Combining interactive communication and nicotine replacement therapy for smokers: abridged secondary publication

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KEY MESSAGES

1. Mobile healthcare enables high-reach, low-cost, and personalised smoking cessation support.
2. We assessed the effectiveness of interactive communication technologies (instant messaging and chatbot) plus nicotine replacement therapy for smoking cessation in 664 smokers in Hong Kong.
3. Compared with controls, the intervention group had higher rates of abstinence at 6 months (3.9% vs 3.0%, odds ratio [OR]=1.31) and 12 months (5.4% vs 4.5%, OR=1.21), but the differences were not statistically significant.
4. Our findings have guided the establishment of two chatbots to promote smoking cessation services and COVID-19 vaccination.

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Introduction

Mobile healthcare (mHealth) enables high-reach, low-cost, and personalised smoking cessation (SC) support.[1] Compared with brief advice alone, combining instant messaging (IM)-based intervention with brief advice led to a higher validated abstinence rate among smokers in Hong Kong (odds ratio [OR]=1.68, 95% confidence interval [CI]=1.03-2.74).[2] Artificial intelligence chatbots can supplement human advisors in IM for behavioural support. Nicotine replacement therapy (NRT) combined with behavioural intervention is recommended for achieving long-term abstinence.[3] The provision of NRT sampling has been efficacious to increase quit attempts among unmotivated smokers.[4] This study aimed to determine the effectiveness of combining interactive communication technologies (IM and chatbot) with NRT sampling for SC among smokers in Hong Kong.

Methods

This study was conducted between August 2019 and May 2020. We proactively approached smokers at various locations in Hong Kong. Inclusion criteria were (1) individuals aged ≥18 years with a habit of smoking at least one cigarette daily, (2) exhaled carbon monoxide level of ≥4 parts per million, (3) having a smartphone and agreeing to install IM apps and a chatbot, and (4) Hong Kong residency with the ability to read and communicate in Chinese. Smokers were excluded if they had psychiatric or psychological diseases and were taking psychotropic medications; were using cessation medication, NRT, or other SC services; or had contraindications to NRT use.

Participants were randomly assigned to the intervention or control group. Participants in both groups received brief advice based on the AWARD model (Ask, Warning, Advice, Referral, Do-it-again). Participants were asked about their smoking history (Ask); warned about the harms of continued smoking using the test results of exhaled carbon monoxide level and a health warning leaflet (Warn); advised to quit as soon as possible by using NRT or SC services (Advise); and offered referral to SC services, which are free to Hong Kong residents and provide evidence-based SC treatments such as behavioural counselling, NRT, and acupuncture (Refer). The above advice was repeated for relapsed smokers (Do-it-again).

Participants in the intervention group received 1 week of free NRT sampling (Nicotinell; GlaxoSmithKline, Brentford, London, UK) and 12

weeks of personalised behavioural support using interactive communication technologies guided by social cognitive theory and the transtheoretical model. Regular instant messages were tailored to the participants' surnames, sociodemographic characteristics, smoking habit at baseline, and updated smoking status. In total, 21 messages were sent according to a pre-set schedule: once daily for 1 week, twice weekly for 4 weeks, and once weekly for the remaining 7 weeks. The schedule was adjusted according to each participant's stage of change (quit date set at baseline) as determined via the transtheoretical model and as requested by smokers during IM conversations. In addition, synchronous, personalised, and interactive psychosocial support was delivered by trained SC advisors through IM conversations. Advisors provided real-time responses such as support to avoid or manage situations with high risk of smoking. Advisors periodically sent proactive IM messages to initiate the conversation (eg, asking about recent SC progress) and delivered evidence-based advice guided by social cognitive theory and the transtheoretical model. Advisors actively referred smokers to cessation services if they expressed such a need. Furthermore, SC advisors proactively sent six reminders of the URL of a chatbot called 'Quit Buddy' through IM once every 2 weeks for 12 weeks. The chatbot content did not change during the trial.

Participants in the control group received the same AWARD intervention at baseline, regular SMS messages regarding generic advice about healthy lifestyles and reminders to participate in follow-up surveys and biochemical validation for quitting.

Primary outcomes were rates of validated smoking abstinence at 6 and 12 months after treatment initiation. Secondary outcomes included self-reported 7-day point prevalence and continuous (24-week) abstinences, quit attempts, smoking reduction (ie, self-reported reduction in number of cigarettes per day by ≥50% of the baseline amount), and cessation service use at 6 and 12 months.

The validated quit rate for participants who received AWARD advice with active referral to SC services was approximately 9% at the 6-month follow-up.[5] Considering an estimated effect size of 1.8 derived from a meta-analysis,[1] along with 80% power and a 1:1 allocation ratio, the sample size required to identify a significant difference (with two-sided type I error of 0.05) in biochemically validated quit rates between groups was 664 (332 per group).

Analyses were based on an intention-to-treat protocol. Logistic regression analysis was used to compare SC outcomes between groups. Sensitivity analyses were conducted to assess the robustness of the intervention effect on outcomes.

Results

Of 711 smokers screened, 664 were eligible and consented to participate. The retention rates were 69.9%, 67.2%, and 73.2% at 3, 6, and 12 months, respectively. Retention rates were similar between groups (P=0.49-0.95). The two groups were comparable in terms of baseline characteristics (P=0.09-0.99, Table 1). Most participants were men (74.4%) and were aged 18 to 39 years (62.5%). Of the participants, 62.3% had low cigarette dependence, 59.6% had never attempted to quit, and 51.7% did not intend to quit within 30 days.

Compared with the control group, the intervention group had higher rates of biochemically validated abstinence at 6 months (3.9% vs 3.0%, OR=1.31, 95% CI=0.57-3.04) and 12 months (5.4% vs 4.5%, OR=1.21, 95% CI=0.60-2.45), but the differences were not statistically significant (Table 2). There were no significant differences in self-reported 7-day point-prevalent abstinence, self-reported 24-week continuous abstinence, smoking reduction, or use of SC services at 6 and 12 months. Compared with the control group, the intervention group had higher rates of quit attempts at 6 months (47.0% vs 38.0%, OR=1.45, 95% CI=1.06-1.97). Sensitivity analyses yielded similar results.

Discussion

Interactive communication technologies plus NRT did not significantly improve SC outcomes including validated abstinence, self-reported 7-day point-prevalent abstinence, self-reported 24-week continuous abstinence, smoking reduction, or use of SC services at 6 and 12 months. However, the intervention significantly increased the rate of quit attempts at 6 months, but this effect was not sustained at 12 months. The real-world effect might have been underestimated because the control group received AWARD and similarly scheduled SMS messages regarding general health. Thus, the effect size of the present study was smaller than the 1.8 reported in a meta-analysis,[1] although a direct comparison might not be feasible because of heterogeneity in study settings, smoking characteristics, and intervention components. In addition, the present study included 59.6% of participants who had never attempted to quit, which differs from previous SC trials that included smokers with intention to quit only.

The present study had several limitations. First, our findings may not be generalisable to populations with a more balanced sex ratio among smokers or regions with limited SC services. Second, considering the low intervention engagement, the beneficial effects may have been underestimated. Third, interaction of the effects of each intervention component was beyond the scope of the

TABLE 1. Baseline characteristics of participants (n=664)

Characteristic	Intervention (n=332)*	Control (n=332)*	P value
Sex			0.72
Male	249 (75.0)	245 (73.8)	
Female	83 (25.0)	87 (26.2)	
Age, y			0.92
18-29	99 (30.3)	103 (31.9)	
30-39	104 (31.8)	109 (33.8)	
40-49	78 (23.9)	69 (21.4)	
50-59	35 (10.7)	31 (9.6)	
≥60	11 (3.4)	11 (3.4)	
Marital status			0.17
Single	154 (51.2)	175 (58.3)	
Married/cohabited	128 (42.5)	112 (37.3)	
Divorced/separated/widowed	19 (6.3)	13 (4.3)	
Educational attainment			0.94
Primary or below	2 (0.6)	2 (0.6)	
Secondary	160 (48.8)	161 (50.2)	
Tertiary	166 (50.6)	158 (49.2)	
Employment status			0.42
Employed	278 (85.0)	282 (87.9)	
Unemployed	41 (12.5)	30 (9.4)	
Retired	8 (2.5)	9 (2.8)	
Monthly household income, HK$			0.99
≤19999	48 (16.5)	48 (16.8)	
20000-29999	90 (30.9)	87 (30.4)	
≥30000	153 (52.6)	151 (52.8)	
Daily cigarette consumption, sticks			0.38
1-10	232 (69.9)	236 (71.1)	
11-20	91 (27.4)	92 (27.7)	
≥21	9 (2.7)	4 (1.2)	
Time to first cigarette of the day, minutes			0.22
>60	97 (29.3)	104 (31.3)	
31-60	57 (17.2)	40 (12.1)	
6-30	89 (26.9)	87 (26.2)	
≤5	88 (26.6)	101 (30.4)	
Cigarette dependence (Heaviness of Smoking Index)			0.46
Low (0-2)	213 (64.2)	201 (60.5)	
Moderate (3-4)	113 (34.0)	127 (38.3)	
High (5-6)	6 (1.8)	4 (1.2)	
Previous quit attempt			0.34
Never	204 (61.5)	192 (57.8)	
Ever	128 (38.6)	140 (42.2)	
Intention to quit			0.10
Within next 7 days	84 (25.3)	75 (22.6)	
Within next 30 days	92 (27.7)	70 (21.1)	
Within next 60 days	19 (5.7)	24 (7.2)	
Not decided yet	137 (41.3)	163 (49.1)	0.41
Perceptions of quitting (1-10)			
Importance	7.1±2.1	6.8±2.1	0.10
Difficulty	7.3±2.5	7.0±2.4	0.09
Confidence	5.9±2.0	5.7±2.1	0.16

* Data are presented as No. (%) of participants; total number of participants in each group may not equal to 332 owing to missing data

TABLE 2. Primary and secondary outcomes (n=664)

	Intervention (n=332)*	Control (n=332)*	Logistic regression model†	P value	Complete case analysis†	P value	Multiple imputation†	P value
Validated abstinence								
6 months	13 (3.9)	10 (3.0)	1.31 (0.57-3.04)	0.53	1.34 (0.58-3.13)	0.49	1.22 (0.53-2.82)	0.64
12 months	18 (5.4)	15 (4.5)	1.21 (0.60-2.45)	0.59	1.22 (0.60-2.47)	0.59	1.14 (0.56-2.33)	0.72
Self-reported 7-day point-prevalent abstinence								
6 months	32 (9.6)	28 (8.4)	1.12 (0.68-1.97)	0.59	1.19 (0.69-2.05)	0.53	1.09 (0.65-1.84)	0.74
12 months	34 (10.2)	32 (9.6)	1.07 (0.64-1.78)	0.80	1.07 (0.64-1.80)	0.79	1.14 (0.68-1.92)	0.61
Self-reported 24-week continuous abstinence								
6 months	14 (4.2)	19 (5.7)	0.73 (0.36-1.47)	0.37	0.91 (0.49-1.72)	0.78	0.91 (0.48-1.72)	0.78
12 months	21 (6.3)	20 (6.0)	1.05 (0.56-1.98)	0.87	0.88 (0.49-1.59)	0.67	0.88 (0.49-1.59)	0.67
Smoking reduction by ≥50% of baseline								
6 months	59 (17.8)	54 (16.3)	1.13 (0.75-1.71)	0.55	1.17 (0.76-1.82)	0.48	1.12 (0.73-1.71)	0.61
12 months	80 (24.1)	67 (20.2)	1.28 (0.88-1.85)	0.20	1.33 (0.89-1.99)	0.16	1.34 (0.90-2.00)	0.15
Quit attempt								
6 months (cumulative)	156 (47.0)	126 (38.0)	1.45 (1.06-1.97)	0.019	1.51 (1.05-2.17)	0.026	1.37 (0.98-1.91)	0.068
12 months (cumulative)	179 (53.9)	159 (47.9)	1.27 (0.94-1.73)	0.12	1.38 (0.96-1.99)	0.08	1.24 (0.88-1.77)	0.22
Use of smoking cessation services								
6 months (cumulative)	32 (9.6)	21 (6.3)	1.58 (0.89-2.80)	0.12	1.64 (0.92-2.95)	0.10	1.66 (0.94-2.94)	0.08
12 months (cumulative)	42 (12.7)	33 (9.9)	1.31 (0.81-2.13)	0.27	1.34 (0.81-2.19)	0.25	1.39 (0.86-2.25)	0.18

* Data are presented as No. (%) of participants
† Data are presented as odds ratio (95% confidence interval)

present study. Nevertheless, these components independently demonstrated effectiveness in our previous SC trials.[2,4,5]

Our findings guided subsequent research to enhance engagement, specifically concerning interactive communication technologies, to maximise intervention efficacy. We have developed a WhatsApp chatbot called 'Dr Wise' to promote SC services (https://wa.me/85223328977) in collaboration with the Tung Wah Group Hospitals Integrated Centre on Smoking Cessation. We also developed a web-based chatbot 'Vac chat, fact check' to promote COVID-19 vaccination.

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Disclosure

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1. Guo N, Luk TT, Wu YS, et al. Effect of mobile interventions with nicotine replacement therapy sampling on long-term smoking cessation in community smokers: a pragmatic randomized clinical trial. Tob Induc Dis 2023;21:44.

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