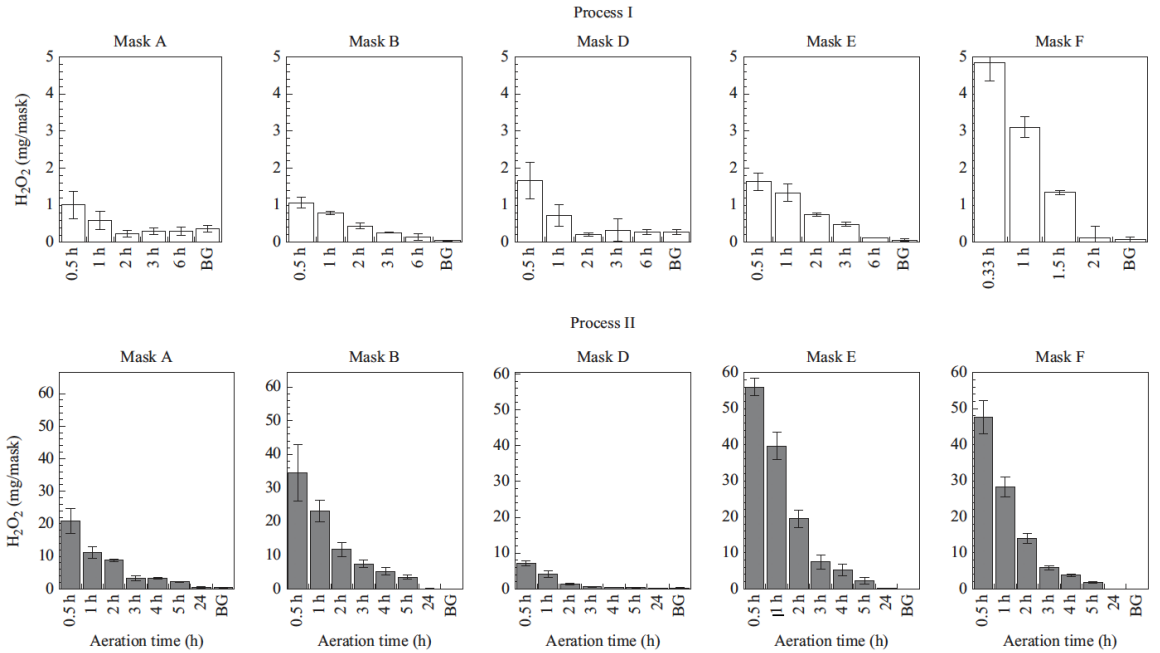
Does Reprocessing/Decontamination Respirators leave residues?



Evaluation of hydrogen peroxide and ozone residue levels on N95 masks following chemical decontamination

P. Kumkrong [a,*], L. Scoles [a], Y. Brunet [a], S. Baker [a], P.H.J. Mercier [a,b], D. Poirier [a]

[a] National Research Council Canada, Ottawa, Ontario, Canada
[b] Corem, Québec, Canada



P. Kumkrong et al. / Journal of Hospital Infection xxx (xxxx) xxx

Figure 4. Residual hydrogen peroxide concentration and associated standard deviation (mg/mask) after aeration of N95 masks (A, B, D, E, and F) from decontamination process I and process II compared to untreated masks (BG).

Table I
Particle filtration test, pressure test, and estimation of the population which needs to wear a

Description	Filtration value (%)					Pressure (max acceptable value set at 0.7)
	0.3 µm	0.5 µm	1 µm	3 µm	5 µm	(mbar)[c]
IIR-surgical mask[a]	59	75	84	100	100	0.15
3M 1862 +[a]	96	98	99	99	100	0.20
ePM$_1$ 60%[b]	40	60	73	99	95	0.23
ePM$_1$ 60%[b] between quilt fabric	56	78	87	97	99	0.47
ePM$_1$ 85%[b]	90	96	98	100	100	0.31
ePM$_1$ 85%[b] between quilt fabric	94	98	99	97	97	0.72
F7[b]	41	55	65	99	100	0.07
F7[b] between quilt fabric	55	72	82	97	97	0.43
F9[b]	78	88	92	100	99	0.15
F9[b] between quilt fabric	77	89	94	97	97	0.50
M5[b]	3	6	11	90	96	0.05
M5[b] between quilt fabric	19	38	54	96	97	0.39
Cleaning cloth between quilt fabric	21	40	54	92	93	0.39
Coffee filter (double) between quilt fabric	90	99	99	98	98	2.18
Felt 155 g between quilt fabric	20	39	55	96	97	0.36
Leather	100	100	100	99	99	2.92
Microfibre fabric	59	88	95	99	99	1.50
Household paper towel (1 layer) between quilt fabric	42	70	82	95	94	0.64
Household paper towel (2 layers) between quilt fabric	65	90	96	98	98	1.01
Polypropelene fabric 1	10	27	41	65	75	0.41
Polypropelene fabric 2	5	18	28	55	61	0.18
Quilt fabric (2 layers)	16	37	55	94	95	0.31
Quilt fabric (4 layers)	34	59	69	63	71	0.66
Quilt fabric (6 layers)	46	74	88	98	98	0.97
Static dust cloth between quilt fabric	21	40	57	94	96	0.35
Tea towel (1 layer)	5	15	14	35	36	0.05
Tea towel (2 layers)	5	13	23	84	88	0.10

Filtration Efficiency is not the only variable to consider. Breathability is important!

Available online at www.sciencedirect.com
Journal of Hospital Infection
journal homepage: www.elsevier.com/locate/jhin

Is there an adequate alternative to commercially manufactured face masks? A comparison of various materials and forms

G.R. Teesing[a,b,*,†], B. van Straten[c,d,†], P. de Man[e,†], T. Horeman-Franse[c,†]

[a] Department of Public Health, Erasmus MC, University Medical Center Rotterdam, Rotterdam, the Netherlands
[b] The Municipal Public Health Service Rotterdam-Rijnmond, Rotterdam, the Netherlands
[c] Delft University of Technology, Department of BioMechanical Engineering, Delft, the Netherlands
[d] Van Straten Medical, De Meern, the Netherlands
[e] Department of Medical Microbiology and Infection Control, Franciscus Gasthuis en Vlietland, Rotterdam, the Netherlands

PPE Laboratory Testing is Important

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Low-Quality Masks Infiltrate U.S. Coronavirus Supply

Many imported masks fall short of N95 standards, tests show, putting workers on the front lines of battling the virus at risk

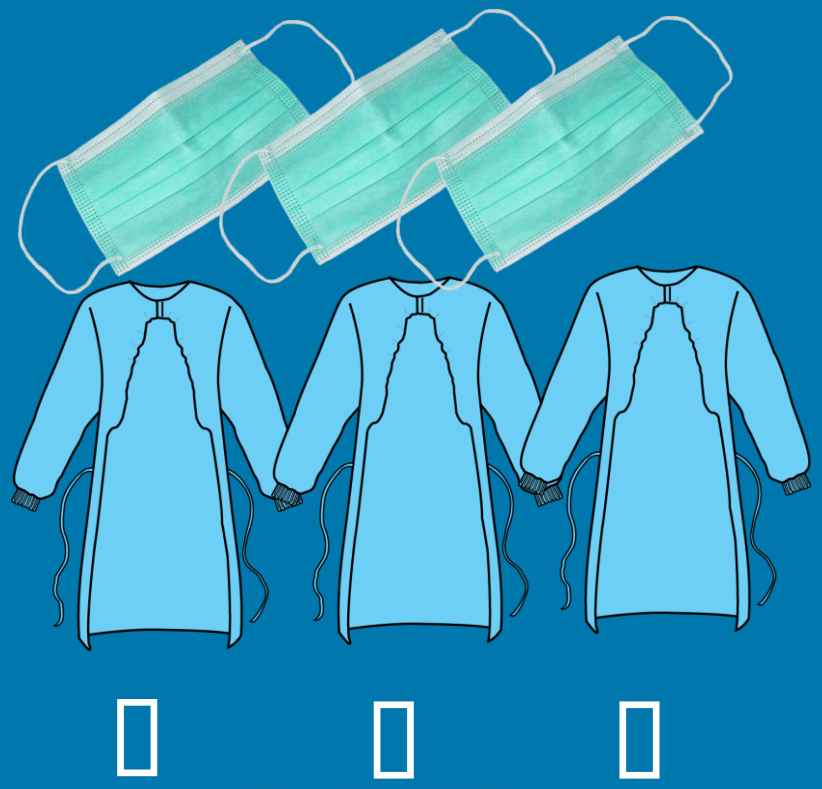
Workers on a production line for masks in Shanghai.

PHOTO: ALY SONG/REUTERS

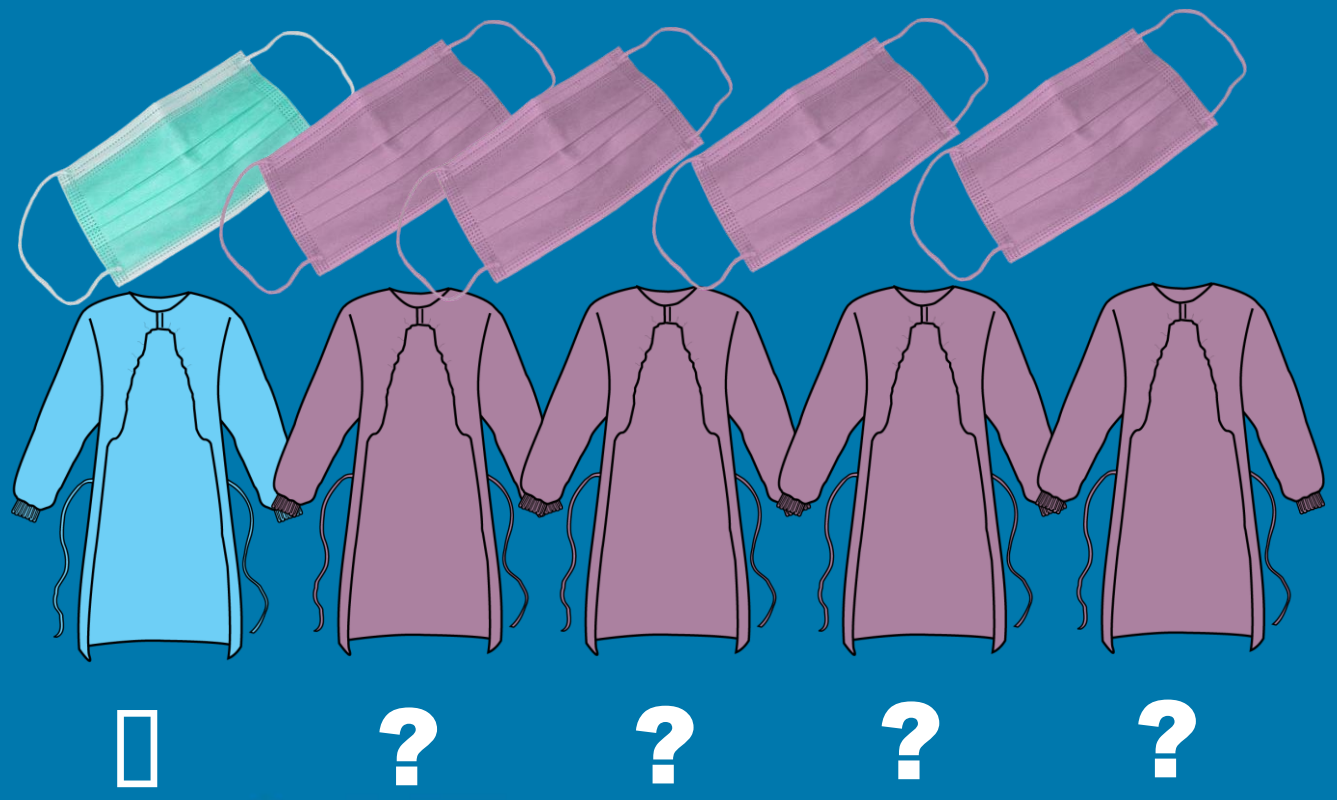
Millions of counterfeit N95 masks distributed to health care workers in the U.S.

Masks imitating the real thing are flooding U.S. ports, and authorities can hardly keep pace.

During COVID, PPE supply from trusted vendors was challenged, while demand increased



Therefore, we needed to source from alternative vendors, with unknown quality



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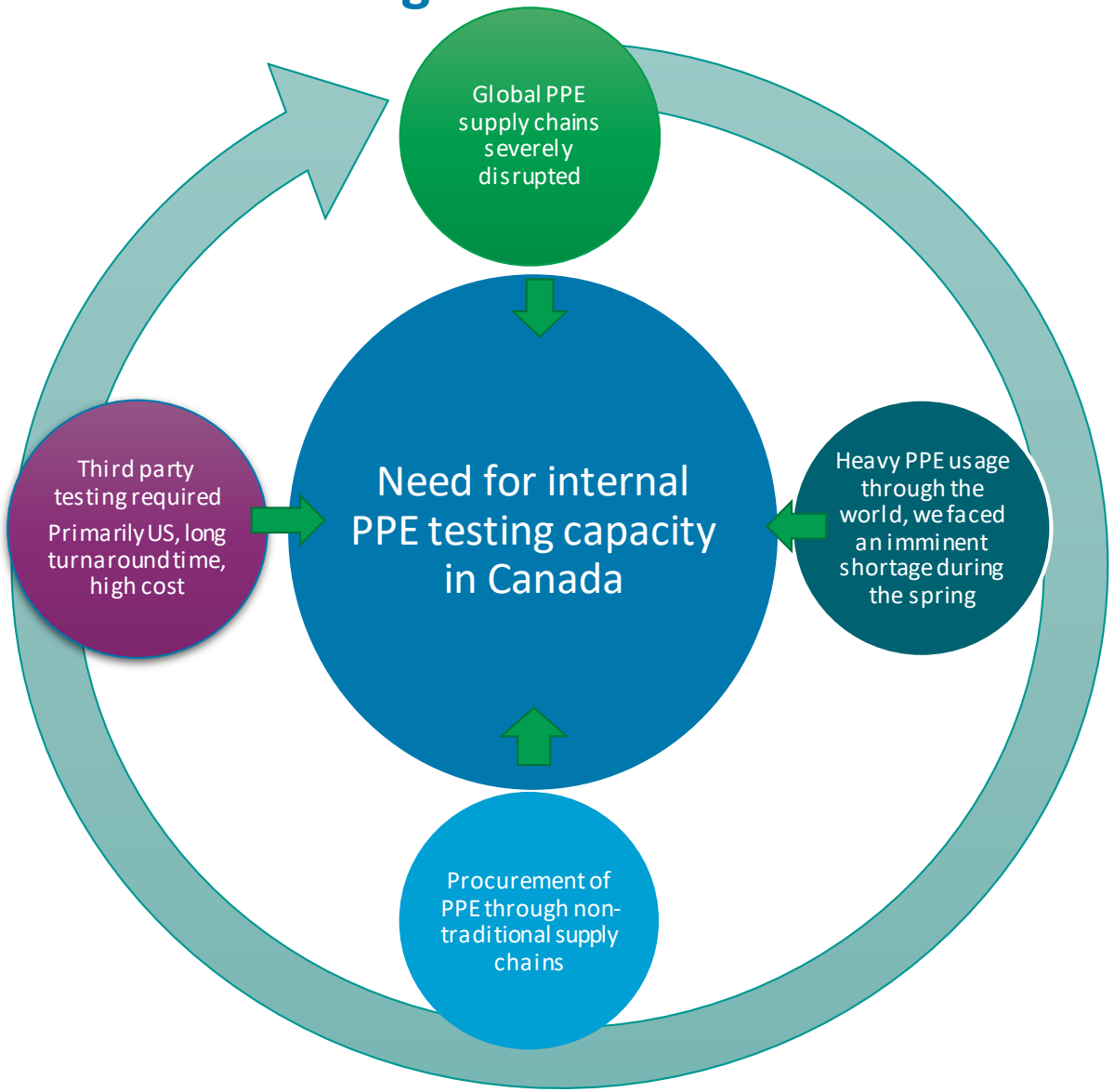
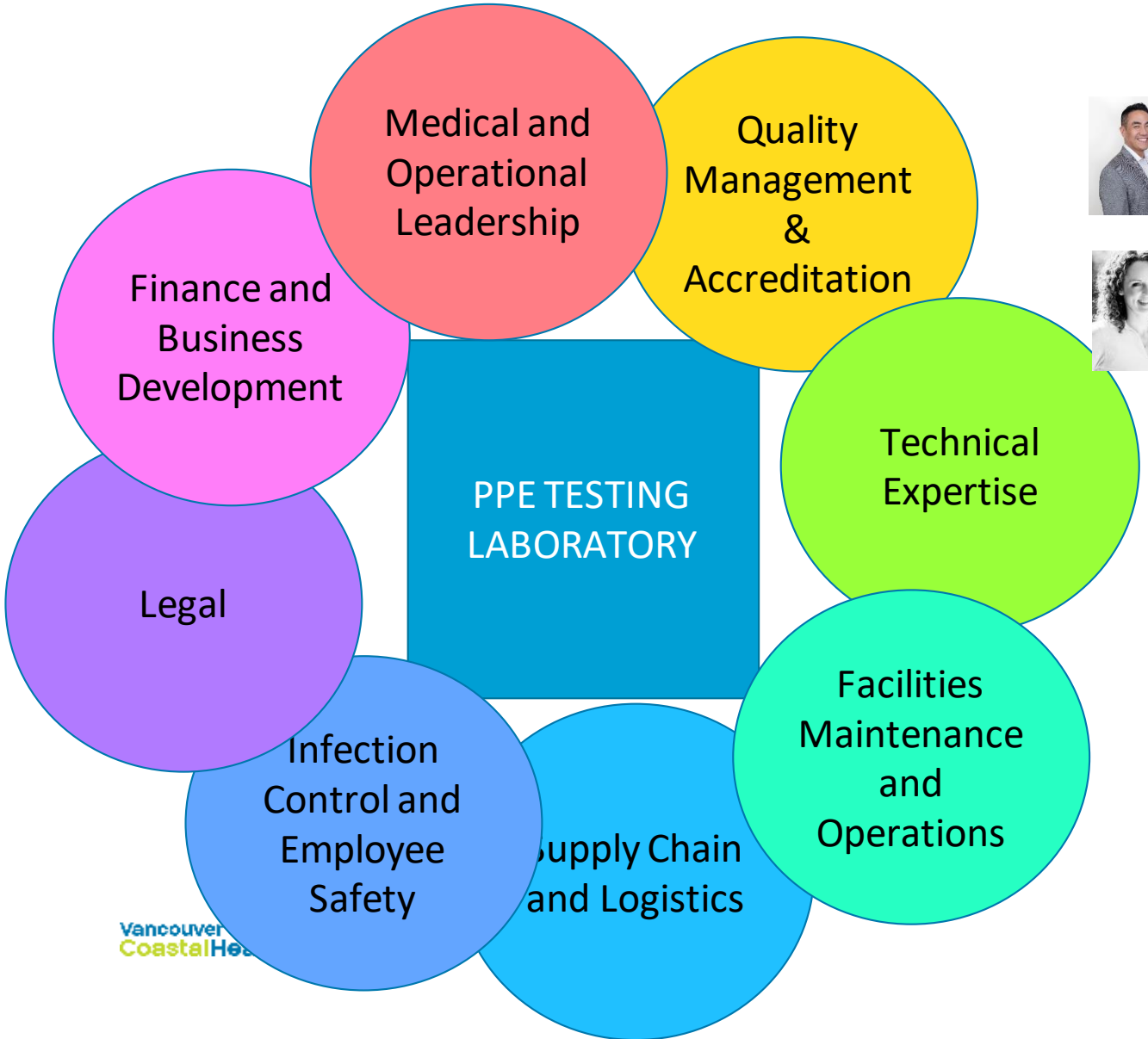
The Need for Canadian PPE Testing



A Multidisciplinary Team Built an ISO-accredited PPE Testing Laboratory



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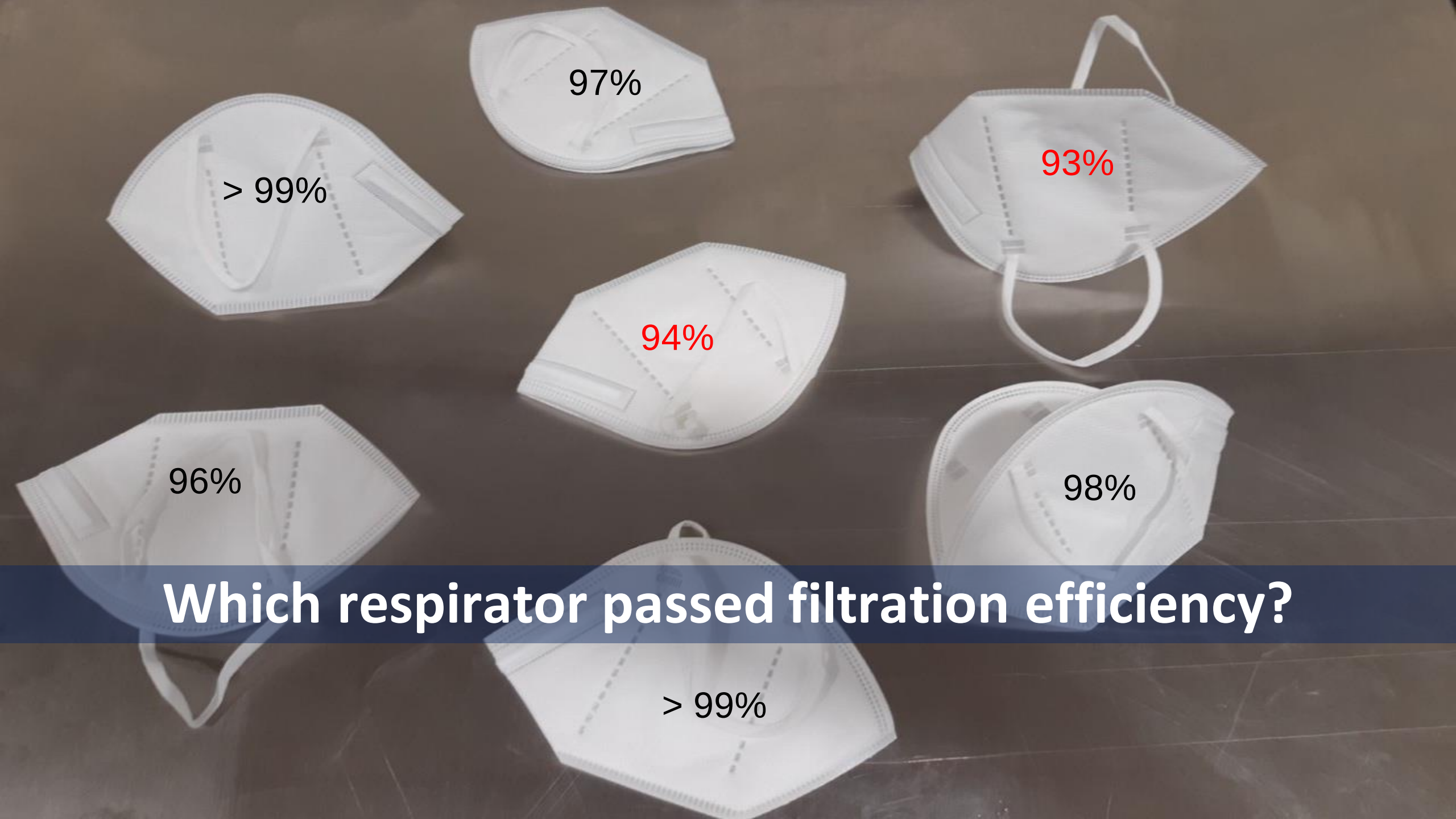
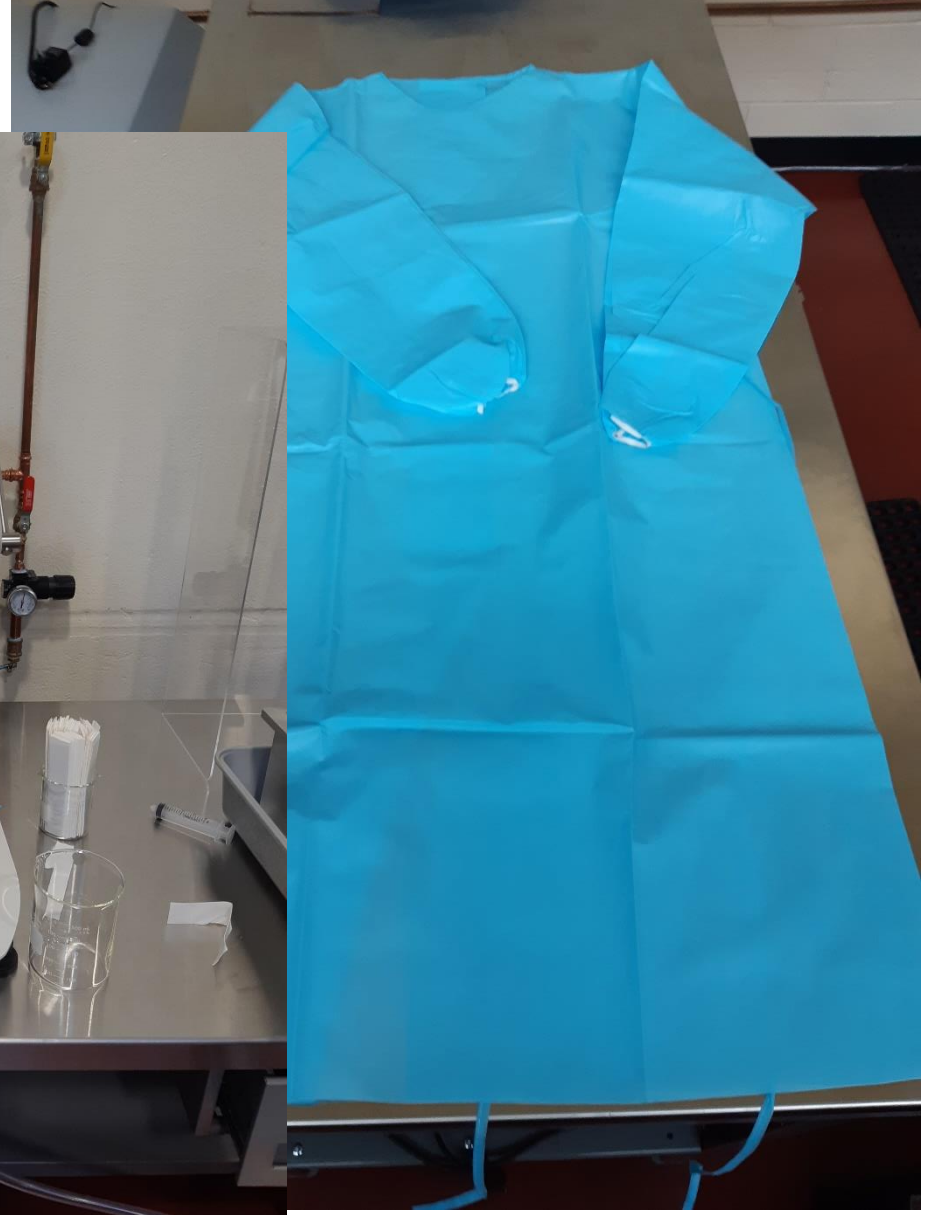
PPE Testing Laboratory Test Menu

PPEfl	Test	Description
N95 respirator	NaCl Filter Efficiency (TEB-APR-STP-0059)	This test measures the filtration efficiency of respirators using NaCl aerosols
	Quantitative fit testing (CSA Z94.4-18 Section 9, Annex C)	This test measures the fit of respirators to ensure a good seal on the users face based on particle counting technology in the PortaCount machine
	N95 inhalation and exhalation efficiency (STP-007, STP-003)	Measures the inhalation and exhalation breathing resistance for air-purifying respirators, including N95 filtering face-piece respirators.
N95 respirator and Proc/Surg Masks	Fluid Resistance (ASTM – F1862)	Evaluates resistance of medical face masks to penetration by the impact of a small volume (~2 mL) of a high-velocity stream of synthetic blood.
Procedural/Surgical Mask	Breathability (differential pressure)	Measures the differential pressure required to draw air through a medical face mask.
	Bacterial Filtration and Particulate Filtration efficiency (ASTM F2101 – BFE, F2299 – PFE).	Measures filtration efficiency of medical masks using a viable bacterial test organism and a 0.1 micron latex particle
	Flame Spread	Measures the flammability of the mask material
Surgical/Isolation Gown	Water impact testing (AATCC TM42-2017e)	This test measures the resistance of fabrics to the penetration of water by impact, predicting the fluid resistance of fabrics and PPE items
	Hydrostatic Water Pressure Test (AATCC - 0127)	Measures the resistance of a gown or fabric to the penetration of water under a constantly increasing pressure.



Which respirator passed filtration efficiency?



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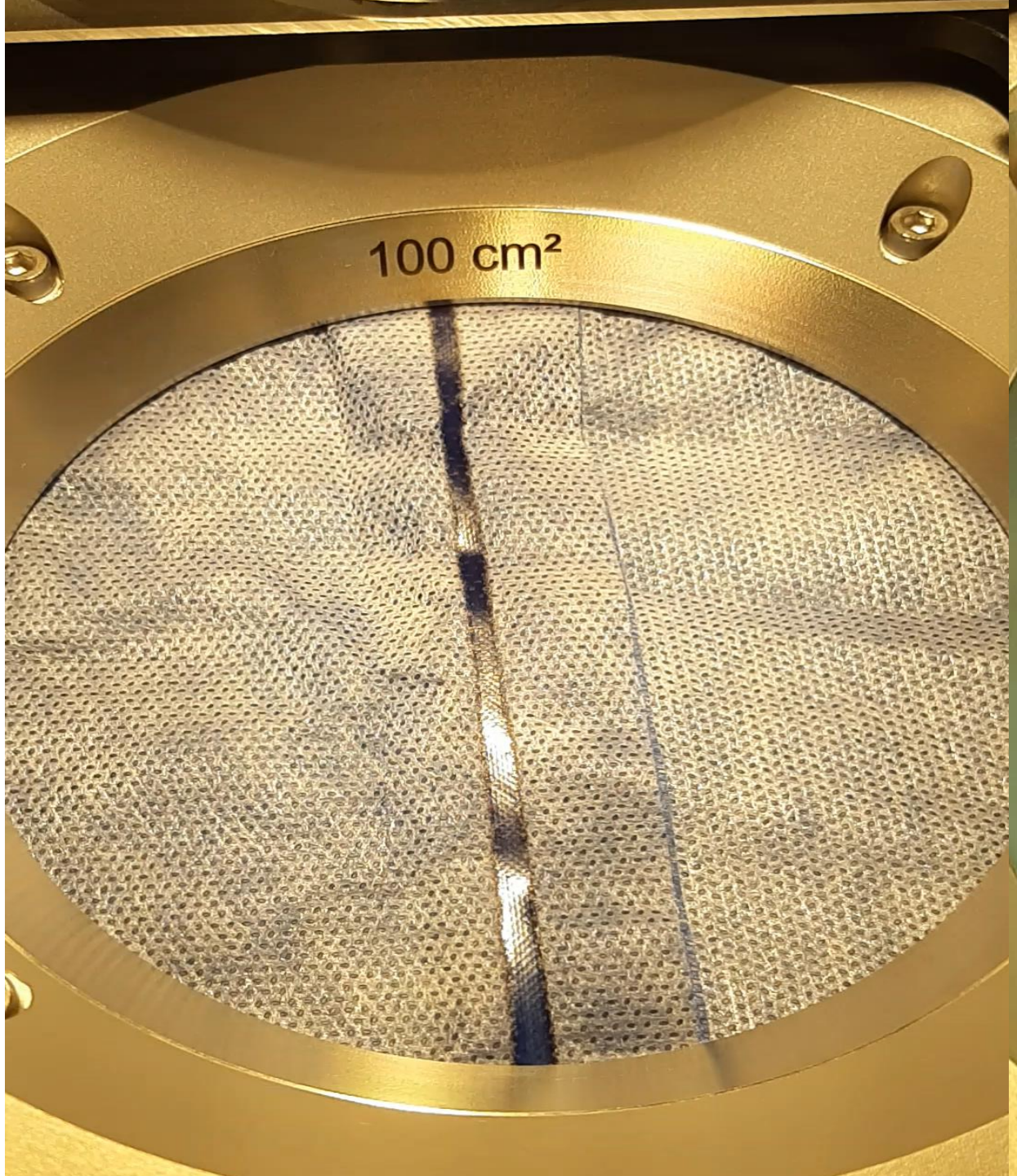
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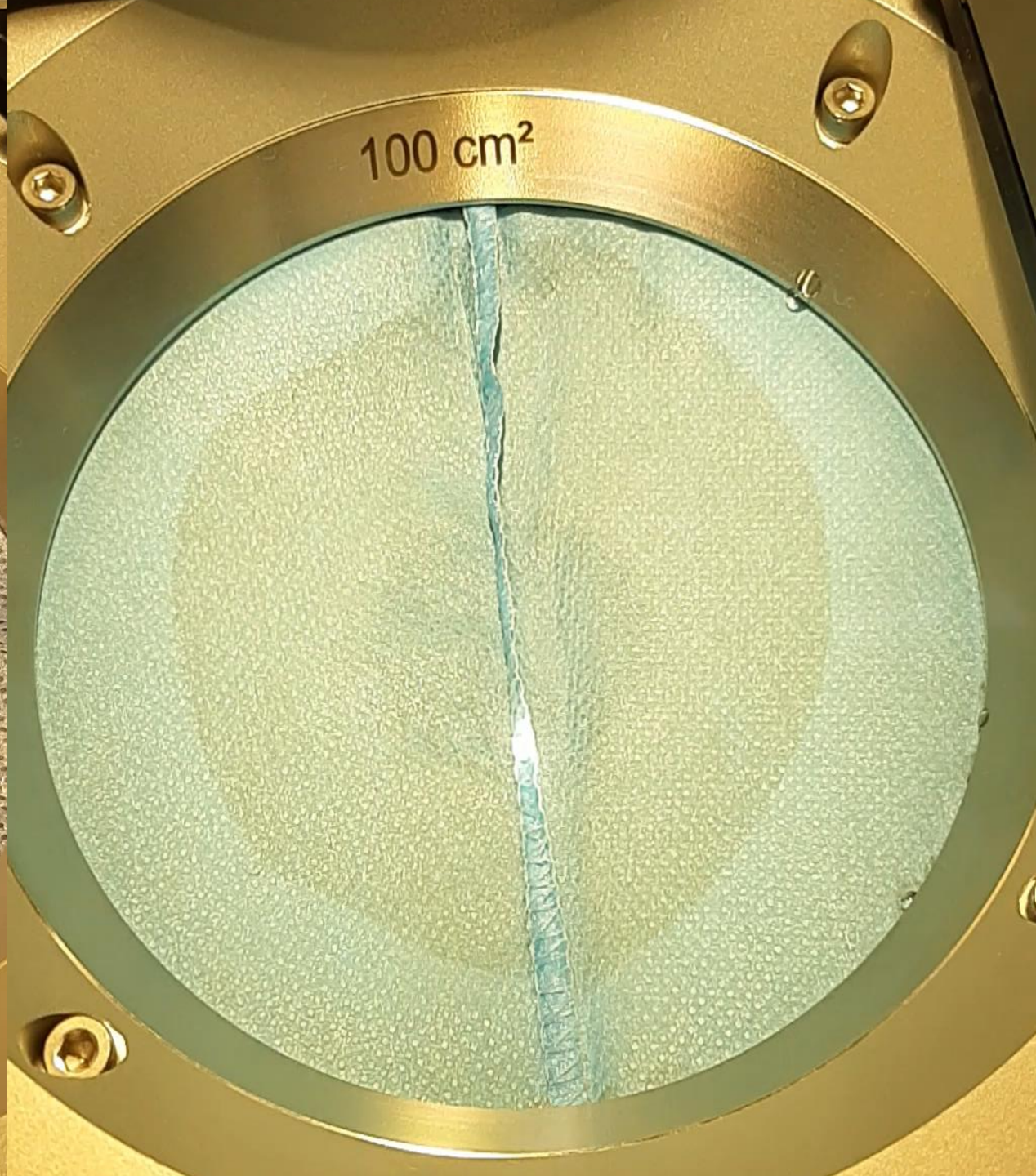

100 cm²

Laboratory Testing of PPE Identifies PPE that are Unsafe for Use

PPE Item	Sample	Test	Number Tested	Total Number of PPE Items	Test Result
N95 Respirator	N95 “A”	Filtration Efficiency	1141	156,000	Fail
	KN95 “A”	Filtration Efficiency	167	1,200,000	Fail
	KN95 “B”	Filtration Efficiency	301	1,300,000	Safe for use
	KN95 “C”	Filtration Efficiency	32	450,000	Safe for use
	KN95 “D”	Filtration Efficiency	50	1,000,000	Fail
Gowns	GOWN “A”	Spray Impact and Hydrostatic Pressure	50	250,000	Safe for use (AAMI Level 2)
	GOWN “B”	Spray Impact and Hydrostatic Pressure	32	100,000	Fail
	GOWN “C”	Spray Impact and Hydrostatic Pressure	32	1,00,000	Fail
	GOWN “D”	Spray Impact and Hydrostatic Pressure	20	14,000	Safe for use (AAMI Level 2)

N95's, KN95's and Medical Masks are Tested Differently

	Filtration Efficiency of N95, KN95, and Medical Masks			
Standard Test Method	TEB-APR-STP-0059 (NIOSH)	GB 19083-2010 (Medical KN95)	GB2626-2006 (KN95)	ASTM F2299 (Particulate Filtration Efficiency for Medical Masks)
Aerosol Type	NaCl	NaCl	NaCl	Latex Bead
Aerosol Size - count median diameter (nm)	75	75	75	100 - 5000
Aerosol Charge Neutralization	Yes	No	Yes	Yes
Flow Rate (LPM)	85	85	85	Not specified
Face Velocity (cm/s)	5-10	~32	~32	0.5-25
Filtration Efficiency (%)	95	95	95	95-98
Inhalation Resistance (Pa)	≤343	≤343	≤350	≤240
Exhalation Resistance (Pa)	≤245	NaCl	≤250	NA
Fit Test Requirement	Covered under CSA Z94.4	Yes - overall fit factor >100	No	No
Fluid Resistance (mm Hg)	80 - 160 (surgical N95 respirators under ASTM F1862)	80	No	80 - 160 (under ASTM F1862)

Different International Standards have Varying Thresholds for Mask Acceptability

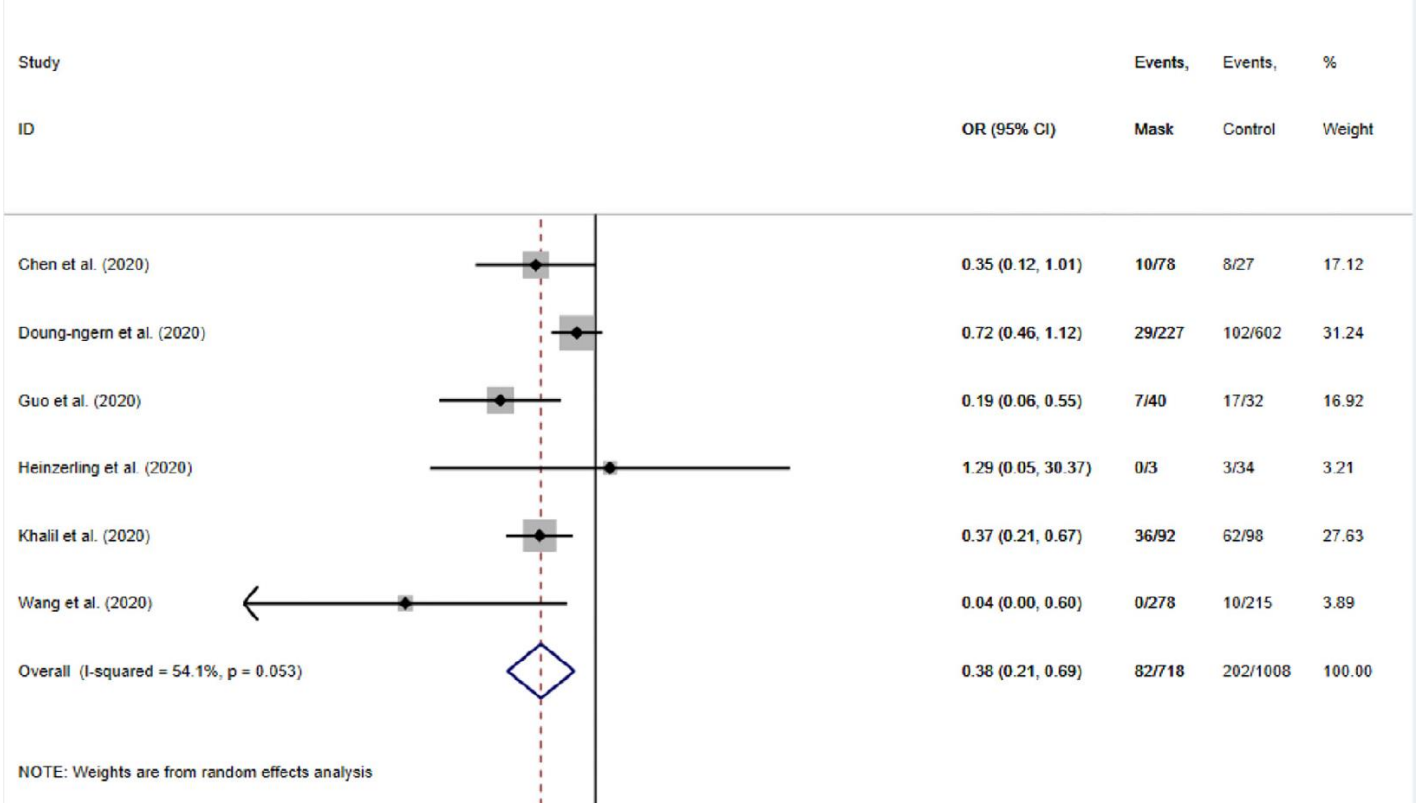
	ASTM F2100-11			EN 14683				YY 0469-2011	YY/T0969-2013
	Level 1	Level 2	Level 3	Type I	Type IR	Type II	Type IIR	Surgical mask	Medical mask
BFE (3.0 microns)	≥ 95	≥ 98	≥ 98	≥ 95	≥ 95	≥ 98	≥ 98	≥ 95	≥ 95
PFE (0.1 microns)	≥ 95	≥ 98	≥ 98	/	/	/	/	≥ 30	/
Fluid Resistance (mmHg)	80	120	160	/	120	/	120	120	/
Breathability (H2O/cm2)	< 4.0	< 5.0	< 5.0	< 3.0	< 5.0	< 3.0	< 5.0	< 5.0	< 5.0
Flame Spread	Class 1	Class 1	Class 1	/	/	/	/	Class 1	/

Do different standards impact how we interpret studies?

Table 1
Characteristics of eligible studies

	Study	Year	Country	Virus	Mask group		Control group		Mask type
					Infections*	Mask†	Infections‡	Control§	
1	Chen et al.	2021	China	2019-nCoV	10	78	8	27	Mask¶
2	Doung-ngern et al.	2020	Thailand	2019-nCoV	29	227	102	602	Mask¶
3	Guo et al.	2020	China	2019-nCoV	7	40	17	32	Mask¶
4	Heinzerling et al.	2020	USA	2019-nCoV	0	3	3	34	Mask¶
5	Khalil et al.	2020	Bangladesh	2019-nCoV	36	92	62	98	N95
6	Wang et al.	2020	China	2019-nCoV	0	278	10	215	N95

*Infections in the mask group.
†Total sample in the mask group.
‡Infections in the control group.
§Total sample in the control group.
¶Specific type of mask was not reported.



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Major Article

Face masks to prevent transmission of COVID-19: A systematic review and meta-analysis

Yanni Li MPH [a,1], Mingming Liang MPH [b,c,1], Liang Gao MD, PhD [d], Mubashir Ayaz Ahmed MD [e], John Patrick Uy MD [e], Ce Cheng DO [f], Qin Zhou PhD [g], Chenyu Sun MD, MSc [e,*]

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Thank you