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Control experiment for health center users to compare the usage of hand sanitizers through nudges during the COVID-19 pandemic in Japan

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Masaki Takebayashi^{1*},
and
Kurenai Takebayashi^{2,3}

¹Graduate School of Aomori
University of Health and Welfare,
Aomori prefecture, Japan

²Kamitousan Public Health
Center, Aomori prefecture, Japan

³Mutsu Public Health Center,
Aomori prefecture, Japan.

*Corresponding Author
Email: 1691001@ms.auhw.ac.jp

To assess the effectiveness of promoting hand hygiene by nudges, the control experiment was conducted during the COVID-19 pandemic in Japan. Hand sanitizers were placed at entrances of health centers A (nudge group) and B (non-nudges/reference group). The users of each group were approximately 40 daily. In the nudge group, during week 1, the conventional notice was displayed. From weeks 2 to 4, sequential nudges based on the framework "MINDSPACE" were implemented: drawing an arrow on the floor towards a hand sanitizer, posting altruism messages, and providing trends in hand sanitizer usage. From weeks 5 to 8, no additional interventions were implemented. Until week 4, usage in the nudge group increased steeply. Although the gap narrowed after week 5, usage in the nudge group (1.7 times of week 1 usage) was higher than that in the reference group (1.4 times of week 1 usage) at week 8. The nudges cost 0.9 USD and were prepared within 3 hours. The series of nudges can be implemented with low cost and short preparation time, and the effect may last until week 8; these nudges will meet practitioners' needs during the COVID-19 pandemic.

Keywords: COVID-19 prevention, hand sanitizer, nudge, MINDSPACE

INTRODUCTION

In Japan, the first coronavirus disease 2019 (COVID-19) patient was confirmed in January 2020, and the pandemic spread rapidly after that. Hand disinfection with alcohol is recommended for COVID-19 prevention (WHO, 2020. JMHLW, 2020). Almost all public buildings in Japan had hygiene stations at the entrance halls, but many Japanese might not use them in practice. For example, the city of Tsukuba (Ibaraki prefecture, Japan) observed that only 14.5% of city hall users disinfected their hands at the entrance in April 2020 (TNSGS, 2020). Without hand hygiene, many people would face the risk of infection. Therefore, effective interventions for hand hygiene were urgent. There are two possible reasons for low usage of hand sanitizer: there is no feedback function (e.g., buzzer sound) to make individuals aware that they inadvertently passed by hand sanitizer stations, and they postpone disinfection intending to use it later, as hand sanitization is a

typical example of intertemporal choice, i.e., costs now, benefits later.

Recently, nudges have gained attention as a behavioral change method in public health. A nudge is "any aspect of the choice architecture that alters people's behavior predictably without forbidding any options or significantly changing their economic incentives" (Thaler and Sunstein, 2009). Nudges may be appropriate for promoting hand sanitization. It is suggested that nudges can be useful in cases of intertemporal choice or when feedback is ineffective (Thaler and Sunstein, 2009). The World Health Organization suggested multimodal strategies and minimum criteria for implementation of hand hygiene (WHO, 2009), including nudge elements (e.g., reminders).

Many studies have been conducted on hand hygiene promotion with nudges. However, some need large costs, and some do not reveal the specific cost or preparation time

Table 1. Weekly interventions in the nudge group

Week	Interventions	Nudges used
1	The conventional notice "Use disinfectant" was displayed. This notice was continued until week 8.	None.
2	We drew an arrow on the floor towards a hand sanitizer dispenser with yellow curing tape.	The presence of a hand sanitizer was prominently reminded by the arrows drawn on the floor (Salience).
3	In addition to the intervention implemented in week 2, we posted the following bulletin: "Please remember to disinfect your hands, as it is the norm for residents. I am planning to measure the hand sanitizer usage and publish the results in academic journals. Director of Health Center KT."	We designed multiple nudges as described below: (1) Emotional appeal to altruism by reminding the staff of "what they should be doing as a public servant" and "the opportunity to cooperate in academic research" (Affect, Norms). (2) Humans modify their behavior in a socially desirable way when being watched by others (Pfattheicher et al, 2018) (Priming). (3) Specifying the name of the director indicated that the message was important (Messengers).
4	The bulletin used in week 3 was removed (interventions of weeks 1 and 2 were pending), and trends in hand sanitizer usage were provided via email and postings.	The intervention appealed to the peer effect (Norms).
5-8	The interventions used in week 4 were continued, but no additional interventions were conducted.	Same as above.

(Luangsanatip et al, 2015). To promote action, reducing hassle factors makes a difference (BIT, 2014), and to reduce hassle factors, it is important to show that interventions can be implemented with low costs and short preparation time.

Frameworks are essential to design effective nudges. One of the most popular frameworks is MINDSPACE, a checklist consisting of the following elements: "Messengers," "Incentives," "Norms," "Defaults," "Salience," "Priming," "Affect," "Commitment," and "Ego." The Behavioural Insights Team in the United Kingdom Institute for Government, who developed this framework, mentioned that MINDSPACE could be applied in practice through exploring, enabling, encouraging, engaging, exemplifying, and evaluating (BIT, 2010). A combination of these functions might improve hand disinfection without adding hassle factors for practitioners.

Meanwhile, most of the previous studies on hand hygiene promotion with nudges (e.g., Caris et al., 2018) were conducted before the pandemic; hence, its efficacy could be different from that during the COVID-19 pandemic. Thus, previous studies might not meet practitioners' needs. Suggesting useful hand hygiene promotions for preventing COVID-19 with cost and preparation time is necessary.

In this study, interventions were designed to promote hand hygiene use with the nudges concept using the MINDSPACE framework for preventing COVID-19.

MATERIALS AND METHODS

Research design and target institutions

This was a control experiment to compare hand sanitizer usage at the entrances of two public buildings. Prefectural public health center 'A' represents the nudge group (number of staff members was 34), and city health center 'B' in the same area represents the reference group (number of staff

members was 9) in Aomori Prefecture, Japan. These institutions were chosen because of three reasons. First, the local task forces for disease prevention were established in the health centers, and high-level hand hygiene was necessary for the users. Second, the local infection situation would have affected the hand sanitizer usage; the close location of the two institutions was important. In this area, some clusters of COVID-19 cases were already present. Third, it was assumed that the number of users at both entrances would be approximately the same, almost 40, as a few citizens visit public health center A but over 30 citizens visit city health center B every day.

Intervention

For the nudge group, the detailed nudges were implemented in Table 1 sequentially from the first week of April 2020. At this time, few nudges to promote hand hygiene against the COVID-19 pandemic had been proposed in Japan. In this study, easy-to-implement nudges were designed according to 'MINDSPACE.' During week 1, the conventional notice, "Use this hand sanitizer," had been displayed, which was posted in February 2020. Sequential nudges were implemented from week 2 to week 4. From weeks 5 to 8, no additional interventions were performed. For the reference group, the notice, "Use this hand sanitizer," was displayed throughout the 8 weeks.

Materials and outcome

During the eight weeks, hand sanitizer usage was observed, which was measured on Monday at 8:30 (measured on the following weekday if Monday was a national holiday) and Friday at 17:00. The weekly change was used as the outcome. Results were adjusted according to the number of weekdays (i.e., for a week with four weekdays, usage was adjusted by multiplying by 1.25 (5 standard weekdays

Table 2. Data of hand sanitizer usage

	Week	Usage (mL)		Comparison ratio with week 1 (times)	
		Nudge Group	Reference Group	Nudge Group	Reference Group
Baseline	1	180	160	1	1
Span 1(with sequential nudges)	2	290	190	1.611	1.188
	3	300	180	1.667	1.125
	4	340	188	1.889	1.172
Span 2(without additional nudges)	5	325	200	1.806	1.250
	6	300	220	1.667	1.375
	7	300	210	1.667	1.313
	8	310	230	1.722	1.438
Total usage		2345	1578	13.028	9.859

divided by 4 = 1.25)). The cost and time required for the intervention were also measured.

Ethical considerations

The intervention was implemented as part of usual facility management. Permission was obtained from the directors of both institutions. The collected information did not contain personally identifiable details. After the study, the results were shared with relevant organizations, including those in the reference group.

RESULTS

The hand sanitizer usage ratios (baseline was week 1) are shown in Table 2. The usage quantity of week 1 was 180 mL in the nudge group and 160 mL in the reference group. The usage increased in both groups, especially in the nudge group where usage compared with that at baseline increased more steeply until week 4 (week 2: 1.6 times, week 3: 1.7 times, week 4: 1.9 times), and then eased after week 5 (week 5: 1.8 times, week 6-8: 1.7 times each). The total amount of hand sanitizer used by the nudge group was 13.0 times that used in week 1 (baseline), and for the reference group, the total amount used was 9.9 times that used in week 1 during the period of the study.

To implement the nudges completely, it took less than 3 hours and cost approximately 100 Yen (0.9USD) for stationary goods.

DISCUSSION

In this study, the effect of low-cost nudges was measured to promote hand sanitization and the weekly hand sanitizer usage trends between the nudge and reference groups.

During the 8 weeks, the nudge group had a greater increase in total hand sanitizer usage. A previous study (Roshan et al, 2020) showed that the use of hand sanitizers increased as the phases of the COVID-19 pandemic progressed. Although this might have explained the increasing usage in both groups, the increase in the nudge

group was more pronounced. This suggested that the interventions used in the nudge group were effective.

Specifically, hand sanitizer usage increased by 1.6 times in week 2. An arrow on the floor could be useful for people to attract their attention to the hand sanitizer. The beneficial effect of arrow-shaped nudges has been reported for handwashing (Blackwell et al, 2018), and this nudge can be a useful intervention for hand sanitizing in a health center setting as well.

Though multiple nudges were implemented in week 3, the usage increase was slower than that in weeks 2 and 4. The poster might have been too long to read in a short time. Information overload can constrain the practice of healthy behaviors (Nagtegaal et al, 2019). "Make it easy," such as simplifying messages, is the principle of nudges (BIT, 2014). Hence, when designing multiple nudges, checking whether they are easy is necessary.

The nudges in week 4 were presumed to have been driven by information about peers' behaviors. A previous study (Armellino et al, 2012) reported an increase in the number of hand washers by using third-party remote video auditing and real-time feedback. In the current study, paper-based feedback of participants' hand sanitizer usage was found to be useful, which also meant lower costs and preparation times than were reported in the previous study.

After week 5, the usage in the nudge group did not increase remarkably. This could be attributed to habituation, i.e., becoming accustomed to the stimulus and not responding to it. Even though habituation might have occurred, at week 8, usage in the nudge group (1.7 times) was higher than that in the reference group (1.4 times). This implies that the effect of nudges until week 4 might continue up to week 8 without additional interventions. Further investigation is needed to ensure that the effects of the intervention can be sustained over time.

At the same time as this experiment, some studies were conducted to promote hand hygiene by nudges for COVID-19 prevention in several countries. Compared with them, this experiment has two strengths. First, a series of nudges was designed to cause the synergy. For example, in one study (Weijers and Koning, 2020), 'salience nudge' and 'altruism nudge' were performed separately and showed no significant difference. Meanwhile, in this experiment, the

nudge group showed more usage still at week 8, which implies that the synergy might work. Another study (Roekel et al., 2021) showed that boosting and improving people's competence to make their own choices (Hertwig and Grüne-Yanoff, 2017) remained a more stable effect than nudging for hand hygiene. Though boosting is important, it will take some time to boost all users. Until completing boosting them, this series of nudges may be useful. Second, the cost and preparation time were shown. These nudges were implemented at 0.9 USD, which were cheaper than those in the previous studies (Luangasanatip et al., 2015), and were completed within 3 hours, which might overcome implementation bottlenecks. Thus, the nudges have the potential to meet the needs of practitioners. To our knowledge, no other studies during the COVID-19 pandemic have both strengths.

This study had some limitations. First, the results might not be generalizable because they were obtained from health centers in a specific area. Second, a prefectural public health center has different characters from a city health center (e.g., functions and users). Third, the difference between the two groups could not be statistically tested, and a simple comparison was made. Larger scale experiments with statistical tests are necessary. Finally, it was not possible to identify who used the sanitizer and how frequently it was used. Detailed surveys should be planned to develop effective interventions depending on the segmented target groups.

In conclusion, the weekly trends in hand sanitizer usage were compared between the nudge group, which was provided with a series of nudges, and the reference group, which only had access to a promotional poster. In the nudge group, the usage increased steeply until week 4. Although it did not increase remarkably after week 5, it was still higher than that of the reference group by week 8. The series of nudges can be implemented with low cost and short preparation time, and the effect may continue to week 8.

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Conflict of Interests

The authors declare that there is no conflict of interests

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