Supplementary Information

for

Pandemic-induced environmental dilemma of disposable masks: solutions from the perspective of life cycle

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This Electronic Supplementary Information contains **3 tables**.

Table S1. Estimate of global consumption of masks during 2017-2021.

Year	P_{China} (billion) [a]	C_{Global} (billion) [b]		
		Lower limit	Upper limit	Median
2017	3.90	5.42	7.22	6.19
2018	4.50	6.25	8.33	7.14
2019	5.00	6.94	9.26	7.94
2020	102.50	142.36	189.81	162.70
2021	71.30	99.03	132.04	113.17

[a] P_{China}— annual mask production of China from iiMedia Research[1].

[b] C_{Global}—annual global consumption of masks estimated by the following formula:

$$P_{Global} = \beta \times \frac{P_{China}}{S} \quad (1)$$

where *S* represents the share of China's production in the global production, which is assumed to be 54% (upper limit), 63% (median), and 72% (lower limit)[2]; β represents the proportion of used masks in produced masks, which is assumed to be 100%.

Table S2. Estimate of annual consumption of masks with different key parameters.

No.	Country	Population [a]	Mask use ratio-B-2020 (%) [b]	Mask use ratio-B-2021 (%)	Annual mask consumption (billion)								
					Frequency-1 [c]			Frequency-2			Frequency-3		
					A [d]	B-2020	B-2021	A	B-2020	B-2021	A	B-2020	B-2021
1	China	1,439,323,776	62	73	257.07	324.68	384.05	149.96	189.40	224.03	42.85	54.11	64.01
2	India	1,380,004,385	57	67	141.42	288.51	337.05	82.50	168.30	196.61	23.57	48.08	56.18
3	US	331,002,651	54	50	80.44	65.71	60.68	46.92	38.33	35.39	13.41	10.95	10.11
4	Brazil	212,559,417	54	65	51.35	42.08	50.36	29.95	24.55	29.37	8.56	7.01	8.39
5	Indonesia	273,523,615	60	75	44.85	59.99	75.19	26.16	34.99	43.86	7.47	10.00	12.53
6	Japan	126,476,461	83	93	34.07	38.52	42.98	19.87	22.47	25.07	5.68	6.42	7.16
7	Russia	145,934,462	42	50	31.62	22.37	26.59	18.44	13.05	15.51	5.27	3.73	4.43
8	Mexico	128,932,753	63	82	29.73	29.60	38.51	17.34	17.27	22.46	4.95	4.93	6.42
9	Nigeria	206,139,589	27	33	27.46	20.26	25.06	16.02	11.82	14.62	4.58	3.38	4.18
10	Pakistan	220,892,340	34	47	22.64	27.52	37.73	13.20	16.05	22.01	3.77	4.59	6.29
11	Bangladesh	164,689,383	49	59	18.81	29.30	35.27	10.97	17.09	20.58	3.13	4.88	5.88
12	Turkey	84,339,067	66	71	18.77	20.30	22.02	10.95	11.84	12.85	3.13	3.38	3.67
13	Iran	83,992,949	43	48	18.69	13.14	14.90	10.90	7.67	8.69	3.12	2.19	2.48
14	Germany	83,783,942	43	50	18.64	13.12	15.22	10.88	7.66	8.88	3.11	2.19	2.54
15	UK	67,886,011	29	47	16.50	7.19	11.64	9.62	4.19	6.79	2.75	1.20	1.94
16	France	65,273,511	48	61	15.67	11.51	14.61	9.14	6.72	8.52	2.61	1.92	2.44
17	Philippines	109,581,078	81	85	15.08	32.67	34.06	8.80	19.06	19.87	2.51	5.44	5.68
18	South Korea	51,269,185	87	95	12.31	16.33	17.85	7.18	9.53	10.41	2.05	2.72	2.98

19	Italy	60,461,826	67	76	12.22	14.92	16.92	7.13	8.71	9.87	2.04	2.49	2.82
20	Argentina	45,195,774	74	81	11.54	12.22	13.36	6.73	7.13	7.79	1.92	2.04	2.23
21	Egypt	102,334,404	22	35	11.27	8.24	13.01	6.58	4.81	7.59	1.88	1.37	2.17
22	Colombia	50,882,891	73	82	11.17	13.55	15.30	6.52	7.90	8.93	1.86	2.26	2.55
23	Spain	46,754,778	71	82	10.95	12.08	14.08	6.39	7.05	8.21	1.83	2.01	2.35
24	Vietnam	97,338,579	55	73	10.83	19.45	26.05	6.32	11.35	15.19	1.81	3.24	4.34
25	DR Congo	89,561,403	30	40	10.55	9.98	13.11	6.16	5.82	7.65	1.76	1.66	2.19
26	Thailand	69,799,978	66	81	10.42	16.99	20.59	6.08	9.91	12.01	1.74	2.83	3.43
27	South Africa	59,308,690	61	79	10.18	13.32	17.21	5.94	7.77	10.04	1.70	2.22	2.87
28	Canada	37,742,154	44	73	8.95	6.06	10.15	5.22	3.53	5.92	1.49	1.01	1.69
29	Ukraine	43,733,762	52	60	8.84	8.26	9.58	5.15	4.82	5.59	1.47	1.38	1.60
30	Iraq	40,222,493	30	31	8.60	4.41	4.52	5.02	2.57	2.64	1.43	0.74	0.75
31	Saudi Arabia	34,813,871	61	75	8.56	7.74	9.62	4.99	4.52	5.61	1.43	1.29	1.60
32	Algeria	43,851,044	30	34	8.20	4.86	5.51	4.78	2.83	3.21	1.37	0.81	0.92
33	Malaysia	32,365,999	60	83	7.39	7.08	9.88	4.31	4.13	5.76	1.23	1.18	1.65
34	Peru	32,971,854	76	87	7.15	9.20	10.47	4.17	5.37	6.11	1.19	1.53	1.75
35	Poland	37,846,611	50	52	6.65	6.97	7.14	3.88	4.07	4.17	1.11	1.16	1.19
	Global	7,922,350,433	51	60	1236.51	1485.51	1735.94	721.30	866.55	1012.63	206.09	247.58	289.32

[a] Data from Worldometer[3].

[b] Mask use ratio represents proportion of the population who always wear masks in public. The data of 2021 and 2022 are adopted from IHME[4].

[c] Frequency represents how often a person replaces a mask. Frequency-1 is 1 mask per capita per day[5]; Frequency-3 is 1 mask per capita every 6 days[2]; Frequency-2 is the average value of Frequency-1 and Frequency-3.

[d] The data in Column **A** (Frequency-1) are adopted from Ref. 5;[5] the data in Column **A** (Frequency-2 and Frequency-3) are calculated according

to Ref. 5 and varying the Frequency. The data in Column **B** are calculated by the following formula:

$$C = p \times MSR \times F \times t \times 10^{-9} \quad (2)$$

where C represents the annual consumption (in billion); p represents the population; MSR represents the mask use rate; F represents the frequency; t represents days of a year.

Table S3. Estimate of hospital waste related to the COVID-19 pandemic.

No.	Country	Hospital waste generation rate (kg/bed/day) [a]	Cumulative cases [b]	Length of hospital stay (day) [c]	Cumulative hospital waste generation (tonnes)
1	China	0.6	136700	14	1148.28
2	India	0.8	38566027	5	146960.67
3	Iran	3.7	6236567	5	115688.32
4	Pakistan	0.3	1345801	5	2018.70
5	Bangladesh	1.1	1653182	5	9009.84
6	Indonesia	0.7	4280248	5	13910.81
7	Nepal	2.1	896584	5	9189.99
8	Sri Lanka	2.3	599363	5	6892.67
9	Saudi Arabia	0.9	638327	5	2712.89
10	Japan	2.3	2017531	5	22697.22
11	Jordon	2.5	1117397	5	13967.46
12	South Korea	0.4	719269	5	1258.72
13	Kazakhstan	5.4	1202369	5	32463.96
14	Lao PDP	0.5	128248	5	320.62
15	Viet Nam	0.9	2094802	5	9007.65
16	Thailand	2.0	2361702	5	24089.36
17	Lebanon	2.5	840514	5	10296.30
18	Malaysia	1.9	2820927	5	26798.81
19	Libya	1.3	401444	5	2609.39
20	Ethiopia	1.8	460602	5	4122.39
21	Nigeria	2.5	251694	5	3100.45
22	Cameroon	0.6	114113	5	313.81
23	Ghana	1.2	154891	5	929.35
24	Tunisia	0.8	817051	5	3186.50
25	Algeria	1.0	230470	5	1106.26
26	Mauritius	0.4	70134	5	154.29
27	Egypt	1.2	403990	5	2423.94
28	Morocco	0.5	1068941	5	2832.69
29	Sudan	0.9	53959	5	234.72
30	Tanzania	1.8	32393	5	291.54

31	Turkey	1.6	10735324	5	87671.81
32	Greece	0.3	1742363	5	2317.34
33	Serbia	1.9	1501621	5	14415.56
34	Italy	4.1	9418256	5	193074.25
35	Bulgaria	2.0	860877	5	8608.77
36	Netherlands	1.7	3720816	5	31626.94
37	Norway	3.9	571655	5	11147.27
38	France	3.3	15201084	5	250817.89
39	Spain	4.4	8834363	5	194355.99
40	Germany	3.6	8460546	5	152289.83
41	Latvia	1.2	319027	5	1882.26
42	UK	3.3	15613287	5	257619.24
43	Brazil	3.3	23416748	5	380522.16
44	Bolivia	0.5	785094	5	1962.74
45	El Salvador	0.4	123577	5	228.62
46	Ecuador	2.1	629507	5	6578.35
47	Canada	8.2	2844912	5	116641.39
48	USA	8.4	68199861	5	2864394.16
	Global		340543962		7023086.84

[a] Data from Ref. 6.[6]

[b] Data from WHO,[7] as of January 21, 2022.

[c] Data from Ref. 8.[8]

Assuming that all COVID-19 infected cases have got hospitalization, the detailed calculation process of hospital waste generation is as follows:

$$W = 10^{-3} \times R \times N \times T \quad (3)$$

where W is the cumulative hospital waste generation (tonnes), R is the hospital waste generation rate (kg/bed/day), N is the cumulative cases, and T is the length of hospital stay (day).

During calculating the global hospital waste generation, we first calculated the hospital waste generation rate outside of China (R') by Eq. (4). Since the total number in these 47 countries accounts for 71.8% of the total case number outside of China, the calculated R' can represent the average R outside of China. Then, we calculated the global cumulative hospital waste generation (W_{global}) by summing the results of China and outside of China by Eq. (5):

$$R' = \frac{\sum_{i=2}^{i=48} R_{Country\,(i)} \times N_{Country\,(i)}}{\sum_{i=2}^{i=48} N_{Country\,(i)}} \quad (4)$$

$$W_{global} = R' \times \left(N_{global} - N_{China}\right) \times T2 + R_{China} \times N_{China} \times T1 \quad (5)$$

where *T1* represents 14 days and *T2* represents 5 days.

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