

# Characterizing Bioaerosol Risk from Environmental Sampling

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## **SUPPORTING INFORMATION**

**Figure S1.** Number of spores in different environmental compartments over time for a single room model.

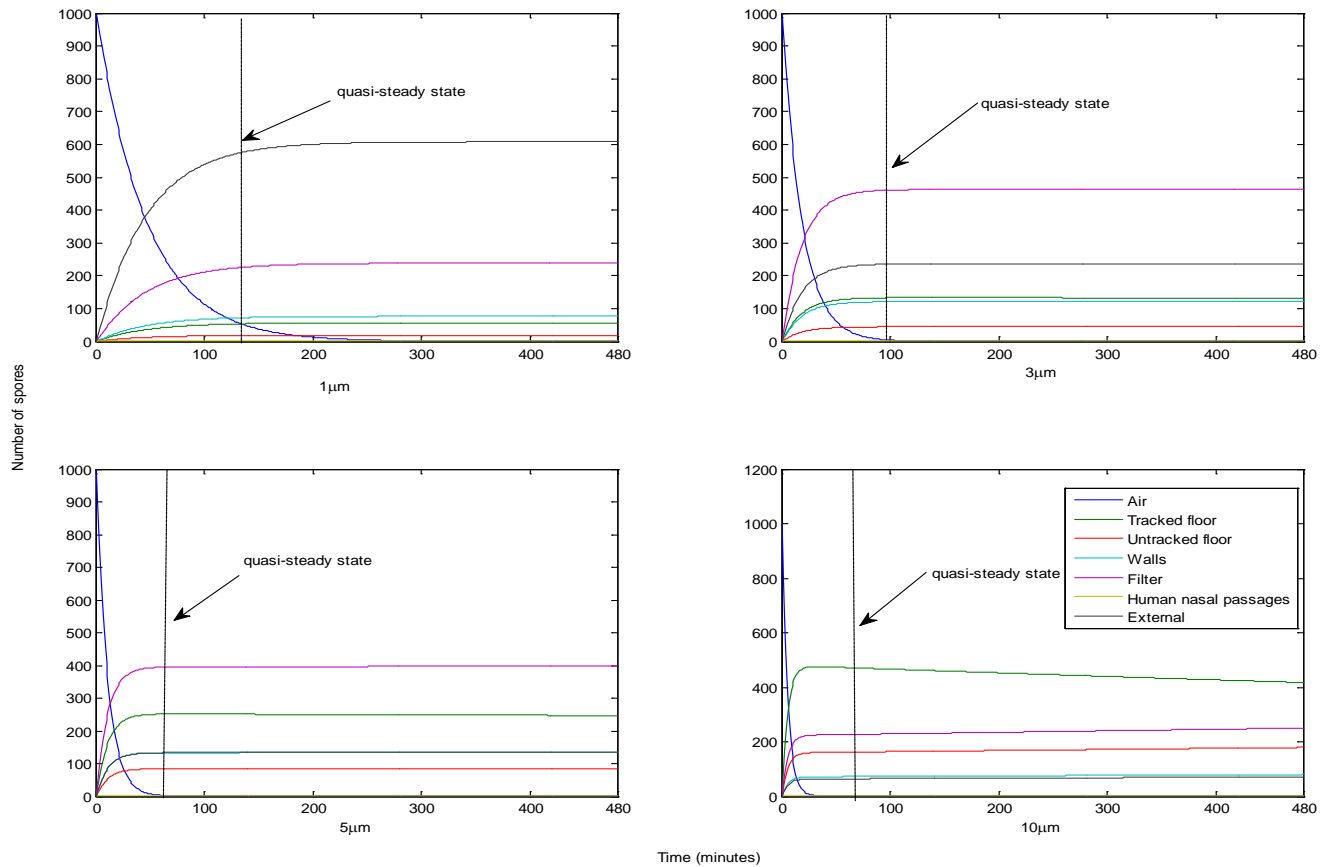
**Figure S2.** The distribution of *Bacillus anthracis* with different diameters after 8 hours.

**Table S1.** Inputs and their values used in Equations 2 and 7

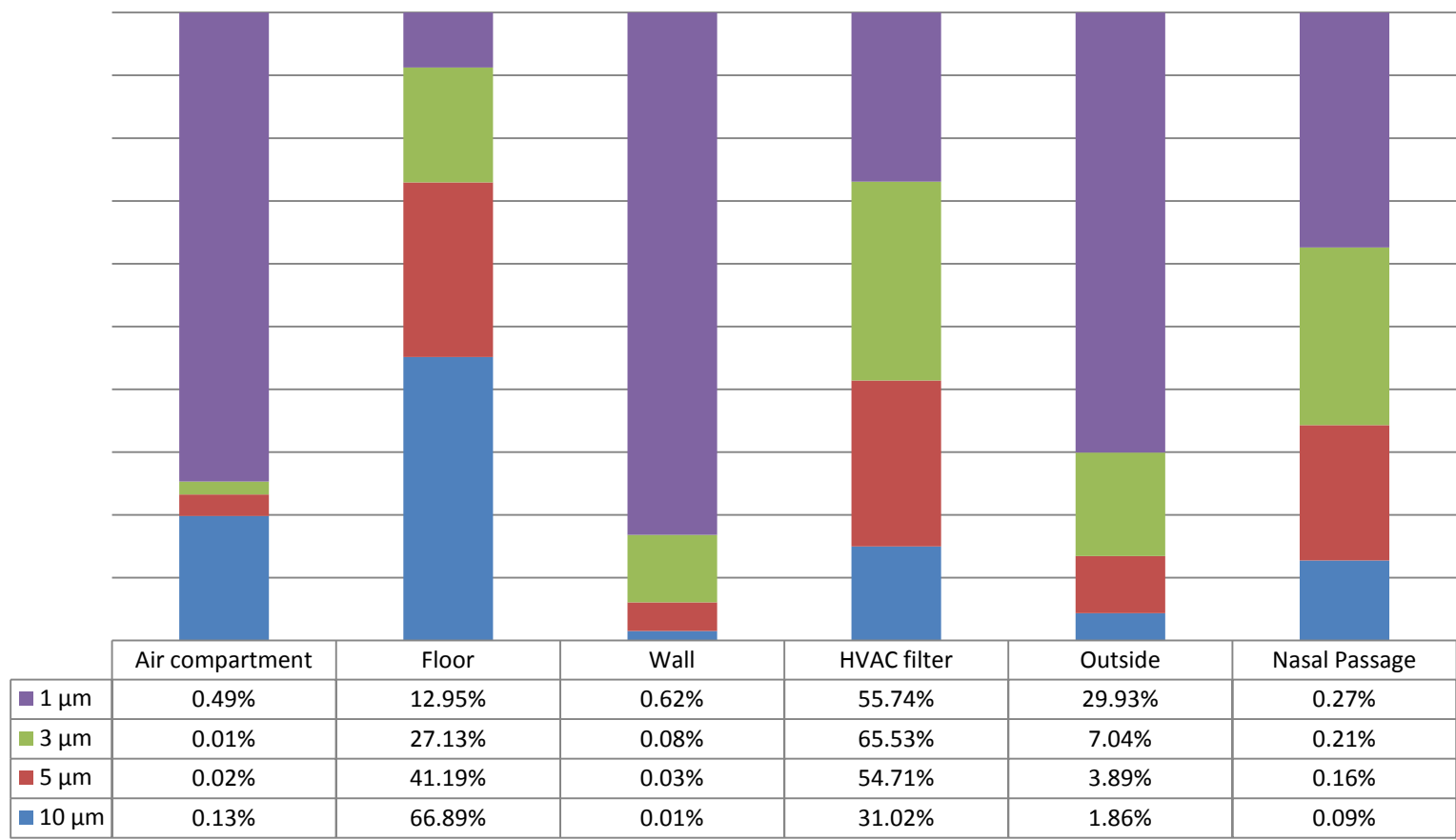
**Table S2.** Results for approaches to identify two size fractions

**Table S3.** Results for approaches to identify 1 micron size fraction

**Table S4.** Results for approaches to identify 10 micron size fraction



**Figure S1.** Number of spores in different environmental compartments over time for a single room model. The approximate time at which a quasi-steady state is reached (see text) is indicated by a vertical line in each plot.



**Figure S2.** The distribution of *Bacillus anthracis* with different diameters after 8 hours. The percentages in the table are distributions of *B. anthracis* spores among different compartments, while the heights of different colors in one bar denote the distribution of spore sizes in that compartment.

**Table S1.** Inputs and their values used in Equations 2 and 7

Parameter Symbol	Meaning	Unit	Diameter	Best Estimate	Source
V	Volume of model the office	m <sup>3</sup>		78.4	Author decision
Q	Discharge from the air compartment	m <sup>3</sup> /s		0.087	1
p	Fraction of air recirculated into the building by the HVAC system			0.8	2
$\rho_p$	Particle density	kg/m <sup>3</sup>		1000	Author decision
ACH	Air change rate	times/hour		4	Author decision
Inh	Occupants' inhalation rate	m <sup>3</sup> /hour		1.02	3
$e_f$	The efficiency of the filter at removing particles		1 $\mu$ m	0.098	4
			3 $\mu$ m	0.49	
			5 $\mu$ m	0.74	
			10 $\mu$ m	0.88	
$e_n$	The efficiency of the nasal passages at removing particles		1 $\mu$ m	0.14	5, 6
			3 $\mu$ m	0.45	
			5 $\mu$ m	0.62	
			10 $\mu$ m	0.77	
$\lambda_{w(ce)}$	Deposition rates onto the walls (ceilings)	hour <sup>-1</sup>	1 $\mu$ m	0.1	4
			3 $\mu$ m	0.4	
			5 $\mu$ m	0.8	
			10 $\mu$ m	0.9	
$\lambda_{t(urf)}$	Deposition rates onto the tracked (untracked) surface	hour <sup>-1</sup>	1 $\mu$ m	0.1	4
			3 $\mu$ m	0.6	
			5 $\mu$ m	2.0	
			10 $\mu$ m	8.1	
$\mu_2$	Resuspension rate from the untracked surface into the air compartment	hour <sup>-1</sup>	1 $\mu$ m	1.2 $\times 10^{-4}$	4
			3 $\mu$ m	1.9 $\times 10^{-3}$	
			5 $\mu$ m	3.8 $\times 10^{-3}$	
			10 $\mu$ m	3.4 $\times 10^{-2}$	

**Table S2.** Results for approaches to identify two size fractions

Selected compartments	Size fractions to be identified ( $\mu\text{m}$ )	Set of size distribution	HVAC operation condition	Ratio of occupants' risk (compared to full model)			Ratio of spores exiting the room (compared to full model)				
				No measurement error	Measurement error			No measurement error	Measurement error		
					50%	5%	95%		50%	5%	95%
Untracked floor Walls	1,10	Nominal	0.50	0.68	0.69	0.45	1.12	0.93	0.93	0.60	1.28
			0.75	0.68	0.69	0.43	1.06	0.92	0.92	0.63	1.26
			0.95	0.68	0.68	0.42	1.08	0.92	0.92	0.62	1.23
		Light	0.50	0.58	0.59	0.35	0.84	0.86	0.86	0.62	1.14
			0.75	0.58	0.58	0.34	0.84	0.86	0.86	0.61	1.12
			0.95	0.60	0.59	0.36	0.82	0.86	0.86	0.61	1.09
		Heavy	0.50	0.78	0.85	0.55	1.35	0.96	0.98	0.64	1.36
			0.75	0.78	0.83	0.54	1.34	0.96	0.99	0.62	1.38
			0.95	0.77	0.82	0.54	1.32	0.96	0.97	0.63	1.34
	Overall						0.34	1.35		0.60	1.38
	3,10	Nominal	0.50	0.88	0.90	0.47	1.75	0.98	1.01	0.69	1.33
			0.75	0.90	0.91	0.45	1.68	0.99	0.99	0.72	1.32
			0.95	0.92	0.92	0.44	1.70	0.99	1.00	0.73	1.31
		Light	0.50	0.85	0.87	0.37	1.38	0.97	0.98	0.73	1.23
			0.75	0.87	0.86	0.37	1.37	0.97	0.97	0.73	1.22
			0.95	0.90	0.88	0.41	1.36	0.99	0.99	0.74	1.21
		Heavy	0.50	0.92	0.98	0.58	2.12	0.99	1.04	0.72	1.40
			0.75	0.93	0.94	0.57	2.08	0.99	1.04	0.71	1.40
			0.95	0.95	0.95	0.56	2.13	1.00	1.04	0.71	1.37
	Overall					0.37	2.13		0.69	1.40	
	5,10	Nominal	0.50	1.08	1.11	0.49	2.39	1.02	1.05	0.74	1.39
			0.75	1.10	1.11	0.46	2.30	1.02	1.05	0.76	1.37
			0.95	1.15	1.14	0.45	2.30	1.03	1.05	0.77	1.36
		Light	0.50	1.11	1.14	0.39	1.90	1.03	1.04	0.77	1.30
			0.75	1.13	1.13	0.39	1.89	1.04	1.03	0.78	1.30
			0.95	1.19	1.16	0.46	1.86	1.06	1.06	0.80	1.30
		Heavy	0.50	1.06	1.10	0.59	2.88	1.01	1.08	0.75	1.48
0.75			1.07	1.03	0.59	2.79	1.01	1.08	0.74	1.46	
0.95			1.11	1.10	0.58	2.89	1.02	1.09	0.75	1.42	
Overall					0.39	2.89		0.74	1.48		

1. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the nominal scenario are 0.14%, 1.46%, 8.40%, and 90%. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the light scenario are 0.28%, 2.92%, 16.80%, and 80%. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the heavy scenario are 0.07%, 0.73%, 4.20%, and 95%.

2. If a negative release quantity is identified, it will be assumed 0.

3. Values in the 'Overall' row come from the lowest 5% and the highest 95% ratios.

**Table S2.** Results for approaches to identify two size fractions (continued)

Selected compartments	Size fractions to be identified ( $\mu\text{m}$ )	Set of size distribution	HVAC operation condition	Ratio of occupants' risk (compared to full model)			Ratio of spores exiting the room (compared to full model)					
				No measurement error	Measurement error		No measurement error	Measurement error				
					50%	5%		95%	50%	5%	95%	
Untracked floor HVAC	1,10	Nominal	0.50	3.67	3.74	0.42	21.23	1.88	1.89	0.81	7.46	
			0.75	3.71	3.68	0.40	21.04	1.92	1.92	0.79	7.67	
			0.95	3.69	3.75	0.37	18.44	1.94	1.94	0.76	6.92	
		Light	0.50	4.45	4.47	0.29	14.56	2.60	2.60	0.76	7.14	
			0.75	4.46	4.59	0.29	14.02	2.64	2.63	0.80	6.91	
			0.95	4.37	4.08	0.25	13.26	2.66	2.50	0.74	6.83	
		Heavy	0.50	2.83	1.94	0.53	25.86	1.46	1.48	0.79	7.01	
			0.75	2.88	2.03	0.54	25.25	1.49	1.51	0.82	6.99	
			0.95	2.90	2.77	0.53	25.27	1.50	1.54	0.82	7.22	
			Overall									
	3,10	Nominal	0.50	1.12	1.13	0.42	4.83	1.05	1.18	0.79	1.96	
			0.75	1.11	1.12	0.40	4.83	1.05	1.19	0.75	1.99	
			0.95	1.09	1.09	0.37	4.20	1.05	1.16	0.76	1.87	
		Light	0.50	1.16	1.16	0.29	3.32	1.10	1.13	0.72	1.87	
			0.75	1.15	1.14	0.29	3.15	1.10	1.12	0.74	1.81	
			0.95	1.11	1.04	0.26	2.98	1.08	1.08	0.71	1.75	
		Heavy	0.50	1.08	1.04	0.54	5.91	1.03	1.25	0.77	1.98	
			0.75	1.08	1.04	0.55	5.75	1.03	1.23	0.78	1.95	
			0.95	1.06	1.05	0.53	5.78	1.02	1.23	0.77	2.00	
			Overall									
	5,10	Nominal	0.50	0.96	0.96	0.43	3.74	0.98	1.12	0.77	1.59	
			0.75	0.94	0.95	0.41	3.73	0.98	1.12	0.75	1.56	
			0.95	0.92	0.92	0.38	3.24	0.97	1.08	0.74	1.53	
		Light	0.50	0.94	0.94	0.29	2.57	0.97	1.02	0.68	1.44	
			0.75	0.93	0.92	0.29	2.41	0.96	1.01	0.70	1.42	
			0.95	0.90	0.84	0.26	2.28	0.94	0.98	0.70	1.36	
		Heavy	0.50	0.97	1.07	0.55	4.57	0.99	1.19	0.77	1.68	
0.75			0.96	1.07	0.56	4.45	0.99	1.18	0.76	1.70		
0.95			0.94	1.03	0.54	4.46	0.98	1.18	0.76	1.67		
		Overall										

1. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the nominal scenario are 0.14%, 1.46%, 8.40% and 90%. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the light scenario are 0.28%, 2.92%, 16.80%, and 80%. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the heavy scenario are 0.07%, 0.73%, 4.20%, and 95%.

2. If a negative release quantity is identified, it will be assumed 0.

3. Values in the 'Overall' row come from the lowest 5% and the highest 95% ratios.

**Table S2.** Results for approaches to identify two size fractions (continued)

Selected compartments	Size fractions to be identified ( $\mu\text{m}$ )	Set of size distribution	HVAC operation condition	Ratio of occupants' risk (compared to full model)			Ratio of spores exiting the room (compared to full model)				
				No measurement error	Measurement error		No measurement error	Measurement error			
					50%	5%		95%	50%	5%	95%
Wall HVAC	1,10	Nominal	0.50	0.64	0.68	0.45	1.08	1.00	1.00	0.68	1.38
			0.75	0.63	0.67	0.45	1.04	1.00	1.01	0.69	1.36
			0.95	0.64	0.66	0.44	1.03	1.00	1.00	0.68	1.34
		Light	0.50	0.53	0.54	0.35	0.81	0.99	1.00	0.72	1.29
			0.75	0.53	0.53	0.35	0.79	0.99	0.99	0.73	1.25
			0.95	0.54	0.54	0.34	0.77	0.99	0.99	0.74	1.24
		Heavy	0.50	0.75	0.85	0.58	1.33	1.00	1.03	0.65	1.43
			0.75	0.75	0.84	0.57	1.30	1.00	1.02	0.65	1.42
			0.95	0.74	0.83	0.55	1.29	1.00	1.01	0.67	1.45
			Overall			0.34	1.33			0.65	1.45
	3,10	Nominal	0.50	0.83	0.85	0.48	1.98	1.01	1.04	0.73	1.50
			0.75	0.84	0.87	0.50	1.87	1.01	1.04	0.73	1.48
			0.95	0.88	0.90	0.48	1.92	1.01	1.03	0.72	1.45
		Light	0.50	0.77	0.78	0.38	1.51	1.01	1.03	0.76	1.36
			0.75	0.80	0.80	0.38	1.45	1.01	1.02	0.77	1.31
			0.95	0.85	0.85	0.37	1.42	1.02	1.02	0.77	1.27
		Heavy	0.50	0.88	1.03	0.63	2.41	1.00	1.07	0.69	1.57
			0.75	0.89	1.02	0.61	2.36	1.00	1.06	0.68	1.59
			0.95	0.92	0.99	0.59	2.37	1.01	1.04	0.70	1.58
			Overall			0.37	2.41			0.68	1.59
	5,10	Nominal	0.50	1.18	1.19	0.53	3.91	1.00	1.09	0.78	1.92
			0.75	1.23	1.28	0.55	3.69	1.00	1.10	0.76	1.91
			0.95	1.34	1.35	0.52	3.75	1.00	1.09	0.77	1.82
		Light	0.50	1.24	1.27	0.41	3.05	0.99	1.07	0.80	1.63
0.75			1.30	1.32	0.42	2.86	0.99	1.06	0.79	1.58	
0.95			1.43	1.43	0.41	2.89	0.99	1.06	0.80	1.52	
Heavy		0.50	1.13	1.41	0.70	4.88	1.00	1.15	0.74	2.11	
		0.75	1.16	1.38	0.67	4.59	1.00	1.13	0.73	2.07	
		0.95	1.24	1.37	0.65	4.72	1.00	1.11	0.75	2.06	
		Overall			0.41	4.88			0.73	2.11	

1. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the nominal scenario are 0.14%, 1.46%, 8.40%, and 90%. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the light scenario are 0.28%, 2.92%, 16.80%, and 80%. The size fractions of 1, 3, 5, and 10 $\mu\text{m}$  for the heavy scenario are 0.07%, 0.73%, 4.20%, and 95%.

2. If a negative release quantity is identified, it will be assumed 0.

3. Values in the 'Overall' row come from the lowest 5% and the highest 95% ratios.

**Table S3.** Results for approaches to identify 1 micron size fraction

Selected compartments	Set of size distribution	HVAC operation condition	Ratio of occupants' risk (compared to full model)			Ratio of spores exiting the room (compared to full model)				
			No measurement error	Measurement error		No measurement error	Measurement error			
				50%	5%		95%	50%	5%	95%
Untracked floor	Nominal	0.50	183.54	184.80	119.86	230.24	84.83	85.72	47.44	123.82
		0.75	175.64	176.12	111.43	220.65	83.78	84.12	45.01	123.21
		0.95	165.41	165.92	107.83	205.04	82.25	82.64	45.59	118.42
	Light	0.50	114.72	114.18	73.57	145.08	72.48	71.97	40.02	105.94
		0.75	108.57	110.13	69.70	138.18	70.91	72.45	39.07	105.43
		0.95	100.74	99.65	64.65	124.95	68.68	67.56	37.69	97.80
	Heavy	0.50	255.79	251.93	156.45	320.39	92.01	89.89	47.17	134.83
		0.75	248.06	249.84	153.65	314.43	91.39	92.41	47.42	137.76
		0.95	237.74	236.79	148.31	298.00	90.49	89.92	47.22	133.99
	Overall				64.65	320.39			37.69	137.76
Wall	Nominal	0.50	1.02	1.02	0.64	1.38	0.33	0.33	0.20	0.44
		0.75	1.01	1.02	0.65	1.39	0.33	0.33	0.21	0.46
		0.95	1.00	1.01	0.67	1.33	0.34	0.34	0.23	0.45
	Light	0.50	0.79	0.79	0.54	1.03	0.35	0.35	0.24	0.46
		0.75	0.79	0.79	0.54	1.04	0.36	0.36	0.25	0.48
		0.95	0.79	0.79	0.56	1.02	0.37	0.37	0.27	0.48
	Heavy	0.50	1.26	1.26	0.74	1.78	0.31	0.31	0.18	0.44
		0.75	1.25	1.25	0.74	1.80	0.31	0.31	0.19	0.45
		0.95	1.24	1.24	0.72	1.75	0.32	0.32	0.18	0.45
	Overall				0.54	1.80			0.18	0.48
HVAC filter	Nominal	0.50	25.70	25.49	14.96	35.66	8.57	8.49	4.90	12.08
		0.75	24.90	25.01	14.17	34.88	8.51	8.55	4.76	12.13
		0.95	23.72	23.37	13.97	32.68	8.41	8.28	4.87	11.78
	Light	0.50	17.67	17.53	10.97	24.00	8.23	8.16	5.03	11.36
		0.75	17.01	16.91	11.21	22.73	8.15	8.09	5.29	11.05
		0.95	16.06	16.11	10.23	21.23	7.98	8.01	5.00	10.71
	Heavy	0.50	34.15	34.31	18.87	47.85	8.76	8.80	4.76	12.48
		0.75	33.43	33.77	17.36	47.63	8.73	8.82	4.45	12.66
		0.95	32.31	32.19	17.86	46.61	8.68	8.64	4.71	12.75
	Overall				10.97	47.85			4.45	12.75

1. The size fractions of 1 $\mu$ m for the nominal scenario is 0.14%. The size fractions of 1 $\mu$ m for the light scenario is 0.28%. The size fractions of 1 $\mu$ m for the heavy scenario is 0.07%.

2. If a negative release quantity is identified, it will be assumed 0.

3. Values in the 'Overall' row come from the lowest 5% and the highest 95% ratios.



**Table S4.** Results for approaches to identify 10 micron size fraction

Selected compartments	Set of size distribution	HVAC operation condition	Ratio of occupants' risk (compared to full model)			Ratio of spores exiting the room (compared to full model)				
			No measurement error	Measurement error		No measurement error	Measurement error			
				50%	5%		95%	50%	5%	95%
Untracked floor	Nominal	0.50	0.44	0.44	0.21	0.64	0.85	0.85	0.41	1.25
		0.75	0.42	0.42	0.22	0.60	0.84	0.83	0.45	1.21
		0.95	0.39	0.40	0.21	0.58	0.82	0.83	0.44	1.21
	Light	0.50	0.27	0.27	0.16	0.39	0.72	0.73	0.42	1.06
		0.75	0.25	0.26	0.15	0.37	0.71	0.73	0.42	1.04
		0.95	0.24	0.23	0.13	0.33	0.69	0.68	0.38	0.96
	Heavy	0.50	0.61	0.61	0.31	0.93	0.92	0.91	0.47	1.39
		0.75	0.60	0.60	0.31	0.88	0.91	0.92	0.47	1.35
		0.95	0.57	0.57	0.30	0.84	0.90	0.89	0.47	1.33
	Overall				0.13	0.93			0.38	1.39
Wall	Nominal	0.50	0.57	0.57	0.36	0.77	1.11	1.11	0.70	1.49
		0.75	0.56	0.56	0.36	0.76	1.12	1.12	0.72	1.53
		0.95	0.55	0.55	0.35	0.74	1.15	1.15	0.74	1.54
	Light	0.50	0.44	0.44	0.30	0.59	1.20	1.19	0.82	1.59
		0.75	0.44	0.44	0.30	0.58	1.22	1.22	0.85	1.62
		0.95	0.43	0.44	0.31	0.57	1.27	1.28	0.89	1.67
	Heavy	0.50	0.71	0.71	0.41	0.99	1.06	1.06	0.61	1.49
		0.75	0.70	0.70	0.42	1.00	1.07	1.08	0.64	1.54
		0.95	0.68	0.69	0.40	0.95	1.08	1.10	0.63	1.51
	Overall				0.30	1.00			0.61	1.67
HVAC filter	Nominal	0.50	0.49	0.49	0.28	0.69	0.95	0.95	0.53	1.34
		0.75	0.47	0.47	0.26	0.67	0.95	0.94	0.52	1.35
		0.95	0.45	0.45	0.24	0.64	0.94	0.94	0.51	1.33
	Light	0.50	0.34	0.34	0.21	0.46	0.92	0.92	0.58	1.24
		0.75	0.32	0.32	0.21	0.44	0.91	0.90	0.58	1.23
		0.95	0.30	0.30	0.19	0.42	0.89	0.89	0.55	1.21
	Heavy	0.50	0.65	0.66	0.36	0.95	0.98	0.99	0.53	1.43
		0.75	0.63	0.63	0.33	0.92	0.97	0.96	0.50	1.41
		0.95	0.61	0.60	0.33	0.88	0.97	0.96	0.53	1.40
	Overall				0.19	0.95			0.51	1.43

1. The size fractions of 10 $\mu$ m for the nominal scenario is 90%. The size fractions of 10 $\mu$ m for the light scenario is 80%. The size fractions of 10 $\mu$ m for the heavy scenario is 95%.

2. If a negative release quantity is identified, it will be assumed 0.

3. Values in the 'Overall' row come from the lowest 5% and the highest 95% ratios.

## Reference

- (1) EPA, *Exposure Factors Handbook*. Washington, DC : Exposure Assessment Group, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency: 1997.
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