Supplementary Material for

Evaluating consumer exposure to disinfecting chemicals against coronavirus disease 2019 (COVID-19) and associated health risks

Dingsheng Li[a], Alessandro Sangion[b], Li Li[a,*]

a. School of Community Health Sciences, University of Nevada Reno, Reno, Nevada, United States, 89557-274

b. Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, Ontario, Canada, M1C 1A4

* Corresponding author at: 1664 N. Virginia Street, Mail Stop 0274, Reno, NV 89557-0274, United States
E-mail address: lili@unr.edu

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Text S1 Quantification of the use rates of disinfecting chemicals

The "surface application" scenario: $U = S_{surface} \cdot AL \cdot C$, and

The "hand hygiene" scenario: $U = AM \cdot C$.

whereby,

$S_{surface}$: Area of the disinfected hard surfaces (in m^2). We assume that S_{hard} follows the normal distribution, with a mean (central tendency) of 3 m^2 in each home taken from McCready et al. (2013) and a relative standard deviation of 30% considering the variation in the floor area of a home (based on the mean and standard deviation of "the area of the first floor" in houses recorded in the U.S. Residential Energy Consumption Survey database). The normal distribution is selected because it approximates the surveyed distribution in the area of the first floor (with a skewness of 0.58 close to 0 for the normal distribution, and a kurtosis of 4.30 close to 3 for the normal distribution).

AL: Area-specific application load of disinfectant product per use (in g/m^2). We assume that *AL* follows a normal distribution with a mean of 8.70 g/m^2 and a standard deviation of 0.32 g/m^2, which is derived based on experimental data that cleaning a 3868 ± 108 cm^2 kitchen sink consumes 3.37 ± 0.077 g of "wet fraction" in wet wipes (Weerdesteijn et al. 1999).

AM: Amount of disinfectant product per use (in g). We follow the assumption in Sanderson et al. (2006) that $AL_{surface}$ follows a uniform distribution ranging from 1.6 to 1.7 g (internal data from the Soap and Detergent Association).

C: Weight fraction of active ingredient (in %). A search of the U.S. EPA's Chemicals and Products Database (CPDat) (Dionisio et al. 2018) (available through the U.S. EPA's CompTox Chemistry Dashboard) indicates that the weight fraction of a disinfecting chemical varies by up to three orders of magnitude between specific disinfecting products and that there is considerable overlap between the weight fractions of different disinfecting chemicals. For instance, available records show that the reported weight fraction of a benzalkonium chloride mixture (CASRN 8001-54-5; DTXSID 9034317) ranges from 0.38% in antibacterial hand soaps and sprays to 17.4% in multi-purpose sprays, whereas that of triclosan (CASRN 3380-34-5; DTXSID 5032498) ranges from 0.1% to 7% in antibacterial hand soaps. It should be noted that product-specific records of weight fraction are incomplete in CPDat: records are missing for several disinfecting chemicals investigated in our work (see the list in Section 2.3) or their certain types of disinfecting products. As such, instead of collecting reported weight fractions for individual specific chemical-product combinations, we use an estimate pooling weight fractions of all the investigated disinfecting chemicals in the "product category" of cleaning products predicted by Isaacs et al. (2018), which ranges from the 5^{th} percentile of 0.0071% to the 95^{th} percentile of 9.3%, with a median of 1.8%. We assume that it follows a triangular distribution. We do not consider the dilution of disinfectants during use.

Text S2 Inhalation exposure during the spraying of disinfecting products

The inhalation exposure during the spraying of disinfecting products is estimated to be 67 ng/kg/d (the worst case) by the spray module (for non-volatile substances) in ConsExpo (web version 1.0.7, last update: March 31, 2020). This rough estimation assumes exposure duration to be 10 min, which is the maximum "contact time", i.e., the duration that a disinfecting chemical is in contact with the novel coronavirus (SARS-CoV-2) to achieve complete inactivation, recommended by the U.S. Environmental Protection Agency for disinfecting products (U.S. Environmental Protection Agency 2020). The inhalation rate is assumed to be 25 L/min (a default in ConsExpo). We assume an instantaneous release of disinfectants. Other parameters are the same as those used in the PROTEX simulation.

Table S1 Properties of the active ingredients (neutral forms) in disinfecting products against COVID-19

Chemical	CAS#	Molar mass (g/mol)[a]	logK_{OW}[b]	logK_{AW}[c]	pKa[d]	OH reaction rate constant (cm^3/molecule/s)[e]	log V_P (Pa)[f]	log S_W (mol/L)[g]	log HL_B (hour)[h]
C8BAC	959-55-7	283.88 (248.24)	0.504	-3.5		2.50E-11	-1.66	-4.55	0.87 (0.18)
C10BAC	965-32-2	311.94 (276.27)	1.802	-4.58		2.63E-11	-2.58	-4.39[i]	0.82 (0.19)
C12BAC	139-07-1	339.99 (304.30)	2.62[j]	-10.68		3.04E-11	-6.46[k]	-2.17[l]	0.77 (0.2)
C14BAC	139-08-2	368.05 (332.33)	3.14[m]	-6.68		3.58E-11	-3.74[n]	-3.45[o]	0.74 (0.21)
C16BAC	122-18-9	396.1 (360.36)	3.02[p]	-8.13		3.74E-11	-3.63	-1.89[q]	0.71 (0.22)
C18BAC	122-19-0	424.15 (388.39)	3.36[r]	-6.95		3.89E-11	-4.81	-4.25[s]	0.69 (0.23)
C12ADEAC	14351-42-9	368.05 (332.33)	3.032	-4.38		3.56E-11	-3.76	-5.77	0.85 (0.21)
C14ADEAC	27479-29-4	396.1 (360.36)	3.7	-4.28		3.71E-11	-3.92	-6.03	0.82 (0.22)
DODAC	5538-94-3	305.98 (270.32)	2.353	-5.99		2.36E-11	-2.69[t]	-3.09[u]	0.9 (0.32)
DDDAC	7173-51-5	362.08 (326.38)	2.53[v]	-5.64		2.60E-11	-2.22[w]	-2.97[x]	0.84 (0.32)
ODDAC	32426-11-2	334.03 (298.35)	2.781	-2.96		2.5E-11	-2.59	-6.025	0.87 (0.32)
C14ADBAS	68989-01-5	514.8 (332.33)	3.02	-4.21		3.58E-11	-3.35	-5.53	0.74 (0.21)
Benzethonium Chloride	121-54-0	448.09 (412.32)	1.02[y]	-13.58		6.21E-11	-7.56[z]	-0.37[aa]	0.91 (0.14)
Cetrimonium Bromide	57-09-0	364.456 (284.33)	2.66	-7.85		2.03E-11	-2.22	-0.76[ab]	0.9 (0.32)
Chloroxylenol	88-04-0	156.61	3.27[ac]	-3.66	9.7[ad]	7.11E-11	0.03	-2.7[ae]	0.58 (0.16)
Thymol	89-83-8	150.221	3.30[af]	-4.75	10.62[ag]	9.4E-11	-0.53[ah]	-2.175[ai]	0.83 (0.11)
O-Phenylphenol	90-43-7	170.211	3.12[aj]	-4.3	10	5.58E-11	-0.31[ak]	-2.405[al]	0.63 (0.1)
Triethylene glycol	112-27-6	150.174	-1.75[am]	-8.18	14.06	3.26E-11	-0.97[an]	0.82[ao]	-0.04 (0.23)
Bronopol	52-51-7	199.988	0.47	-9.34	12.02	2.07E-12	-2.77[ap]	0.175[aq]	0.05 (0.15)
Chlorhexidine Gluconate	18472-51-0	897.76 (504.20)	-1.86[ar]	-8.66	11.51[as]	1.67E-10	-2.29[at]	-0.02[au]	1.51 (0.15)
Triclocarban	101-20-2	315.58	3.63[av]	-6.61	12.7[aw]	1.66E-11	-5.92	-5.7 [ax]	2.13 (0.08)
Triclosan	3380-34-5	289.54	4.8[ay]	-5.89	7.9[az]	1.68E-11	-3.99	-4.495[ba]	2.05 (0.09)

Notes

a) Molar mass in g/mol; in brackets are the molar mass of the parent compound without counterion.

b) Predicted using the ACD/Labs Consensus Model unless indicated if experimentally determined values are available.

c) Calculated from V_P and S_W: $K_{AW} = V_P/(S_W*R*T)$, where T is the temperature (298.15 K) and R is the ideal gas constant (8314.463 Pa L mol^{-1} K^{-1}).

d) Predicted using ACD/Labs unless indicated if experimentally determined values are available.

e) Consensus of EPI Suite™ and OPERA predictions.

f) Consensus of NICEATM and OPERA predictions.

g) Consensus of NICEATM and OPERA predictions.

h) Predicted using the biotransformation model published in Papa et al. (2018) and implemented in QSARINS-Chem (Gramatica et al. 2014); in brackets are the 95% confidence intervals of the predictions.

i) Converted from an experimentally determined value of >=10 mg/ml (log S_W = -4.49 mol/L) at 63 °F (17.2 °C) according to the National Toxicology Program in the PubChem database.

j) Converted from an experimentally determined value at 24 °C, determined using shake flask method according to the OECD Guideline 107 and EU Method A.8 reported and in the Registered Substances Dossier by the European Chemical Agency (ECHA) (European Chemical Agency 2020).

k) Experimental value at 25 °C, determined using the Knudsen cell effusion method according to OECD Guideline 104 and EU Method A.4 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

l) Converted from an experimentally determined value of > 2000 mg/L (log S_W = -2.23 mol/L) at 20 °C, determined using the preliminary solubility test method as part of the partition coefficient test according to the OECD 107 as well as using the CMC method, according to ISO 4311 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

m) Converted from an experimentally determined value of logK_{OW} = 3.20 at 20 °C, determined using shake flask method according to the OECD Guideline 107 and EU Method A.8 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

n) Experimental value at 25 ºC, determined using the vapor pressure balance method according to OECD Guideline 104 and EU Method A.4 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

o) Converted from an experimentally determined value of 115 mg/L (log S_W = -3.51 mol/L) at 20 °C, determined using the flask method according to the OECD Guideline 105 and EU Method A.6 as well as using the CMC method according to ISO 431 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

p) Experimental value at 25 º C (pH 5.8), determined using the reverse phase high-performance liquid chromatography method according to OECD Guideline 117 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

q) Experimental value at 25 ºC, determined using the spectrophotometric analytical method according to the OECD Guideline 105 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

r) Arithmetic mean of experimental values reported by Hansch et al. (1985) (logK_{OW} = 3.23 at 25 ºC), and by ECHA (European Chemical Agency 2020) in the Registered Substances Dossier (logK_{OW} = 3.89 at 20 ºC) and Hodges et al. (2019) (logK_{OW} = 3.03 at 25 ºC). The value measured using a slow-stirring method by Hodges et al. (2019) is excluded because “the values determined using the slow-stirring method seem lower than would be expected,

particularly given the size of the longer alkyl chain molecules".(Hodges et al. 2019)

s) Converted from an experimentally determined value of 20.8 mg/L (log S_W = -4.31 mol/L) at 20 ºC reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

t) Experimental value at 25 °C, determined using the effusion method based on vapor pressure balance according to OECD Guideline 104 and EU Method A.4 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

u) Experimental value of the critical micelle concentration at 25 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

v) Converted from an experimentally determined value of logK_{OW} = 2.59 at 20 °C, derived as the ratio of the solubility in octanol (250 g/L) to that in water (0.65 g/L; critical micelle concentration) and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

w) Experimental value at 25 °C, determined using the isothermal thermogravimetric effusion method according to OECD Guideline 104 and EU method A.4 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

x) Experimental value of the critical micelle concentration at 25 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

y) Converted from an experimentally determined value logK_{OW} =1.08 at 20 °C, determined using the shake-flask method according to the OECD Guideline 107 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

z) Experimental value at 25 °C, determined using the vapor pressure balance method according to OECD Guideline 104 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

aa) Arithmetic mean of experimental values: (i) log S_W = 0.13 mol/L at 25 °C based on a measurement of 530 g/L at 20 °C determined using the modified flask method according to OECD 105 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020) and (ii) log S_W = -0.87 mol/L at 25 °C based on a measurement of 50 mg/mL at 64° F reported by the National Toxicology Program in the PubChem database.

ab) Converted from an experimentally determined value of 55 g/L at 20 °C measured by a simple water solubility test and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

ac) Experimental value at 25 °C reported by Sangster (2019).

ad) Taken from Kortum et al. (1961).

ae) Arithmetic mean of two values at 20 °C (i) log S_W = -2.72 mol/L, based on measurements of 0.3 g/L (pH 4 and 7) and 0.8 g/L (pH 10) as reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020), and (ii) log S_W = -2.79 mol/L by Yalkowsky et al. (2003)

af) Experimental value at 25 °C reported by Hansch et al. (1985).

ag) Experimental value at 20 °C as reported by Serjeant and Dempsey (1979).

ah) Experimental values at 25 °C reported by Jones (1960).

ai) Arithmetic mean of two experimental values: (i) log SW = -2.16 mol/L at 25 °C based on a value of 900 mg/L at 20 °C reported by Yalkowsky and Dannenfelser (1992) (ii) log SW = -2.19 mol/L based on a reported value of 980 mg/L at 25 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

aj) Arithmetic mean of experimental values reported by Hansch et al. (1985) (logK_{OW} = 3.09 at 25 °C) and by ECHA (European Chemical Agency 2020) in the Registered Substances Dossier (logK_{OW} = 3.15 at 25 °C converted from a value of 3.18 at 22.5 °C determined by the shake-flask method according to EU Method A.8).

ak) Arithmetic mean of experimental values at 25 °C (i) log V_P = -0.57 Pa (V_P = 0.267 Pa) reported by Kundel (1975) and (ii) log V_P = -0.04 Pa (V_P = 0.906 Pa) determined by effusion method according to EU Method A.4 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

al) Arithmetic mean of two experimental values (i) Log W_S = -2.39 mol/L (W_S = 700 mg/L) at 25 °C reported by Tomlin (2004) and (ii) Log W_S = -2.42 mol/L at 25 °C converted from a value of 0.56 g/L at 20 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

am) Experimental value at 25 °C reported by Meylan and Howard (1995).

an) Geometric mean of two values at ~25 °C (i) 0.000655 hPa reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020) and (ii) 0.00132 mmHg by Daubert and Danner (1989).

ao) Experimental value at 25 °C reported by Riddick et al. (1986).

ap) Converted from an experimentally determined value $V_P = 1.68\times10^{-3}$ Pa at 20 °C (Tomlin 2004).

aq) Arithmetic mean of two experimental values (i) log W_S= 0.13 at 25 °C converted from a value of 255000 mg/L at 22 °C reported by Yalkowsky et al. (2003) and (ii) log W_S = 0.22 at 25 °C converted from a value of 286 g/L at 20 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

ar) Converted from the experimental value of logK_{OW} = -1.81 at 20.7 °C determined by the Shake Flask Method reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

as) pKa of the base predicted by ACD/Labs

at) Experimental value at 25 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

au) Converted from a value of Ws = 750 g/L at 20 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

av) Experimental value at 25 °C determined by using reverse phase high-performance liquid chromatographic method according to OECD Guideline No. 117 reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

aw) Experimental value as reported by Wu et al. (2009).

ax) Experimental value at 25 °C measured by the spectrophotometric analytical method as per OECD 101 and reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

ay) Arithmetic mean of two experimental values (i) logK_{OW} = 4.76 at 25 °C reported by the Chemicals Inspection And Testing Institute (Chemicals Inspection and Tetsing Institute 1992) and (ii) logK_{OW} = 4.84 at 25 °C converted from a logK_{OW} = 4.9 at 20 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

az) Experimental value reported by O'Neil and Heckelman (2013).

ba) Arithmetic mean between two values (i) log Ws = -4.4 at 25 °C Converted from an experimentally determined value of 10 mg/L at 20 °C reported by Yalkowsky and Dannenfelser (1992) and (ii) log W_S = -4.59 at 25 °C Converted from an experimentally determined value of 6.5 mg/L at 20 °C reported in the Registered Substances Dossier by ECHA (European Chemical Agency 2020).

Table S2 Modeled exposures to DODAC and *O*-phenylphenol assuming their lifetimes in organic films are 240 and 9200 days, relative to the default assumption of no degradation (= 100%).
N.B.: There is no difference between age groups.

	DODAC	*O*-phenylphenol
240 days	16%	93%
9200 days	88%	99%
Default assumption (no degradation)	100%	100%

Table S3 Summary of *in vivo* toxicological data from the U.S. EPA's CompTox Chemistry Dashboard and European Chemicals Agency

Chemicals	CAS#	RfD (mg/kg/day)	DNEL (mg/kg/day)		Hazard
			General population	Worker	
C8BAC	959-55-7	NA	NA		
C10BAC	965-32-2	NA	NA		
C12BAC	139-07-1	NA	No hazard identified		
C14BAC	139-08-2	NA	No hazard identified		
C16BAC	122-18-9	NA	NA		
C18BAC	122-19-0	NA	No hazard identified		
C12ADEAC	14351-42-9	NA	NA		
C14ADEAC	27479-29-4	NA	NA		
DODAC	5538-94-3	NA	1.6	2.67	Irritation
DDDAC	7173-51-5	0.1	No hazard identified	8.6	Irritation; decreased total cholesterol level
ODDAC	32426-11-2	NA	NA		
C14ADBAS	68989-01-5	NA	NA		
Chloroxylenol	88-04-0	NA	Low hazard	5	Skin sensitization
Triethylene glycol	112-27-6	2	No hazard identified		Delayed ossification of the supraoccipital bone in fetal mice
Benzethonium Chloride	121-54-0	NA	NA		
Cetrimonium Bromide	57-09-0	NA	Hazard unknown	0.4	Irritation
Bronopol	52-51-7	NA	0.7	2	Irritation
Chlorhexidine Gluconate	18472-51-0	NA	3	5	Irritation
Chlorhexidine	55-56-1	NA	NA		
Thymol	89-83-8	NA	8.3	16.6	Histopathological changes in the forestomach
O-Phenylphenol	90-43-7	NA	0.4	21.84	Irritation
Triclocarban	101-20-2	NA	0.25	0.7	Low hazard
Triclosan	3380-34-5	0.3 - 4	No hazard identified	2.8	Irritation; hepatocellular hypertrophy; effect on the lining of stomach

Table S4 Summary of *in vitro* bioactivity data from ToxCast

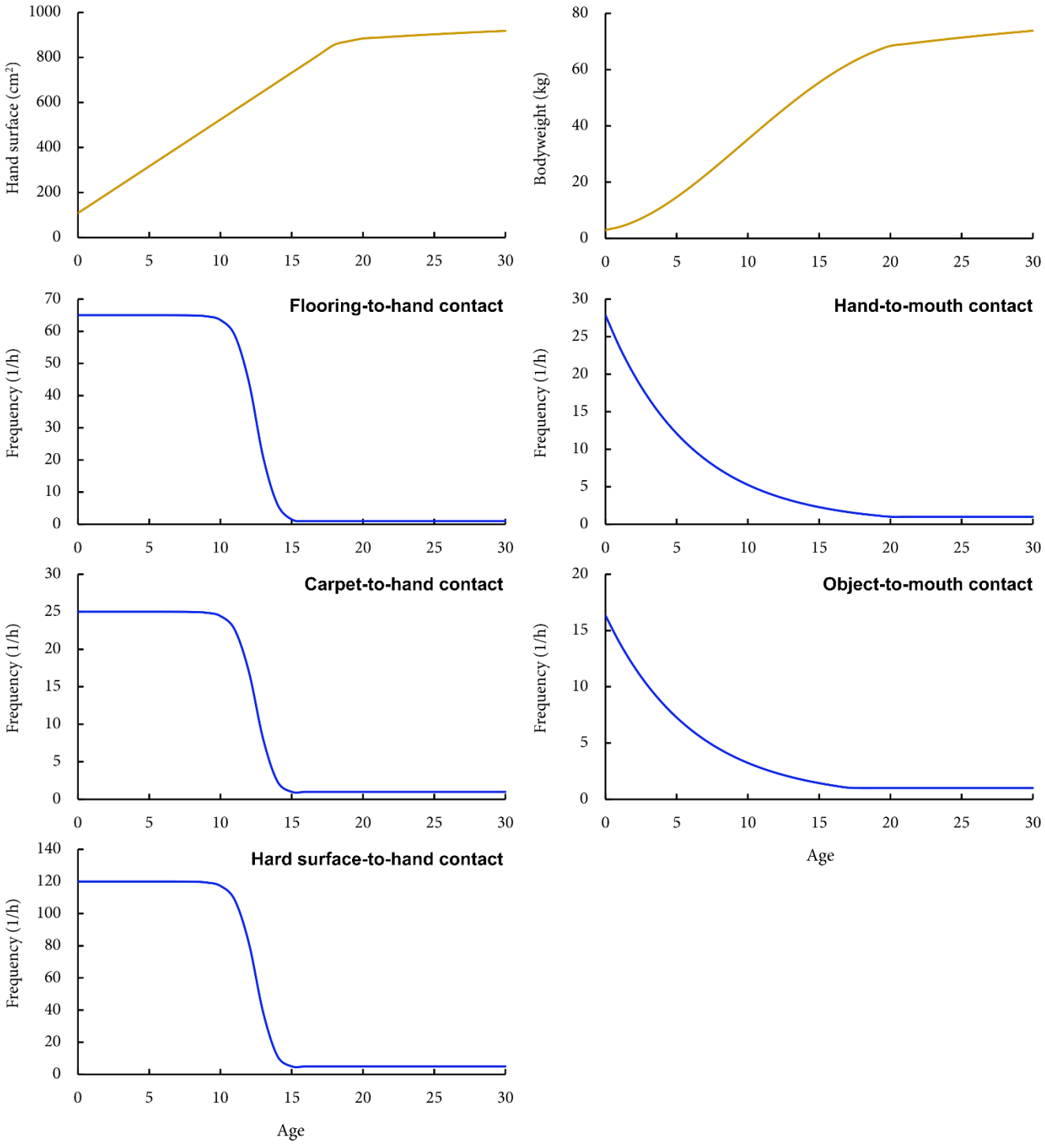
Chemicals	CAS#	Number of active assays	Bioactivity (uM)							Targets of active assay with AC_{50} below cytotoxicity limit
			Cytotoxicity		AC_{50}					
			Center	Limit	5th	25th	50th	75th	95th	
C8BAC	959-55-7	0	NA							
C10BAC	965-32-2	0	NA							
C12BAC	139-07-1	142	35.05	7.33	0.29	0.46	1.88	3.98	6.405	Cell cycle; DNA binding; Nuclear receptor
C14BAC	139-08-2	0	NA							
C16BAC[a]	122-18-9	251	25.3	4.72	0.5272	2	3.22	4	4	Cell adhesion molecules; Cell cycle; Cell morphology; Cytochromes P450; Cytokinetics; DNA binding; G protein-coupled receptor; Ion channel; Kinase; Misc. protein; Oxidoreductase; Phosphatase; Protease; Protease inhibitor; Transporter
C18BAC[a]	122-19-0	245	30.3	6.07	0.2	0.7	1.28	2	4.148	Cell adhesion molecules; Cell cycle; Cell morphology; Cytochromes P450; Cytokinetics; DNA binding; G protein-coupled receptor; Growth factor; Kinase; Misc. protein; Phosphatase; Protease; Protease inhibitor; Transporter;
C12ADEAC	14351-42-9	0	NA							
C14ADEAC	27479-29-4	0	NA							
DODAC	5538-94-3	20	19.6	4.28	0.6676	0.766	0.889	1.0295	1.1419	Cell cycle
DDDAC	7173-51-5	327	29.7	5.2	1.0345	3.9175	4	4	4.637	Cell adhesion molecules; Cell cycle; Cell morphology; Cytochromes P450; DNA binding; G protein-coupled receptor; Growth factor; Ion channel; Kinase; Malformation; Misc. protein; Nuclear receptor; Protease; Protease inhibitor; Transporter
ODDAC	32426-11-2	0	NA							
C14ADBAS	68989-01-5	0	NA							
Chloroxylenol	88-04-0	43	7.625	1.66	NA					
Triethylene glycol	112-27-6	15	0.00129	0	NA					
Benzethonium	121-54-0	235	5.48	26	0.04	0.25	2.39	3.305	4.63	Cell adhesion molecules; Cell cycle; Cytochromes P450;

Chloride										Cytokinetics; DNA binding; Esterase; G protein-coupled receptor; Growth factor; Ion channel; Misc. protein; Nuclear receptor; Protease; Steroid hormone; Transporter;
Cetrimonium Bromide	57-09-0	186	6.74	29.25	0.78125	1.58	3.415	5.1675	6.5175	Cell cycle; DNA binding; Nuclear receptor
Bronopol	52-51-7	185	11.08	57.5	1.397	4.08	9.72	10	10	Cell adhesion molecules; Cell cycle; Cytochromes P450; Cytokinetics; DNA binding; G protein-coupled receptor; Kinase
Chlorhexidine Gluconate	18472-51-0	0	NA							
Chlorhexidine	55-56-1	144	6.32	29.15	2.35	2.64	3.89	5	6.024	Cell cycle; DNA binding; Nuclear receptor
Thymol[a]	89-83-8	21	47.2	12.3	3.277	6.27	10	10	10	Cell morphology; Cytokinetics; G protein-coupled receptor
O-Phenylphenol[a]	90-43-7	91	41.65	9.21	3.536	3.76	4.04	4.33	4.562	Cell cycle; Cytochromes P450
Triclocarban[a]	101-20-2	186	4.93	1	0.162715	0.34	0.48	0.626	0.7948	Cell cycle; Cell morphology; Esterase; Nuclear receptor; Steriod hormone
Triclosan	3380-34-5	321	35.4	7.34	1.406	2.45	4.62	5.2775	6.793	Cell adhesion molecules; Cell cycle; Cell morphology; Cytochromes P450; Cytokinetics; DNA binding; G protein-coupled receptor; Kinase; Malformation; Nuclear receptor; Transporter

Notes

a) More than half of the active assays with AC_{50} lower than cytotoxicity limit have notation indicating original data being noisy.

Figure S1 Age-dependent evolution of hand surface area, bodyweight, frequencies of hand contact with surfaces (flooring, carpet, and hard surfaces), and frequencies of mouthing hands and objects



Note: The surface area of two hands is assumed to be 5% of the total body area calculated according to the literature (Haycock et al. 1978; Mosteller 1987). The age-dependence of bodyweight is obtained by fitting

nationally surveyed data in the U.S. EPA's Exposure Factors Handbook (U.S. Environmental Protection Agency 2019). Frequencies of hand contacts with flooring, carpet, and hard surfaces are taken from Freeman et al. (2001)(for children) and Zhang et al. (2014)(for adults). Frequencies of hand-to-mouth and object-to-mouth contacts are obtained by fitting recommended observed data in the U.S. EPA's Exposure Factors Handbook (U.S. Environmental Protection Agency 2019).

Figure S2 Comparison between PROTEX and ConsExpo predictions of dermal uptake of disinfecting chemicals during 20-s hand washing each day in the "hand hygiene" scenario
"*" marks chemicals with a difference between PROTEX and ConsExpo predictions within an order of magnitude; "#" marks chemicals with a difference between PROTEX and ConsExpo predictions within an order of magnitude

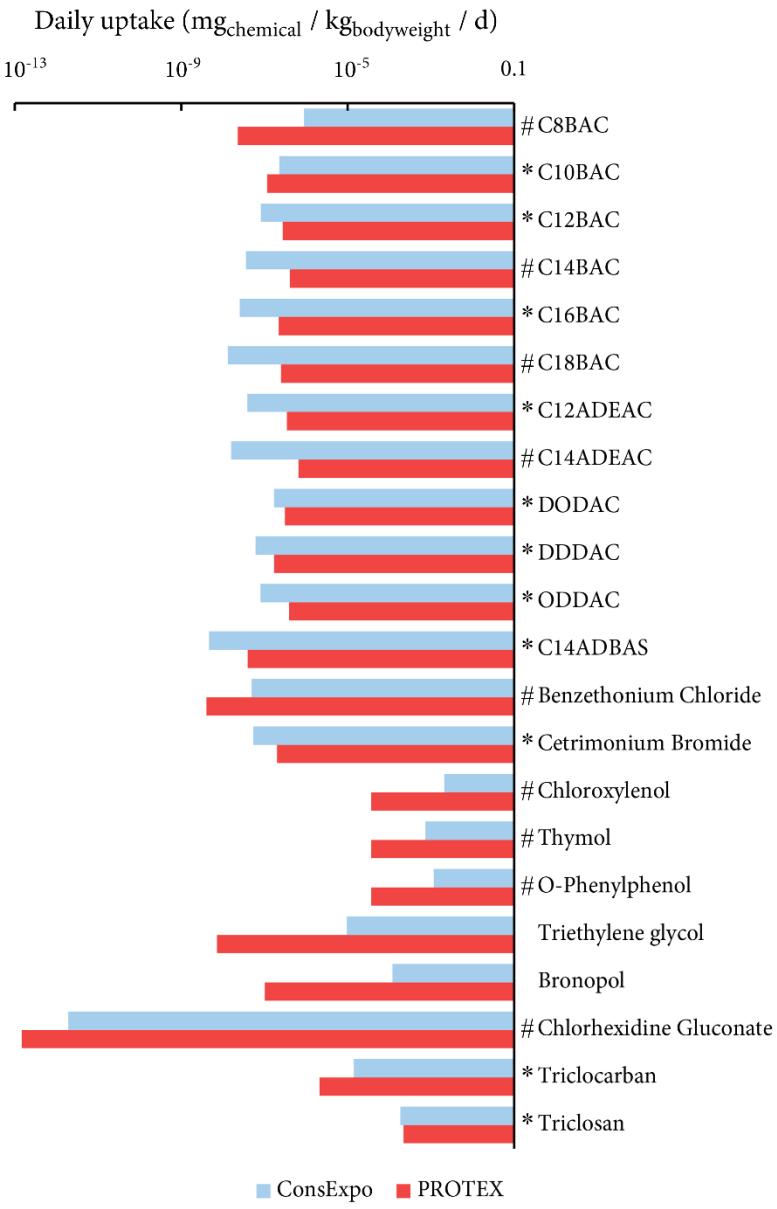


Figure S3 Comparison between PROTEX and ConsExpo predictions of dermal loadings of quaternary ammonium salts on hands in the "surface application" scenario

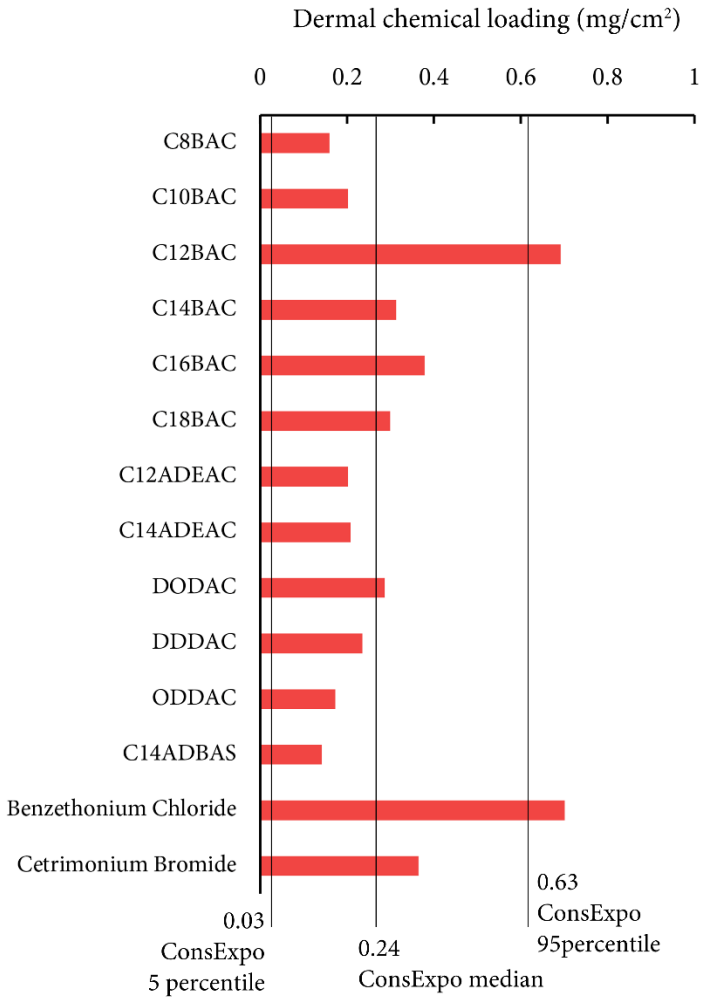


Figure S4 Fate and transport of neutral dioctyl dimethyl ammonium chloride (DODAC) between indoor compartments, assuming no dissociation (ionization) of DODAC

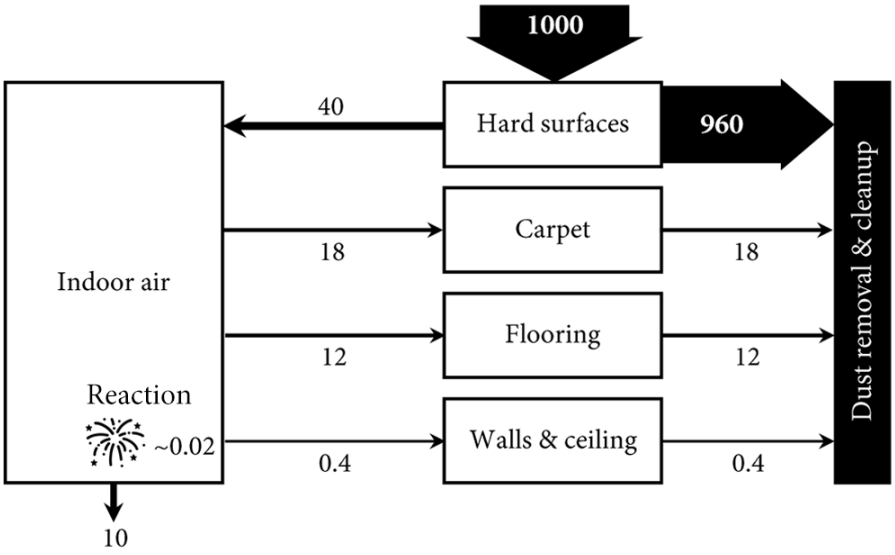
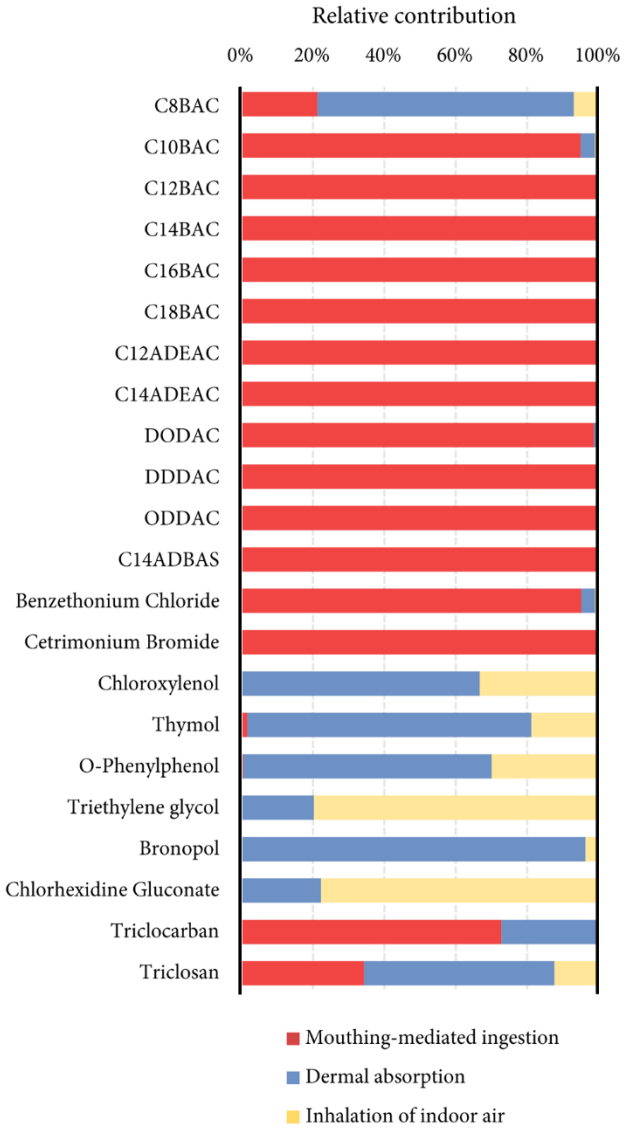


Figure S5 Relative contribution of mouthing-mediated ingestion, dermal absorption, and inhalation of indoor air to aggregate exposure of the modeled 25-year-old child to disinfecting chemicals



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