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Fighting the scarcity of resources: developing an in-house hand hygiene program in intensive care units of a teaching hospital

Abstract

Healthcare-acquired infection is a serious problem, and patients in intensive care units are the most vulnerable group. Hand hygiene is known to be the most effective way to prevent the infection, but healthcare professionals' compliance is not good enough. The best way to improve hand hygiene compliance among healthcare workers in a unit would through programs well-tailored for each unit based on a thorough evaluation of the unit and the designing of the necessary interventions, but the scarcity of resources often hampers such an approach. In order to minimize the required resources and develop a realistic program, this study tried to utilize already proven infection control interventions. By repackaging them using the theory of planned behavior as the framework, we developed a four-week program called HI-TPB whose program components were either introduced in academic journals or well-known hand hygiene guidelines or, more importantly, were previously tried and showed positive results in the hospital of this study. HI-TPB was implemented with nurses in two intensive care units for adults and newborns. The hand hygiene compliance of nurses rose from 70.5% to 92.3% and 74.4% to 91.1%, respectively. This study suggests that, for certain problems, using existing interventions could suffice to reach the goal of improvement, as long as there is already a sufficient amount of information available.

Keywords: hand hygiene, health behavior, compliance, intensive care units, infection control

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Su ha Han,[1] Heon-Jae Jeong[2]

[1]Department of Infection Prevention and Control, Soonchunhyang University Bucheon Hospital, Korea, Baltimore, USA

[2]The Care Quality Research Group, Philadelphia, Pennsylvania, USA

Correspondence: Heon-Jae Jeong, The Care Quality Research Group 1815 JFK Boulevard, Philadelphia, PA, 19103, USA, Tel +1-410-733-2452, Fax + 1-410-955-6959, Email hjeong1@jhu.edu

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Introduction

Many articles have described the importance of hand hygiene in preventing healthcare-acquired infection; consequently, countless projects have been conducted to improve hand hygiene compliance among healthcare professionals.[1-4] However, despite the huge resources that have been invested, the overall average rate of compliance is only around 40% globally, much lower than our expectation.[5,6]

Intensive care units (ICUs) are the place where healthcare workers' hand hygiene is exceptionally critical. Patients in ICUs are severely ill and, thus, need to contact healthcare professionals more frequently;[7] furthermore, patients' supposedly immune-compromised states mean that a simple infection can lead to death. It is understandable that many hand hygiene studies have focused particularly on the ICU settings.[8-13]

The rationale behind such ICU-focused programs is the well-agreed-upon notion that programs designed specifically for the target population would yield better results than a generic program; in other words, one-size-fits-all programs are less likely to succeed.[14-16]

Although the problem sounds clear, developing a program to improve hand hygiene is far more difficult than expected. Indeed, many programs develop guidelines that urge or at least suggest beginning with full range situational assessment followed by a statistical analysis to devise a more effective program.[17,18] However, more often than not, such a thorough assessment and the resulting planning are pricy and usually exceed our time and resource limits.

How can we overcome the scarcity of resources in the comprehensive design process when planning to change the situation? We find a hint from translational science,[19,20] which describes how existing knowledge can be translated into the actual practice. As many previous studies have focused on hand hygiene, much evidence-based knowledge is waiting to be applied to a clinical area of interest. The point is how to utilize such knowledge by reflecting the target area-specific characteristics. Fortunately, almost every ICU has tried various tools and programs to address hand hygiene. Although many such efforts have ended in failure, the information from such trials can serve as the knowledge base for developing a more comprehensive package in a hand hygiene improvement program. The ICUs in which this study was conducted were no exceptions; they have a long history painted with successes and failures. By exploiting such history and evidence-based knowledge around the world, we can develop a program that maximizes its effectiveness while relying on the amount of resources that the organization can hold out.

To do so, we need a framework-a structure that can sort out the various components of the program collectively and exhaustively. The program components may include not only physical aspects, such as the ICU layout, but also cultural aspects and workload balance among healthcare professionals. We chose the Fishbein and Ajzen's theory of planned behavior (TPB), which has been used in numerous behavioral studies and projects, as the framework of our translational backbone of this hand hygiene program in ICUs.[17,21]

As depicted in Figure 1, TPB explains what leads to a certain behavior-in our case, hand hygiene-and intention is assumed to be the most important predictor of the behavior. TPB has three main constructs that determine a person's intention in conducting a certain behavior: attitudes toward the behavior as determined by one's beliefs in the hand hygiene outcome; subjective norm, which is the way in which others support or oppose the behavior; and perceived behavioral control, which is tied to the situation that facilitates or prohibits the behavior.[17] According to the model, external (distal) variables, such

as a person's demographic information and personality traits, are reflected in the three major constructs. Therefore, if a hand hygiene program is effectively tapping into the three constructs in TPB, then the program's comprehensiveness can be justified in its contents.

As such, the primary aim of this study is to devise a way to develop an infection control program in the setting with very limited resources. In addition, we explore whether the developed program is effective in ICUs, the particular setting of interest in which this program was rolled out.

Methods

This study consists of two main phases:

i) Hand hygiene program development and

ii) Program implementation and outcome measurement and analysis. We describe them one by one. The overall steps (upper boxes) and measurement elements (lower boxes) for each step are described in Figure 2.

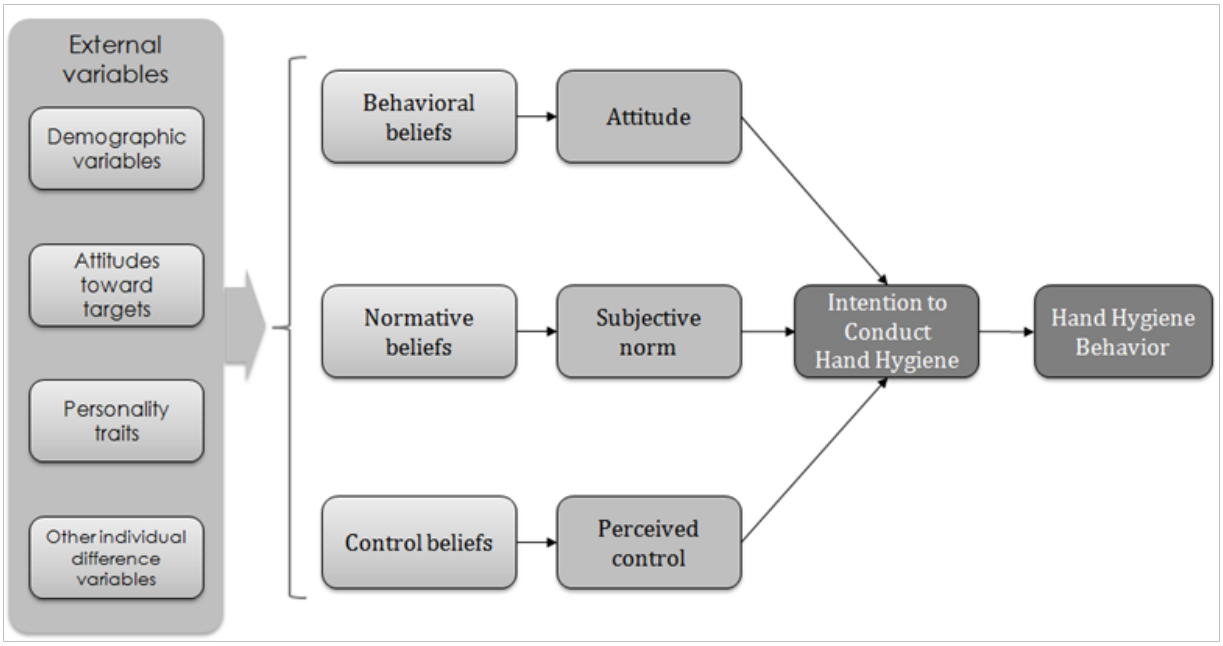

Figure 1 Theory of Planned Behavior and Its Constructs.

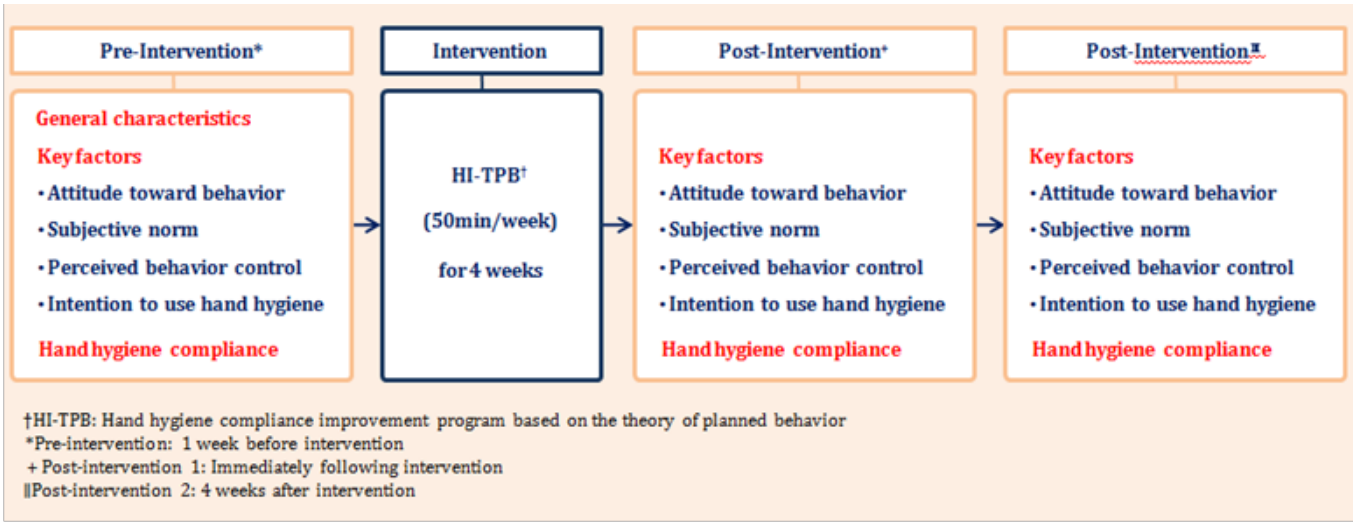

Figure 2 Research Timeline and Measurement Elements.

Program development

We developed a program called HI-TPB (Hand hygiene compliance Improvement program based on the Theory of Planned Behavior), which reflects the World Health Organization's (WHO) multifaceted approach to improve hand hygiene. In order to guarantee program validity, a committee consisting of one nursing school professor, an infection specialist physician, and five nurses in charge of infection control supervised the program's development.

We designed HI-TPB to tap into the three previously discussed main constructs of TPB-attitudes toward hand hygiene, subjective

norm, and perceived behavioral control-under the assumption that these interventions will lead to healthcare professionals' increased intention to wash their hands, thereby ultimately improving hand hygiene compliance.

All the program components were either based on proven evidence introduced in academic journals or well-known hand hygiene guidelines or-more importantly-previously demonstrated to have positive results in the hospital of this study.

In sum, the development of HI-TPB is to put together the fragmented components of previous hand hygiene programs, regardless of whether they were implemented in the hospital or not, under the guidance of a solid conceptual structure supported by TPB.

HI-TPB implementation and outcome measurement

The program was implemented for four weeks in July 2013. For this study, we recruited nurses working in two ICUs of the hospital: adult ICU and neonatal ICU. The program contents are described in detail in a later section; this section focuses on how we measured the effectiveness of the program. As shown in Figure 2, TPB constructs and hand hygiene compliance were measured three times around the intervention: a week before the intervention (the last week of June 2013), the first post-intervention measurement (immediately after the intervention), and finally one month after the intervention (the first week of September). The two post-intervention measurements sought to confirm the sustainability of the program's effects. The TPB construct measurement was conducted using a self-administering survey instrument developed by Jeong et al.,[22] while hand hygiene compliance was measured using a secret-shopper method. Survey administration took three days considering nurses' shifts; therefore, each unit of observation was an individual. As hand hygiene compliance could not be measured for individual nurses to prevent the Hawthorne effect and resource limit, we used the hospital's hand hygiene surveillance data, summarized for every month per clinical area. Each TPB construct was measured using a 7-point Likert scale (-3 to +3), except for intention (1 to 7).

Collected data were analyzed with repeated measures ANOVA and a chi-square test, using the SPSS 16 software package.

Results

HI-TPB Program elements and program implementation

As previously discussed, one of the primary objectives of this study was to design the HI-TPB program to tap into major constructs of the TPB model. Thus, we developed a 4-week HI-TPB program that consists of lectures, group discussions, and practice sessions. Each week, one 50-minute session was provided to small groups (6–9 people) of nurses. Table 1 summarizes the detailed program elements of the final version of the HI-TPB program and their target TPB constructs.

Table 1 HI–TPB Program Elements

Contents			Target TPB Construct			Modality	Duration (min)
			A	S	P		
Week 1	Intro	☐ Introduce the program and recognize the importance of participation ☐ Write hand hygiene statements		◎		Lecture	10
		☐ Explain the goals of hand hygiene					
	Activities	☐ Provide brief overview of the TPB intervention aimed at behavioral change ☐ Watch video related hand hygiene; healthcare workers are shown how invisible microbes can travel through hospitals if hand hygiene is forgotten	◎		◎	Lecture	25
		☐ Share hand hygiene experiences (good vs. bad) ☐ Identify possible risk for not following recommended hand hygiene practices			◎	Group discussion	10
		☐ Provide an overview of effective hand hygiene and hand hygiene practice (peer review), direct feedback of behavior		◎		Practice	4
	Closing	☐ Chant the hand hygiene slogan: ("Ba–Dung–GGak–Ga–Um–Tob"–Korean for "rubbing the palm of the hand–hand back–wrists–thumbs–between fingers–finger tops")					1
	Assignment	☐ Complete hand hygiene diary (daily) ☐ Review the diary at each meeting. Praise the nurses for filling it out and remind them why it is useful			◎		

Table Continued

Contents			Target TPB Construct			Modality	Duration (min)
			A	S	P		
Week 2	Intro	☐ Introduce the program ☐ Chant the hand hygiene slogan				Lecture	5
	Activities	☐ Watch video related to hand hygiene: "Why, when & how of hand hygiene" ☐ Review WHO guidelines for hand hygiene – The five situations that require hand hygiene • – The right hand hygiene method	◎		◎	Lecture	10
		☐ Share hand hygiene experiences (good vs. bad) ☐ Identify barriers and suggest ways to overcome them			◎	Group discussion	10
		☐ Provide performance feedback on personal hand hygiene practices – Have each nurse complete the Glitter bug test using a UV light – Have each nurse repeat hand washing until the UV result is acceptable			◎	Practice	20
	Closing	☐ Explain how to properly perform hand hygiene and hand hygiene practice (peer review)		◎		Practice	5
	Assignment	☐ Complete hand hygiene diary (daily) – Review the diary at each meeting. Praise the nurses for filling it out and remind them why it is useful			◎		
Week 3	Intro	☐ Introduce the program ☐ Chant the hand hygiene slogan				Lecture	5
	Activities	☐ Watch video related to hand hygiene: "The WHO 5 hand hygiene rap"	◎			Lecture	10
		☐ Review the clinical situations in which hand hygiene with soap and water or alcohol rub should be performed ☐ Explain hand hygiene and environment control; emphasize that nurses must practice hand hygiene after contact with surface and equipment in patient care areas, not just after touching patients					
		☐ Sharing hand hygiene experiences (good vs. bad) ☐ Gain confidence in ability to overcome barriers ☐ Complete mind map			◎	Group discussion	15
		☐ Discuss hand culture and sharing feelings and thoughts about how to wash hands the right way			◎	Group discussion	10
	Closing	☐ Explain how to properly perform hand hygiene and hand hygiene practice (peer review); provide direct feedback on behavior		◎		Practice	10
		☐ Hand hygiene diary (daily) – Review the diary at each meeting. Praise the nurses for filling it out and remind them why it is useful			◎		
Week 4	Intro	☐ Introduce the program ☐ Chant the hand hygiene slogan				Lecture	5

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Table Continued

Contents		Target TPB Construct			Modality	Duration (min)
		A	S	P		
Activities	☐ Watch video related to hand hygiene: "The WHO hand hygiene dance video" ☐ Review positive consequences of proper hand hygiene ☐ Provide strategy to prevent the transmission of pathogens; MDRO management, emphasize that good hand hygiene practices are the best way to reduce pathogens present on the skin	◎		◎	Lecture	15
	☐ Lead peer praise of best hand hygiene ☐ Share role model stories of people successfully managing to change their hand hygiene behaviors	◎			Group discussion	20
	☐ Explain how to properly perform hand hygiene and hand hygiene practice (final verbal test)		◎		Practice	5
Closing	☐ Award each nurse a hand hygiene badge and certificate of completion ☐ Congratulate them on their success		◎			5
Assignment	☐ Complete hand hygiene diary (daily) – Review the diary at each meeting. Praise the nurses for filling it in and remind them why it is useful			◎		

A: Attitude toward behavior, S: Subjective norm, P: Perceived behavior control

Characteristics of participants

A total of 42 ICU nurses volunteered for this study. As depicted in Table 2, the majority (73.8%) were in their twenties. For education, almost half (47.6%) of the participants graduated from a four-year nursing school (known as university level), and the other half (52.4%) graduated from a two-year college-level nursing school. Twenty participants (47.6%) worked in the adult ICU and 22 (52.4%) in the neonatal ICU.

Table 2 Characteristics of Participants

Characteristics	n	%
Age (years)		
20–29	31	73.8
30–39	11	26.2
Marital status		
Unmarried	32	76.2
Married	10	23.8
Education		
2–year college	22	52.4
4–year university	20	47.6
Work years		
Less than 1 year	5	11.9
1–2 years	12	28.6
3–4 years	7	16.7
5–9 years	13	31
More than 10 years	5	11.9
Work setting		
Adult ICU	20	47.6
Neonatal ICU	22	52.4

Effects of HI-TPB Program

The results of the repeated measures ANOVA showed that each TPB construct led to a significant increase from pre-intervention to immediate post-intervention (post-intervention 1). As described in Table 3, attitude was improved from 1.68 to 2.52, subjective norm from 2.31 to 2.75, perceived behavioral control from 1.28 to 2.29, and intention from 5.47 to 6.30. To ensure that this improvement was sustainable, we measured the constructs again 4 weeks later (post-intervention 2) and compared the results to those from post-intervention 1. No TPB construct scores decreased; indeed, attitude and perceived behavioral control demonstrated statistically significant improvement, suggesting that HI-TPB provided suitable effects in improving the hand hygiene behavior-related mindset Table 4.

Table 3 Effects of HI–TPB Program on TPB Constructs

	Pre–Intervention	Post–Intervention 1†	Effect of Education‖	P Value	Post–Intervention 2□	Effect of Sustainability¶	P Value
TPB Constructs							
Attitude toward Behavior	1.68±0.76	2.52±0.41	0.84±0.77	<.001	2.59±0.41	0.07±0.20	0.027
Subjective Norm	2.31±0.60	2.75±0.40	0.44±0.65	<.001	2.81±0.38	0.06±0.20	0.058
Perceived Behavior Control	1.28±1.11	2.29±0.56	1.00±0.99	<.001	2.36±0.55	0.08±0.18	0.009
Intention to Hand Hygiene	5.47±1.09	6.30±0.50	0.83±0.87	<.001	6.38±0.47	0.08±0.27	0.073

†Post–intervention 1: after intervention

□Post– intervention 2: 4 weeks after intervention

□Effect of education: difference between pre–intervention and post–intervention 1

¶Effect of sustainability: difference between post–intervention 1 and post–intervention 2

Table 4 Effects of HI–TPB Program on Hand Hygiene Behavior

	Pre–Intervention (April to June 2013)	Post–Intervention (August to October 2013)	Chi–Square	P Value
Adult ICU				
No. of Observations	471	222	44	<.001
No. of Indications	332	205		
Hand Hygiene Compliance Rate (%)	70.5	92.3		
Neonatal ICU				
No. of Observations	129	192	16.42	<.001
No. of Hand Hygiene	96	175		
Hand Hygiene Compliance Rate (%)	74.4	91.1		

The change in hand hygiene compliance before and after HI-TPB program was tested using a chi-square test. Among adult ICU nurses, the compliance rate was 70.5% before the program implementation; it increased to 92.3% after the program. For neonatal ICU nurses, compliance was improved from 74.4% to 91.1%. All these increases were statistically significant ($p < .001$).

Discussion

We began this study with an old saying: "We do not have to reinvent the wheel every time." In other words, instead of designing a brand new hand hygiene compliance improvement program among nurses in a certain ICU, we repackaged previously proven evidence-

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based hand hygiene program components and developed a much more comprehensive program.

What originally drove this endeavor was the scarcity of resources. A program tailored for a specific situation and area could bring better results,[14,15,23] but such a tailoring process usually requires many resources, and researchers have questioned whether tailored program development is really a panacea that could or should be applied to all settings. Especially for a relatively well-defined program like hand hygiene, our approach might be a cost-effective way to utilize various interventions already on the shelf.

However, we encountered an unexpected problem; too many interventions already exist, many of which were essentially duplicated and completely unorganized. Therefore, we needed a framework that could provide structure for us to sort out the various previous interventions and filter out any unnecessary components. We chose the theory of planned behavior as our framework, although we do not assert that it is the best option for any situation. What attracted us was TPB's clear causal relationship between program components and target behavior.[18] Many other options are available for choosing a framework, even for this study. For example, the integrated behavioral model (IBM), an extremely expanded model of TPB, could provide a more comprehensive backbone for program design,[18,24] and the reasoned action approach might have brought a more thorough understanding of social norms than the original TPB.[25] However, caution should be exercised; although a complex model seems more comprehensive, such complexity also requires more resources, which was not what we sought in this study. In addition, one may want to come up with one's own framework, although we suggest using the advantages of existing theoretical frameworks first-again, we do not have to reinvent the wheel.

Despite the identified strengths, this study still has its limitations. From the research standpoint, not having a control group might lessen the validity of the study. However, it should be understood that the process of this program was devised to overcome the scarcity of resources-a situation in which such a complete research design cannot easily be pursued. Another issue is that we might not be able to pinpoint which component of the program was more effective than others or how the interaction of the components with each other benefitted the participants exactly. Indeed, this issue has been identified in many programs utilizing the bundle approach in a clinical setting, which packages several proven interventions and uses them all for patients.[26-28] HI-TPB was a much more complex intervention package than such traditional clinical bundle approaches; therefore, it was practically impossible to rank the effects of the program elements. At this point, one might argue that we might have included too many components in the program-perhaps more than we actually needed. This is a valid question. However, our approach can be tried only when the resources required for designing a tailored program outweighs the resources for this repackaging approach. Therefore, any potential inefficiency from having extra components can be ignored. Specifically, the HI-TPB program mainly consists of four 50-minute sessions; thus, the inefficiency issue was not raised.

Conclusion

The HI-TPB program showed statistically significant improvement in nurses' hand hygiene compliance. In addition, and perhaps more importantly, the improved compliance lasted through the follow-up, suggesting that the program we developed had sustainable effects. Although this approach cannot be applied to all infection control programs, many problems can still be resolved using relatively limited resources, as we've done with the HI-TPB program.

Acknowledgement

None.

Conflict of Interest

None.

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