

## **Online supplement**

### **Association of hand and arm disinfection with asthma control in U.S. nurses**

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**Table E1.** Characteristics of the participants according to frequency of hand and arm hygiene tasks

	Hand hygiene (n=4,031)			Arm hygiene (n=4,006)		
	Never	≤10 times/day	>10 times/day	Never	<1 time/day	≥1 times/day
%	15	39	46	62	17	21
Age, m (sd)	59.0 (4.5)	59.0 (4.3)	58.3 (4.2)	58.8 (4.4)	58.4 (4.2)	58.4 (4.3)
Race (non white), %	5	5	7	5	6	6
Ethnicity (Hispanic), %	3	2	2	2	2	2
Smoking status, %						
Never smoker	68	67	67	68	68	64
Ex-smoker	29	30	29	29	28	31
Current smoker	3	3	4	3	4	5
BMI, %						
<25 kg/m <sup>2</sup>	31	28	28	29	30	23
25-29.9 kg/m <sup>2</sup>	28	31	29	30	30	29
≥ 30 kg/m <sup>2</sup>	41	41	43	41	40	48
Hand hygiene, %						
Never	-	-	-	24	1	0
≤10 times/day	-	-	-	45	38	22
>10 times/day	-	-	-	31	61	78
Arm hygiene, %						
Never	98	71	42	-	-	-
<1 time/day	1	17	23	-	-	-
≥1 times/day	0	12	35	-	-	-
Surface and/or instruments disinfection*, %						
None	74	64	32	60	44	27
Surface only	17	26	39	27	37	36
Instruments	9	10	29	13	19	37
Job type†, %						
ER	1	1	4	2	3	5
OR	1	4	7	2	6	12
ICU	0	1	9	2	4	12
Other inpatient nurse	4	7	21	10	17	21
Nursing in education or administration	27	26	10	22	16	9
Outpatient or community	30	28	27	31	28	19
Other hospital nursing	6	10	11	10	10	10
Nursing outside hospital	29	22	11	21	17	12

BMI – Body Mass Index; ER - emergency room; ICU - intensive care unit; OR - operating room. \* Self-reported weekly use of disinfectants to clean surfaces/instruments. † Evaluated by questionnaire (“Which best describes your current employment status?”)

**Table E2.** Associations of hand and arm hygiene with asthma control, using more detailed categories of asthma control

	Partly controlled asthma (ACT=20-24)	Poorly controlled asthma (ACT=16-19)	Very poorly controlled asthma (ACT≤15)	P <sub>trend</sub>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Hand hygiene (n=3,989)				
Never	1	1	1	
≤10 times/day	1.22 (0.99-1.50)	1.32 (0.96-1.82)	1.96 (1.21-3.18)	0.005
>10 times/day	1.27 (1.04-1.56)	1.22 (0.89-1.67)	2.28 (1.42-3.66)	0.002
Arm hygiene (n=3,965)				
Never	1	1	1	
<1 time/day	1.18 (0.97-1.43)	1.37 (1.03-1.82)	1.52 (1.05-2.21)	0.007
≥1 times/day	1.21 (1.01-1.46)	1.69 (1.30-2.19)	2.47 (1.80-3.37)	<0.001

ACT, Asthma Control Test score. \* Reference category: Controlled asthma (Asthma Control Test score = 25). All models were adjusted for age, smoking status in 2013, body mass index in 2013, race and ethnicity. Separate models were used for hand and arm hygiene. Observations with missing values for covariates (smoking status, body mass index, exposure to surface/instrument disinfectants: all <1%) were excluded from multivariable analyses.

**Table E3.** Associations of hand and arm hygiene with asthma control, with further adjustment for self-reported use of surface and/or instrument disinfectants

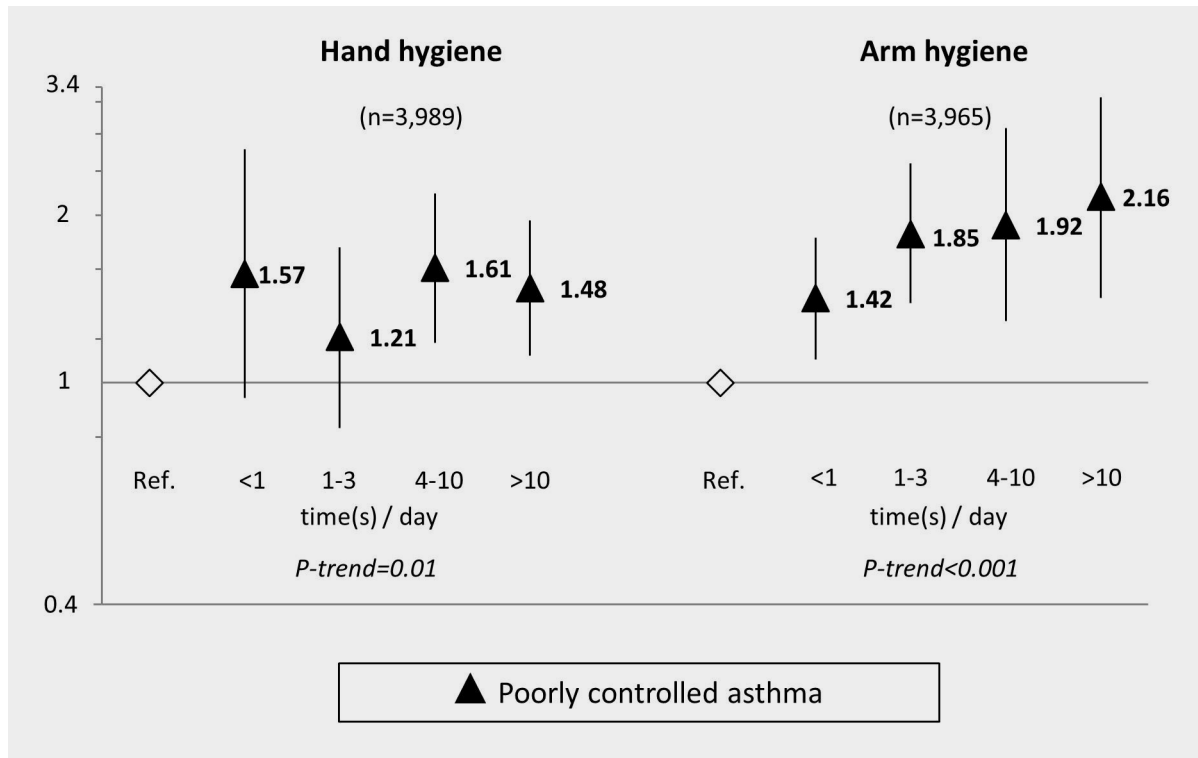
	Partly controlled asthma (ACT=20-24)	Poorly controlled asthma (ACT=16-19)	Very poorly controlled asthma (ACT≤15)	P <sub>trend</sub>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
<b>Model 1†, n=3,966</b>				
Hand hygiene				
Never	1	1	1	
≤10 times/day	1.21 (0.98-1.50)	1.37 (0.99-1.89)	1.93 (1.19-3.14)	0.004
>10 times/day	1.23 (0.99-1.53)	1.22 (0.87-1.71)	2.06 (1.27-3.37)	0.01
Surface and/or instruments				
None	1	1	1	
Surface only	1.02 (0.86-1.21)	0.83 (0.64-1.08)	0.92 (0.66-1.29)	0.38
Instruments	1.13 (0.92-1.39)	1.26 (0.94-1.70)	1.63 (1.14-2.35)	0.01
<b>Model 2‡, n=3,942</b>				
Arm hygiene				
Never	1	1	1	
<1 time/day	1.19 (0.98-1.45)	1.43 (1.07-1.92)	1.54 (1.05-2.24)	0.004
≥1 times/day	1.18 (0.97-1.44)	1.72 (1.31-2.27)	2.31 (1.66-3.21)	<0.001
Surface and/or instruments				
None	1	1	1	
Surface only	1.01 (0.86-1.19)	0.77 (0.60-0.99)	0.88 (0.63-1.22)	0.17
Instruments	1.12 (0.91-1.34)	1.08 (0.81-1.45)	1.41 (0.99-2.02)	0.09

ACT, Asthma Control Test score. \* Reference category: Controlled asthma (Asthma Control Test score = 25). All models were adjusted for age, smoking status in 2013, body mass index in 2013, race and ethnicity. †Model 1 including hand hygiene and self-reported weekly use of disinfectants to clean surfaces/instruments. ‡Model 2 including arm hygiene and self-reported weekly use of disinfectants to clean surfaces/instruments. Observations with missing values for covariates (smoking status, body mass index, exposure to surface/instrument disinfectants: all <1%) were excluded from multivariable analyses.

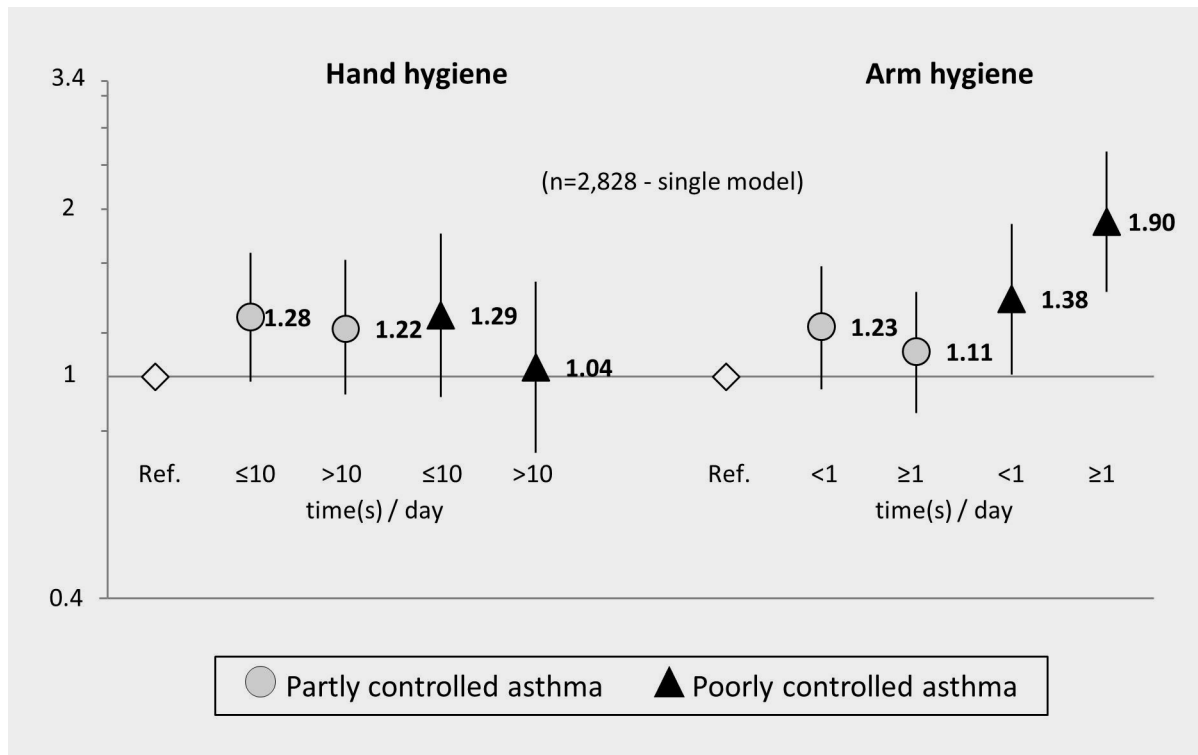
**Table E4.** Associations of hand and arm hygiene with asthma control, with further adjustment for exposure to specific products evaluated by a job-task-exposure matrix

	Partly controlled asthma (ACT=20-24)	Poorly controlled asthma (ACT=16-19)	Very poorly controlled asthma (ACT≤15)	P <sub>trend</sub>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
<b>Model 1†, n=3,966</b>				
Hand hygiene				
Never	1	1	1	
≤10 times/day	1.22 (0.99-1.51)	1.35 (0.98-1.87)	1.89 (1.17-3.07)	0.004
>10 times/day	1.26 (1.01-1.55)	1.19 (0.86-1.65)	1.97 (1.21-3.20)	0.01
JTEM exposure combinations				
No high level exposure	1	1	1	
1): high exposure level to bleach or hydrogen peroxide	0.87 (0.70-1.08)	0.91 (0.65-1.26)	1.08 (0.71-1.65)	0.62
2): high exposure level to formaldehyde or glutaraldehyde	0.96 (0.75-1.22)	0.90 (0.62-1.31)	0.99 (0.61-1.62)	0.67
3): 1) + 2)	1.09 (0.82-1.45)	1.14 (0.75-1.74)	1.63 (1.01-2.64)	0.11
4): 1) + 2) + high exposure level to enzymatic cleaners§	1.07 (0.86-1.34)	1.32 (0.96-1.82)	1.78 (1.21-2.62)	0.01
<b>Model 2‡, n=3,942</b>				
Arm hygiene				
Never	1	1	1	
<1 time/day	1.20 (0.99-1.46)	1.41 (1.06-1.89)	1.50 (1.03-1.46)	0.005
≥1 times/day	1.20 (0.98-1.46)	1.69 (1.28-2.23)	2.23 (1.60-3.11)	<0.001
JTEM exposure combinations				
No high level exposure	1	1	1	
1): high exposure level to bleach or hydrogen peroxide	0.85 (0.69-1.06)	0.86 (0.62-1.19)	1.04 (0.68-1.57)	0.43
2): high exposure level to formaldehyde or glutaraldehyde	0.96 (0.75-1.22)	0.85 (0.58-1.23)	0.97 (0.60-1.58)	0.53
3): 1) + 2)	1.06 (0.80-1.40)	0.95 (0.62-1.42)	1.29 (0.80-2.09)	0.56
4): 1) + 2) + high exposure level to enzymatic cleaners§	1.06 (0.85-1.33)	1.16 (0.84-1.60)	1.57 (1.07-2.31)	0.07

ACT, Asthma Control Test score; JTEM, job-task-exposure matrix. \* Reference category: Controlled asthma (Asthma Control Test score = 25). All models were adjusted for age, smoking status in 2013, body mass index in 2013, race and ethnicity. †Model 1 including hand hygiene and exposure to combinations of specific disinfectants/cleaning products evaluated by the JTEM. ‡Model 2 including arm hygiene and exposure to combinations of specific disinfectants/cleaning products evaluated by the JTEM. Observations with missing values for covariates (smoking status, body mass index, exposure to surface/instrument disinfectants: all <1%) were excluded from multivariable analyses.



**Figure E1.** Associations of hand and arm hygiene with poor asthma control (vs. controlled) using detailed categories of hand and arm hygiene tasks frequency to examine dose-response relationships. Multinomial logistic regressions, adjusted for age, smoking status in 2013, body mass index in 2013, race and ethnicity. Reference category for hand and arm hygiene: “never”.



**Figure E2.** Associations of hand and arm hygiene with asthma control using a more stringent asthma definition. Asthma definition: in addition to asthma case definition used in main analyses, participants had to report use of a prescribed long-term preventive medication (ie, inhaled corticosteroids, cromolyn sodium, nedocromil, salmeterol, theophylline) in the past year. Hand and arm hygiene were entered in the same model for mutual adjustment. Multinomial logistic regressions, adjusted for age, smoking status in 2013, body mass index in 2013, race and ethnicity. Reference category was “never” for hand/arm hygiene and “controlled asthma” for asthma control.