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Title
Predictors of hand hygiene practice and attitude in medical school

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Abstract
Nosocomial infections are common and negatively impact patient care. Despite overwhelming evidence showing diligent hand hygiene practice as a reliable method of reducing nosocomial infection rate, compliance is low among healthcare workers at academic hospitals. Previous studies have indicated a inverse relationship between hand hygiene compliance and level of medical training—medical students are more compliant with hand hygiene practice than resident physicians, who are more complaint than attending physicians. It remains unclear where this decrease in hand hygiene compliance occurs in medical training. While most research focus has been on residency training, this project aims to explore whether hand hygiene laxity begins in medical school.

BACKGROUND

Healthcare-associated infections (HAI) are infections contracted from healthcare facilities including hospitals, nursing homes, and clinics. It accounted for more than 720,000 infections and countless sequelae in U.S. acute care hospitals in 2011[1]. While there are multiple sources of HAI including central lines, in-dwelling catheters, surgical sites, etc., HAI is largely preventable through diligent hand hygiene (HH) practices [2,3]. Two predominant HH practices are alcohol-based hand gels for routine decontamination and handwashing with antiseptic soap for visibly contaminated hands. Despite strong recommendations from the Center for Disease Control and Prevention to perform HH practices before and after patient contact, compliance among healthcare workers remains low [3].

Data suggests physicians have lower HH compliance than other healthcare workers despite having been taught principles of HH in medical school and residency training [4]. Alarmingly, laxity of HH practice may be role-modeled by attending physicians and acquired by trainees. In a study from Haessler et al, there is a wide discrepancy in HH compliance between medical students and resident physicians [5]. While it is plausible that decreased HH compliance in resident physicians develop during residency training, it is also plausible that decreased HH compliance in resident physicians developed during medical school. An early identification of decreased HH compliance in medical school and its predictors allows for earlier, targeted interventions to improve compliance and ultimately lead to improved patient care [7].

RESEARCH GOALS

Primary aim
To assess if hand hygiene practice and attitude of medical students change during their year of clinical training.

Secondary aims
1. To identify personal predictors of HH practice and attitude in third year medical students
2. To assess if hand hygiene practice and attitude of medical students change during the Internal Medicine (IM) clerkship
3. To compare differences in HH practice and attitude among medical students before starting medical school, before starting clinical training, during clinical training, and before graduating medical school
4. To assess if medical students' willingness to remind medical students, residents, and attendings to improve hand hygiene practice changes with more clinical exposure

METHODS

Anonymized paper questionnaires were distributed to first-year (MS1), third-year (MS3), and fourth-year (MS4) medical students at the University of California, San Diego School of Medicine between May 2016 and May 2017. The questionnaire included questions regarding the student's hand hygiene attitude, hand hygiene practice, previous clinical rotation, choice of future specialty, personal hygiene, and comfort level of reminding others to improve hand hygiene.

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<u>Survey questions</u>

Hand hygiene attitude (HHA) questions:
1. A healthcare provider should clean his/her hands before seeing a patient.
2. A healthcare provider should clean his/her hands after seeing a patient.
3. Clean hands prevent infections in the hospital.
4. A patient can expect his/her providers to have clean hands.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Hand hygiene practice (HHP) questions:
1. I clean my hands before seeing a patient.
2. I clean my hands after seeing a patient
3. I use alcohol-based gel to clean my hands when I see a patient, unless there are indications to use soap and water.
4. When I wash my hands with soap and water, I rub my hands with soap for at least 15 seconds.

0-19% of the time	20-39% of the time	40-59% of the time	60-79% of the time	80-100% of the time

Personal hygiene (PH) questions:
1. I wash my hands before I eat.
2. I wash my hands after I use the restroom.
3. I am concerned about germs on my kitchen countertop.

0-19% of the time	20-39% of the time	40-59% of the time	60-79% of the time	80-100% of the time

Future specialty (FS) question:
1. To which medical specialty(ies) did you apply?

Internal Medicine	Dermatology	General Surgery	Urology
Family Medicine	Diagnostic Rad	Orthopaedic Surgery	Neurology
Emergency Medicine	Interventional Rad	Neurological Surgery	Child Neurology
Pediatrics	Anesthesiology	Plastic Surgery	OB/GYN
Pathology	PM&R	CT Surgery	Otolaryngology
Psychiatry	Ophthalmology	Vascular Surgery	

Previous medical specialty (PCC) exposure:
1. Which clinical clerkship(s) did you just complete?
2. Which clinical clerkship(s) have you completed?

Surgery	Pediatrics	Neurology	OBGYN	Psychiatry

Comfort level (CL) of reminding others to improve hand hygiene:
1. I am willing to remind a medical student to clean his/her hands.
2. I am willing to remind a resident to clean his/her hands.
3. I am willing to remind an attending to clean his/her hands.
4. I am comfortable being reminded to clean my hands.

0-19% of the time	20-39% of the time	40-59% of the time	60-79% of the time	80-100% of the time

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Table 1. Breakdown of surveys

Survey name	Survey target	Target characteristics	Questions included in survey	Survey distribution date
Pre-clinical MS1	Incoming MS1	Naïve to medical education	HH attitude PH	During orientation week for new medical students: September 1st, 2016
Pre-clinical MS3	Incoming MS3	Naïve to clinical clerkship	HH attitude PH	During transition to clinical clerkship orientation week: May 13th, 2016
Initial IM	Current MS3	Naïve to Internal Medicine clerkship	PCC* HH attitude HH practice	During Internal Medicine clerkship orientation: Block 1: May 16th, 2016 Block 2: August 15th, 2016 Block 3: November 7th, 2016 Block 4: February 13th, 2017
Exit IM	Current MS3	Finished Internal Medicine clerkship	HH attitude HH practice CL	After Internal Medicine clerkship shelf exam Block 1: August 5th, 2016 Block 2: November 4th, 2016 Block 3: February 10th, 2017 Block 4: May 5th, 2017**
Exit MS4	Current MS4	Finished full year of clinical clerkship Finished residency applications	HH attitude HH practice FS CL	During mandatory small group sessions in Principles to Practice block: February 21st, 2017 February 22nd, 2017

* Students who started on block 1 of IM clerkship were not asked about previous medical specialty exposure as they had no prior clinical clerkship.

** This cohort of students was not yet surveyed at the time of data analysis.

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RESULTS

Table 2. Survey response rates

Survey name	Number of respondents	Attendance	Response rate
Pre-clinical MS1	122	125	98%
Pre-clinical MS3	97	126	77%
Initial IM ALL	107	118	91%
Exit IM ALL	69	86	81%
Initial IM block 1	27	28	96%
Initial IM block 2	26	31	84%
Initial IM block 3	30	31	97%
Initial IM block 4	24	28	86%
Exit IM block 1	22	23	96%
Exit IM block 2	27	31	87%
Exit IM block 3	20	31	65%
Exit MS4	95	120	79%

Table 3. Mean and standard deviation of response to each question

	Pre-clinical MS1		Pre-clinical MS3		Initial IM ALL		Exit IM ALL		Exit MS4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HHA 1	4.98	0.20	4.94	0.43	4.90	0.33	4.87	0.68	4.95	0.23
HHA 2	4.98	0.16	4.94	0.43	4.88	0.38	4.84	0.70	4.93	0.26
HHA 3	4.98	0.16	4.97	0.17	4.83	0.42	4.80	0.74	4.83	0.38
HHA 4	4.57	0.80	4.64	0.70	4.55	0.73	4.57	0.96	4.63	0.67
HHP 1					4.71	0.64	4.86	0.70	4.76	0.47
HHP 2					4.71	0.51	4.80	0.39	4.73	0.51
HHP 3					4.85	0.38	4.57	0.28	4.80	0.43
HHP 4					4.13	1.09	4.86	1.05	3.90	0.51
PH 1	3.48	1.26	3.51	1.43						
PH 2	4.87	0.43	4.89	0.41						
PH 3	4.15	0.83	3.97	0.96						
CL 1							4.26	0.87	4.38	0.72
CL 2							3.32	1.16	3.61	1.03
CL 3							2.71	1.22	2.85	1.16
CL 4							4.59	0.69	4.67	0.65

HH attitude, HH practice, PH, and CL values are calculated as an average of all respondents' response to the questions from each category.

Table 4. Mean and standard deviation of HH attitude, HH practice, PH, and CL in respondents

	HH attitude		HH practice		PH		CL	
Survey name	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Pre-clinical MS1	4.87	0.21			4.16	0.64		
Pre-clinical MS3	4.87	0.32			4.12	0.63		
Initial IM ALL	4.79	0.34	4.60	0.44				
Exit IM ALL	4.77	0.69	4.64	0.34			3.72	0.78
Initial IM 1	4.86	0.27	4.60	0.38				

Initial IM 2	4.81	0.31	4.72	0.43				
Initial IM 3	4.70	0.33	4.53	0.47				
Initial IM 4	4.59	0.44	4.55	0.48				
Exit IM 1	4.74	0.85	4.70	0.28			3.82	0.76
Exit IM 2	4.84	0.29	4.68	0.36			3.62	0.77
Exit IM 3	4.68	0.89	4.53	0.36			3.74	0.83
Exit MS4	4.83	0.28	4.55	0.37			3.88	0.72

Test for normality
Shapiro-Wilk Normality test reveals the mean of responses to HH attitude, HH practice, PH, and CL (except for CL question 3) are not sampled from a population that is normally distributed at $p=0.05$. Given the non-parametric nature, the Mann-Whitney U test is more appropriate than the Student's t-test as the former does not assume samples are taken from a population that is normally distributed.

Correlation between PH and HH attitude
Pearson correlation test performed on the mean of PH responses and HH attitude in pre-clinical MS1 and pre-clinical MS3 shows PH and HH attitude are not related.

MS1: $r(122)=0.06$, $p=0.52$
MS3: $r(97)=-0.004$, $p=0.97$

Correlation between CL and HH attitude
Pearson correlation tests performed on mean of CL responses and HH attitude shows there is no significant correlation in MS3 who just finished Internal Medicine clerkship. However, there is a significant correlation between CL and HH attitude in MS4 who had at least one year of clinical clerkship experience.

Exit IM ALL: $r(69)=0.1266$, $p=0.30$
Exit MS4: $r(94)=0.3389$, $p=0.00083$

Correlation between CL and HH practice
Pearson correlation test performed on the mean of CL responses and HH practice shows there is no significant correlation in MS3 who just finished Internal Medicine clerkship. However, there is a significant correlation between CL and HH attitude in MS4 who had at least one year of clinical clerkship experience.

Exit IM ALL: $r(69)=0.1571$, $p=0.20$
Exit MS4: $r(94)=0.2315$, $p=0.025$

Changes in HH attitude, HH practice, and CL with clinical experience
There are no significant changes in HH attitude, HH practice, and CL with increasing clinical experience. Mann-Whitney U test was performed in pairs. Red text highlights negative differences while green text highlights positive differences that are significantly different. The way to interpret this is to start with a row, then find the desired comparison in the column. For example, HH attitude of Initial IM 3 compared to that of Initial IM 1 is characterized by a Z-score of -2.1 and p-value of 0.04. In this case, the HH attitude of Initial IM 1 is lower than that of Initial IM 3 by 2.1 Z-scores. The Z-score indicates how different the two sets of responses are (cutoff of $Z= +/- 1.96$) and the p-value determines significance of this difference (cutoff is $p=0.05$).

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Table 5. Changes in HH attitude with clinical experience

	Pre-clinical MS3	Initial IM 1	Initial IM 2	Initial IM 3	Initial IM 4	Initial IM ALL	Exit IM 1	Exit IM 2	Exit IM 3	Exit IM ALL	Exit MS4
Pre-clinical MS1	Z=-0.81 p=0.42	Z=-0.39 p=0.70	Z=0.47 p=0.64	Z=2.67 p=0.008	Z=3.37 p=0.0008	Z=1.34 p=0.18	Z=-0.39 p=0.70	Z=-0.08 p=0.94	Z=0.29 p=0.77	Z=-0.30 p=0.76	Z=-0.35 p=0.73
Pre-clinical MS3		Z=0.08 p=0.94	Z=0.93 p=0.35	Z=2.93 p=0.003	Z=3.70 p=0.0002	Z=-1.93 p=0.05	Z=0.07 p=0.94	Z=0.38 p=0.70	Z=0.69 p=0.49	Z=0.37 p=0.71	Z=1.01 p=0.31
Initial IM 1			Z=0.64 p=0.52	Z=-2.1 p=0.04	Z=2.89 p=0.004	Z=-1.10 p=0.27	Z=0.01 p=0.99	Z=0.24 p=0.81	Z=0.47 p=0.64	Z=-0.18 p=0.86	Z=0.55 p=0.58
Initial IM 2				Z=-1.57 p=0.12	Z=2.19 p=0.03	Z=-0.32 p=0.75	Z=-0.61 p=0.54	Z=0.41 p=0.68	Z=-0.08 p=0.94	Z=0.60 p=0.55	Z=-0.24 p=0.81
Initial IM 3					Z=0.72 p=0.47	Z=1.65 p=0.10	Z=-2.07 p=0.04	Z=-1.84 p=0.07	Z=-1.46 p=0.14	Z=2.42 p=0.02	Z=2.17 p=0.03
Initial IM 4						Z=2.49 p=0.01	Z=-2.70 p=0.007	Z=2.60 p=0.009	Z=-2.11 p=0.03	Z=3.21 p=0.001	Z=3.01 p=0.003
Initial IM ALL							Z=-1.05 p=0.29	Z=-0.78 p=0.44	Z=-0.37 p=0.71	Z=-1.3 p=0.19	Z=-0.85 p=0.40
Exit IM 1								Z=-0.22 p=0.83	Z=0.47 p=0.64	Z=-0.16 p=0.87	Z=-0.52 p=0.60
Exit IM 2									Z=0.25 p=0.80	Z=0.11 p=0.91	Z=-0.24 p=0.81
Exit IM 3										Z=0.41 p=0.68	Z=0.10 p=0.92
Exit IM ALL											Z=-0.52 p=0.60

Table 6. Changes in HH practice with clinical experience

	Initial IM 2	Initial IM 3	Initial IM 4	Initial IM ALL	Exit IM 1	Exit IM 2	Exit IM 3	Exit IM ALL	Exit MS4
Initial IM 1	Z=-1.41 p=0.16	Z=-0.36 p=0.72	Z=0.08 p=0.94	Z=0.28 p=0.77	Z=-0.78 p=0.44	Z=-0.68 p=0.50	Z=0.72 p=0.47	Z=0.37 p=0.71	Z=-0.60 p=0.55
Initial IM 2		Z=-2.06 p=0.04	Z=1.33 p=0.18	Z=-1.56 p=0.12	Z=0.76 p=0.45	Z=-0.65 p=0.52	Z=2.25 p=0.02	Z=-1.46 p=0.14	Z=-2.63 p=0.009
Initial IM 3			Z=-0.33 p=0.74	Z=0.87 p=0.38	Z=-1.24 p=0.21	Z=-1.40 p=0.16	Z=0.58 p=0.56	Z=0.95 p=0.34	Z=-0.33 p=0.74
Initial IM 4				Z=0.32 p=0.75	Z=-0.75 p=0.45	Z=0.73 p=0.47	Z=0.61 p=0.54	Z=0.41 p=0.68	Z=-0.49 p=0.62
Initial IM ALL					Z=-0.65 p=0.52	Z=-0.07 p=0.47	Z=1.27 p=0.20	Z=-0.13 p=0.90	Z=1.56 p=0.12
Exit IM 1						Z=0.04 p=0.97	Z=1.62 p=0.11	Z=-0.57 p=0.57	Z=-1.71 p=0.09
Exit IM 2							Z=1.56 p=0.12	Z=-0.61 p=0.54	Z=-1.75 p=0.08
Exit IM 3								Z=1.35 p=0.18	Z=0.001 p=1
Exit IM ALL									Z=-1.58 p=0.11

Table 7. Changes in CL with clinical experience

	Exit IM 2	Exit IM 3	Exit IM ALL	Exit MS4
Exit IM 1	Z=-0.87 p=0.38	Z=0.45 p=0.65	Z=-0.57 p=0.57	Z=0.29 p=0.44

Exit IM 2		Z=-0.44 p=0.66	Z=0.53 p=0.60	Z=1.62 p=0.11
Exit IM 3			Z=-0.02 p=0.98	Z=0.86 p=0.38
Exit IM ALL				Z=1.40 p=0.16

Changes in CL with different hierarchical roles

Students are more comfortable being reminded than reminding others. When reminding others, students are more comfortable reminding other students than reminding residents. Similarly, students are more comfortable reminding residents than reminding attendings. Mann-Whitney U test was performed in paired groups. Red text highlights values that are found to be statistically significant at p=0.05.

Table 8. Changes in CL with different hierarchical roles in all students

	CL 2 (remind a resident)	CL 3 (remind an attending)	CL 4 (being reminded by others)
CL 1 (remind a fellow medical student)	Z=7.02 P<0.00001	Z=10.67 P<0.00001	Z=-3.53 p=0.0004
CL 2 (remind a resident)		Z=5.21 P<0.00001	Z=-9.75 P<0.00001
CL 3 (remind an attending)			Z=-12.29 P<0.00001

Table 9. Changes in CL with different hierarchical roles in MS3

	CL 2 (remind a resident)	CL 3 (remind an attending)	CL 4 (being reminded by others)
CL 1 (remind a fellow medical student)	Z=4.74 P<0.00001	Z=6.72 P<0.00001	Z=-2.16 p=0.03
CL 2 (remind a resident)		Z=2.97 P=0.003	Z=-6.58 P<0.00001
CL 3 (remind an attending)			Z=-7.88 P<0.00001

Table 10. Changes in CL with different hierarchical roles in MS4

	CL 2 (remind a resident)	CL 3 (remind an attending)	CL 4 (being reminded by others)
CL 1 (remind a fellow medical student)	Z=5.16 P<0.00001	Z=8.29 P<0.00001	Z=-2.82 p=0.0048
CL 2 (remind a resident)		Z=4.32 P<0.00001	Z=-7.21 P<0.00001
CL 3 (remind an attending)			Z=-9.43 P<0.00001

Table 11. Changes in HH practice of washing hands with soap and water (HHP4)

	Exit IM ALL	Exit MS4

Initial IM ALL	Z=1.69 p=0.09	Z=2.09 p=0.04
Exit IM ALL		Z=-0.24 p=0.81

Influence of PCC on HH attitude and HH practice

There is no consistent difference in HH attitude and practice when students with different previous clinical clerkship are compared in pair-wise Mann Whitney U test.

Table 12. Differences in HH attitude between students who had different previous clerkship

	OB/GYN	Psychiatry	Neurology	Pediatrics
Surgery	Z=1.22 p=0.22	Z=2.18 p=0.03	Z=-0.18 p=0.86	Z=0.67 p=0.50
OB/GYN		Z=-0.53 p=0.60	Z=1.32 p=0.19	Z=-0.46 p=0.65
Psychiatry			Z=2.25 p=0.02	Z=-1.22 p=0.22
Neurology				Z=0.77 p=0.44

Table 13. Differences in HH practice between students who had different previous clerkship

	OB/GYN	Psychiatry	Neurology	Pediatrics
Surgery	Z=1.11 p=0.27	Z=2.09 p=0.04	Z=0.25 p=0.80	Z=0.70 p=0.48
OB/GYN		Z=-0.76 p=0.45	Z=0.95 p=0.34	Z=-0.46 p=0.65
Psychiatry			Z=1.87 p=0.06	Z=-1.27 p=0.20
Neurology				Z=0.45 p=0.65

Influence of MS4 future specialties on HH attitude and HH practice

Future specialties were self-reported from MS4 who have interviewed for postgraduate residency spots, but have not yet matched, except for those who reported ophthalmology. The specialties were then grouped into procedural and non-procedural where procedural specialties include anesthesiology, ENT, General Surgery, Interventional Radiology, Neurosurgery, OBGYN, Ophthalmology, Orthopaedic Surgery, and Plastics Surgery. 22 responses are procedural specialties and 71 responses are non-procedural specialties.

Table 15. Reported MS4 future specialties

Specialty	Number of responses
Anesthesiology	5
Dermatology	4
Emergency Medicine	12
ENT	1
Family Medicine	8
General Surgery	1
Internal Medicine	24

Interventional Radiology	1
Neurology	2
Neurosurgery	2
OBGYN	4
Ophthalmology	3
Orthopaedic Surgery	2
Pediatrics	7
Plastics Surgery	1
PMR	1
Psychiatry	9
Radiation Oncology	3
Unreported	1

HH attitude: (procedural vs non-procedural)
Z=-0.48, p=0.63

HH practice: (procedural vs non-procedural)
Z=-1.30, p=0.19

CL: (procedural vs non-procedural)
Z=-1.81, p=0.07

DISCUSSION

In general, medical students have strongly favorable hand hygiene attitudes (table 4). Even as pre-clinical MS3 students gain clinical experience, their HH attitudes remain high despite some statistically significant changes. For example, the initial HH attitude of students in block 1 of IM clerkship is lower than that of students in block 3 (Z=-2.1, p=0.04). However, the initial HH attitude of students in block 1 of IM clerkship is higher than that of students in block 4 (Z=2.89, P=0.004). Of note, the HH attitude of students in Initial IM 4 is lower than that of other groups. Taken together, these significant differences are not generalizable and are most likely noise due to comparing groups with small sample sizes. Comparisons of larger aggregate groups (Initial IM ALL and Exit IM ALL) support this idea as these comparisons do not show statistically significant changes. HH attitude may remain strongly positive as students continue to receive didactics sessions that reinforces HH attitudes.

HH practice remains intact as medical students gain clinical experience (table 4). Pair-wise comparisons show no significant changes in HH practice as MS3 progress through IM clerkship and clinical curriculum (table 6). Despite no changes in overall HH practice, a specific HH practice changed between MS3 and MS4: washing hands with soap and water for 15 seconds. This practice is significantly higher in MS3 at the beginning of IM clerkship than in MS4 (Table 11 Z-2.09, p=0.04). It is unclear what causes this change, but this may be due to increased clinical duties of MS4 as compared to MS3. An alternative explanation is that as medical students gain more clinical experience, they begin to model after their superiors including residents, fellows, and attendings. Given that these role models have low compliance rate with proper hand washing with soap and water, MS4 may have picked up these behaviors with longer exposure to these "bad habits."

Factors that may impact HH attitude and HH practice include personal hygiene, choice of future specialty, previous clerkship experience, and comfort level of reminding others/being reminded to improve hand hygiene practice. There is no correlation between personal hygiene and HH attitude in pre-clinical MS1 (r=0.06, p=0.52) and pre-clinical MS3 (r=-0.004, p=0.97). The choice of future specialties in procedural fields is not correlated with HH attitude, practice, or CL.

While it has been suspected that the hierarchical structure in medical education impacts HH attitude and HH practice, this relationship has not been well characterized. In our study, we find that there is a correlation between CL and HH attitude and practice in MS4 (r(94)=0.34, p=0.0008; r(94)=0.23, p=0.025). In addition, we find medical students are more comfortable with being reminded to improve HH practice and reminding those closer to their hierarchical standing. When reminding others to improve HH practices, medical students are more comfortable reminding fellow medical students than residents (Z=7.02, p<0.00001) and more comfortable reminding residents than attendings (Z=10.67, p<0.0001). This difference in comfort level of reminding others/being reminded to improve HH practice widens between MS3 and MS4 as the Z-scores in Table 10 are higher than those in Table 9. Curiously, there is no changes in CL response as students progress through IM clerkship (Table 7). It remains unclear where this change in CL occurs.

One interpretation for the correlation between CL and HH attitude and practice is that students with strong HH attitude and practice would feel more strongly about reminding others to improve HH practices. Another interpretation is that those who have low CL are more timid and pick up poor HH attitude/practice through their clinical experience. Regardless of the direction of the relationship, there is a statistically significant correlation that makes it a good predictor of HH attitude and practice.

CONCLUSIONS

Hand hygiene attitude and practice do not change significantly between pre-clinical and clinical curriculum in medical school. Personal hygiene is not correlated with HH practice and attitude. Comfort level of reminding others/being reminded to improve HH practice is correlated with HH attitude and practice.

INNOVATION & LIMITATIONS

Previous studies focused on the impact of group dynamics on HH practice, showing the group's HH compliance is influenced by the attendings' HH compliance and the compliance of the first person to enter a patient's room [5]. Other studies have focused on the influence of HH competency, availability of hand gel dispenser on HH compliance in medical students and residents [6]. This project is unique in that it explores changes in HH practice and attitude at different levels of training in medical school. In addition, this project profiles personal predictors that may influence HH practice and attitude.

Several limitations exist in this study. One limitation of the project is the cross-sectional analysis as the same medical students are not tracked longitudinally though their medical school training. Of note, there has been no drastic changes in the medical school curriculum that might

severely impact HH attitude and HH practice. Another limitation with this study is recall bias as participants may not accurately recall the frequencies with which they wash their hands. In addition, social desirability bias may play a strong role in participants' response to HH attitude as they may not want to answer differently from what is expected of an ideal medical student.

FUTURE DIRECTIONS

While this study provided more understanding of where hand hygiene attitude and practice fall off in medical education, there remains more to be explored. A major limitation of this study is that it is cross sectional and does not follow medical students longitudinally. It is worthwhile to expand the study to track the same cohort of students through their entire medical school education. Going beyond medical school, it would be enlightening to examine whether HH attitude and practice change in postgraduate years in residency, fellowship, or independent practice without supervision.

REFERENCES

1. Healthcare-associated Infections Progress Report. Center for Disease Control and Prevention. http://www.cdc.gov/HAI/pdfs/progress-report/hai-progress-report.pdf
2. Larson E. Skin hygiene and infection prevention: more of the same or different approaches? Clin Infect Dis 1999;29:1287–94.
3. Boyce JM, Pittet D, Healthcare Infection Control Practices Advisory Committee, HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Society for Healthcare Epidemiology of America/Association for Professionals in Infection Control/Infectious Diseases Society of America.
4. Pittett D. Improving compliance with hand hygiene in hospitals. Infect Control Hosp Epidemiol 2000;21:381-6.
5. Haessler S, Bhagavan A, Kleppel R, Hinchey K, Visintainer P. Getting doctors to clean their hands: lead the followers. BMJ Qual Saf 2012;21:499-502.
6. Barroso V, Caceres W, Loftus P, Evans KH, Shieh L. Hand hygiene of medical students and resident physicians: predictors of attutdes and behavior. Postgrad Med J 2016 pii: postgradmedj-2015-133509.
7. Srigley JA, Corace K, Hargadon DP, Yu D, MacDonald T, Fabrigar L, Garber G. Applying psychological frameworks of behavior change to improve healthcare worker hand hygiene: a systematic review. J Hosp Infect 2015;91:202-10.