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Smartphone app uses loyalty point incentives and push notifications to encourage influenza vaccine uptake

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ABSTRACT

Purpose: Carrot Rewards is a free, incentive-based, smartphone health app available in participating provinces in Canada. One feature of Carrot was designed to incentivize influenza vaccine education messages and encourage vaccine uptake for users in the province of British Columbia. This study aimed to evaluate the uptake of the Carrot Flu Campaign educational quiz and to determine if mobile "push" notifications, plus loyalty point incentives, resulted in users visiting a sponsored pharmacy to discuss and receive the influenza vaccine.
Methods: The Carrot Flu Campaign delivered an in-app quiz, educating users on the importance of the influenza vaccine. Push notifications were then sent to users when they came within 200 m of a sponsored pharmacy. Those who visited the pharmacy collected bonus points and completed a follow up quiz tracking influenza vaccine behaviour. A sub-sample of users completed the Flu Campaign between their baseline and follow up Health Risk Assessment (HRA), a survey which asked about influenza vaccine uptake behaviour. Descriptive statistics were summarized.
Results: A total of 38.1% (30,538/80,228) registered Carrot users completed the Flu Campaign quiz. Of those in participating cities (n = 21,469), 41% clicked on the map to show the nearest sponsored pharmacy and 78% enabled their smartphone's "locations" feature, allowing them to receive the push notifications. A small number of users spoke to a pharmacist (n = 96) and less than half reported receiving the influenza vaccine (38/96; 39.6%). From the HRA sub-sample (n = 3693), approximately 5% more users reported receiving the influenza vaccine during the 2017 influenza season compared to the previous year.
Conclusions: Carrot Rewards used a novel delivery method to educate the general population and showed geolocation could be used to facilitate influenza vaccine uptake. Future iterations could tailor content to target those most at risk and should consider more robust evaluation methods to determine the app's effectiveness.

1. Introduction

The influenza vaccine is a public health initiative designed to prevent the spread of influenza and influenza-related complications, including hospitalization and death [1,2]. There are approximately 12,200 influenza-related hospitalizations and 3500 deaths in Canada each year [3]; the influenza vaccine is a cost-effective way to reduce this burden [2]. Influenza vaccine uptake remains low; however, with approximately 28% of Canadian adults (aged 18–64 years old) reporting receiving the vaccine during the 2015/2016 influenza season [4].

Reasons for not getting the influenza vaccine can include perceived obstacles, such as financial or time barriers [5]. A financial barrier can be the cost of the vaccine. As of September 2017, the influenza vaccine was not universally funded in three of the 13 Canadian provinces or territories, including British Columbia (BC), the setting of this study [6,7]. A common time barrier is the inconvenience of having to attend a doctor's appointment to receive the vaccine [5]. There have been policy changes to allow pharmacists to administer the influenza vaccine in nine Canadian provinces, between 2009 (BC, Alberta) and 2015 (Saskatchewan); however, given that there are 13 jurisdictions in Canada, 30% of

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the country do not have access to pharmacist-administered influenza vaccines [6]. The pharmacist policy change was associated with a modest increase in national influenza vaccine uptake, from 28.2% in the twelve months prior to the policy change, to 30.4% [6]. Despite improved access, other misconceptions about the influenza vaccine, known as "vaccine hesitancy" limit broader uptake [8]. Misconceptions include issues of confidence, such as not trusting the vaccine or provider, and complacency, including no perceived need for a vaccine or not seeing the value of the vaccine [8].

Education-based interventions that aim to change participants' knowledge, beliefs, and attitudes around the influenza vaccine have been moderately successful in increasing uptake of the vaccine [9]. To increase the reach of such behaviour change interventions, public health initiatives have begun to incorporate mobile technology [10]. Smartphones allow people to access health information at a time and location that suits the individual. Most Canadian adults (73%) reported owning smartphones in 2015 [11]. While evidence has supported the use of web-based or text messaging interventions to promote vaccine uptake, smartphone applications (apps) have not yet been widely used [12].

Carrot Rewards, a free smartphone health app, was developed as part of a public-private sector partnership to increase population-level health knowledge and promote healthy behaviours [13,14]. Drawing from the transtheoretical model of behaviour change [15], the objective was to move people from the pre-contemplation to the contemplation stage of change (thinking about getting the vaccine) by educating the user about preventing influenza and the benefits of the vaccine. A micro-learning approach was used to educate users, which entailed receiving short, simple, 'bite-sized' pieces of information, often in quiz format with catchy titles and visually appealing images, which allows for easier understanding and retention of a specific topic [16]. A distinguishing feature of the app is that it rewards users with loyalty point incentives (points that contribute to the purchase of groceries, movie tickets, travel, or gas) to download and engage with the app, such as receiving points for completing short educational health quizzes, known as campaigns. A full description of the app and its development can be found in a process evaluation of Carrot Reward [17].

The Carrot Rewards app was first launched in BC, Canada; within its first three months of operation, over 57,000 people became valid registered users and 60% of users were classified as "very high engagers" for completing over 75% of the health quizzes [17]. Part of the reason behind its success is that 90% of Canadians belong to one or more loyalty programs [18]. Incentives have been shown to be most effective at changing "single-shot" health behaviours, such as vaccination or screening, compared to more complex behaviours such as physical activity [19,20]. Delivering incentives, combined with the high download and use rate, made Carrot Rewards a potential platform to promote influenza vaccine uptake.

The Carrot Flu Campaign involved two parts; first, a quiz that educated users about the importance of the influenza vaccine and promoted influenza clinic awareness (in sponsored pharmacies). All quiz content was guided by the provincial government's policies and promotion of the influenza vaccination, and was reviewed, edited, and approved by the BC Ministry of Health prior to the campaign launch. The second part used a novel geolocation-based "push" notification, which prompted users to speak to a pharmacist about the influenza vaccine when the user was within 200 m of the sponsored pharmacy. Completion of each part of the Flu Campaign resulted in loyalty point rewards.

The purpose of this study was to evaluate the uptake of the Carrot Flu Campaign and determine if the combination of mobile push notifications and loyalty point incentives resulted in users visiting a sponsored pharmacy to discuss and receive the influenza vaccine. A secondary objective was to determine if the Flu Campaign was associated with changes in influenza vaccine uptake behaviour.

2. Methods

2.1. Recruitment and participants

The Carrot Flu Campaign was delivered to all valid Carrot users (n = 80,229) in BC, Canada, from mid-November to mid-December 2016, to coincide with the start of the influenza season, which typically runs from November to April [4]. A valid Carrot user was required to enter their BC postal code and loyalty program card number during app registration and be over the age of 13 years. All valid users agreed to Carrot Rewards' privacy policy, which states that information entered into the app may be used for research purposes. Ethics approval for the secondary data analysis was granted by the University of British Columbia's Behavioural Research Ethics Board [H17-02814].

2.2. Carrot Rewards Flu Shot Awareness Campaign and incentives

The Flu Campaign began with one quiz comprised of six questions (see Appendix 1) and offered four levels of incentives. Screenshots of the Flu Campaign can be found in Fig. 1.

All eligible users received 25 loyalty points for completing the Flu Campaign quiz, which corresponds to approximately $0.25 CAD (incentive 1). Users were then split into two groups, depending on where they lived based on postal code data. The "general group" lived outside the area of the participating pharmacy and received no further offers. The "pharmacy group" received additional Flu Campaign offers, as they lived within one of eight cities where participating pharmacies were located. A total of 28 pharmacies took part, all found within large grocery stores, in urban settings. After completing the first quiz, users in the pharmacy group were informed they could receive "50 times" more loyalty points if they visited the sponsored pharmacy. At this point they were prompted to click on a map showing the nearest sponsored pharmacy location, for which they received additional loyalty points (incentive 2, worth 10 points or approximately $0.10). If the user then enabled the "locations" function on their smartphone, granting Carrot access to their location data, they received push notifications (i.e. prompts) to speak with a pharmacist when they were within 200 m of any participating pharmacy. Users could receive the following push notification up to twice per week during the Flu Campaign: "You're near a [name] pharmacy – talk to your pharmacist about the flu shot to earn up to 50X more!"

Pharmacists were trained by their manager who was also involved in the development of the app. Each pharmacist also received a 1-page information sheet about the Flu Campaign, how it works, and their role, specifically to give out a bonus code to Carrot users who spoke to them about the influenza vaccine (not for actually receiving the vaccine). Users who spoke with a pharmacist could enter the bonus code in the app to receive additional loyalty points (incentive 3, worth approximately 500 points, or $5.00). If the code was entered, the user was then sent a link to complete a follow up survey, which asked if they received the influenza vaccine, for additional loyalty points (incentive 4, worth 15 points or approximately $0.15). Fig. 2 illustrates the flow of

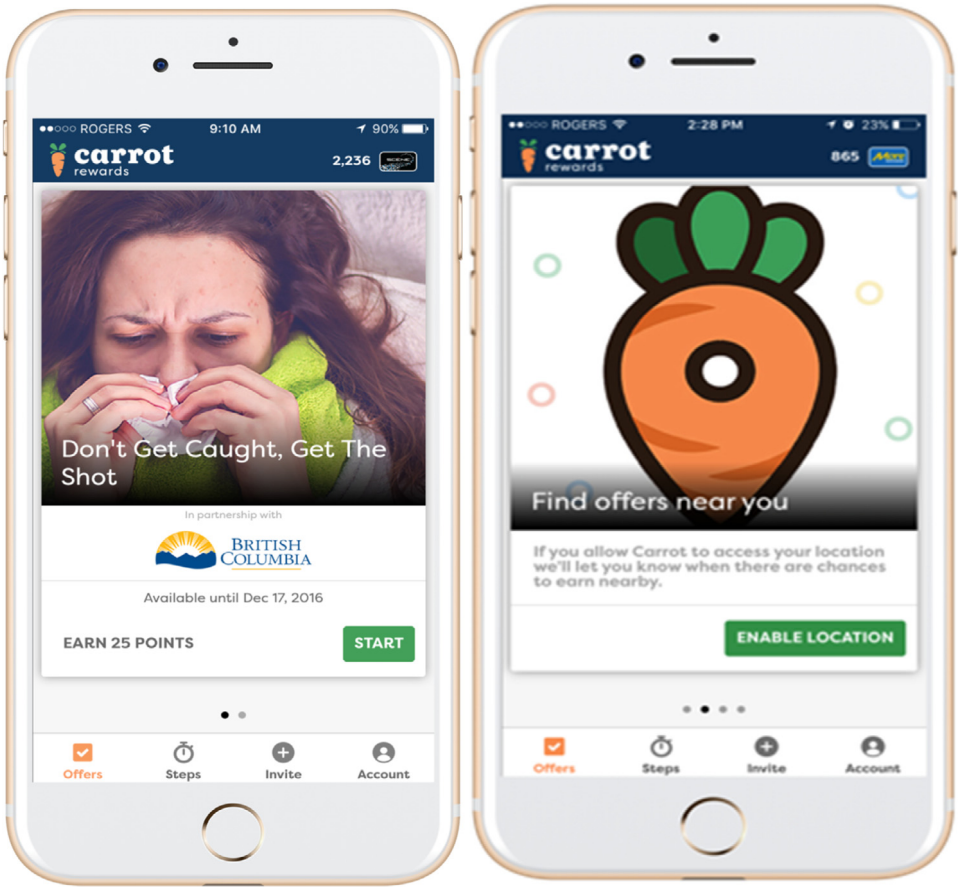

Fig. 1. Screen shots from the Carrot Flu Campaign.

Carrot users through the Flu Campaign. The follow up survey questions are found in Appendix 1.

2.3. Baseline health risk assessment

The Carrot Rewards app also offered users a baseline Health Risk Assessment (HRA) one week after app registration and a follow up quiz five months post-registration, for additional loyalty points [17]. The HRA asked users about various health behaviours, including physical activity, healthy eating, and whether users had received the influenza vaccine.

2.4. Data collection

Data were collected from all users who completed the Flu Campaign quiz, and included basic demographics of gender, age, and postal code. A third of users also completed additional demographic questions, which were collected in a previous study. User demographic data was merged from the previous study if they took part in the Flu Campaign; therefore, only those who took part in both studies had the additional demographic data.

Individual user data included the responses to the Flu Campaign quiz, if they were included in the sponsored pharmacy group, and whether they received incentives 2 and 3. The number of user visits to the pharmacy was determined by the number of bonus codes entered into the app. Also captured were the responses to the follow up quiz questions (incentive 4). Aggregate data included the number of users who turned on their smartphone's location feature and the total number of push notifications sent. Individual data were also collected on responses to the HRA's influenza behaviour question at one week (baseline) and 5 months (follow up) post-registration.

2.5. Data analysis

We conducted a descriptive analysis on demographic data, quiz responses, the number of users awarded each incentive, and on influenza vaccine uptake behaviours for an eligible subsample who received the Flu Campaign between their baseline and their follow up HRA. We did not set an a priori hypothesis, as this was a secondary data analysis and we did not determine the variables or measures used; however, out of interest we conducted an exploratory chi-square test to determine if the proportion of users who reported receiving the influenza vaccine at baseline (influenza season 2015) differed significantly from the proportion of users who reported receiving the influenza vaccine at follow up (influenza season 2016), after completing the Flu Campaign quiz.

The test was exploratory as we made assumptions about the data, due to the wording of the HRA influenza behaviour question and multiple-choice responses. Users were asked "*When did you have your last flu shot? Don't include the "H1N1" flu shot*" and the

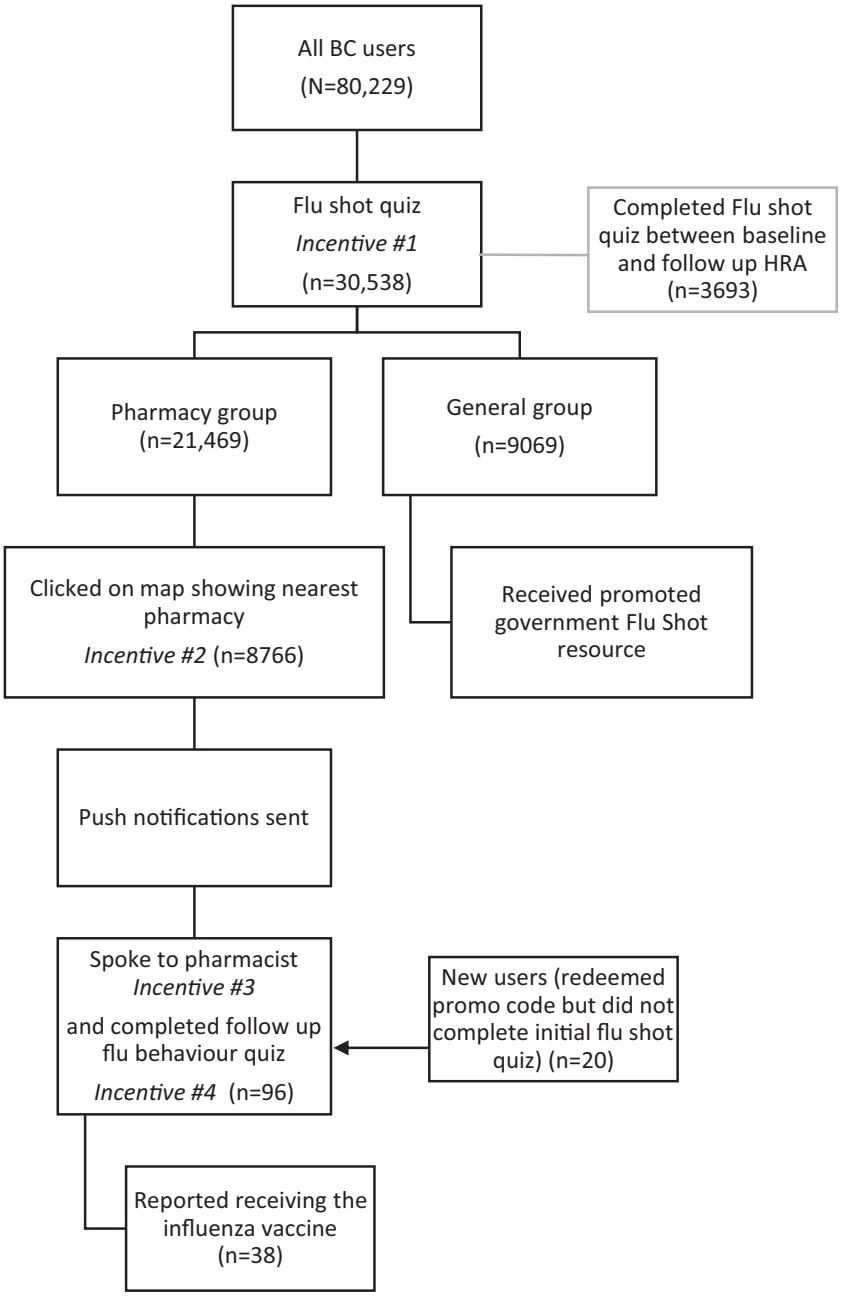

Fig. 2. Participant and incentive flow chart. HRA = Health Risk Assessment.

response "*less than a year ago*" was assumed to indicate that the user had the influenza vaccine during the current influenza season. It is possible, though unlikely, that a user could have received the influenza vaccine the previous season in February or March and selected this response during their follow up in January, which would be "less than a year ago." We converted the data into a dichotomous Yes/No variable, where Yes indicated receiving the influenza vaccine for the current season. Responses categorized as No included "I've never had a flu shot; 1–2 years ago; 2 years ago or more." All data analyses were completed using IBM SPSS Statistics 24. The statistical test was 2-tailed at a 5% significance level.

3. Results

3.1. Demographics

From the date Carrot Rewards was released to the start of the Flu Campaign nine months later, 80,229 users were eligible to receive the Flu Campaign quiz, which was completed by 38.1% (30,538/80,229) of valid users (received incentive 1). The mean age of the sample was 35.96 (±12.94) and nearly two-thirds were female (19,916/30,538; 65.2%). One third of the sample (10,229/30,538; 33.5%) completed demographic questions, found in Table 1.

Table 1
Demographic characteristics of Carrot Flu sub-sample (n = 10,229).

Category	Response	Frequency (n; %)
Income	Less than $20,000	940 (9.2)
	$20,000–40,000	1557 (15.2)
	$40,000–60,000	1665 (16.3)
	$60,000–80,000	1345 (13.1)
	$80,000–100,000	1200 (11.7)
	$100,000–150,000	1398 (13.6)
	Over $150,000	692 (6.8)
	Don't know/rather not say	1432 (14.0)
Employment status	Did not have a job	665 (6.5)
	Had a job but absent from work	304 (3.0)
	Worked at a job or business	7250 (70.9)
	Permanently unable to work	191 (1.9)
	Retired	819 (8.0)
	Other	636 (6.2)
	Rather not say/don't know	364 (3.6)
Education level	Less than high school	302 (3.0)
	High school or equivalent	1965 (19.2)
	College or other non-university certificate	2249 (22.0)
	University certificate below bachelor's level	747 (7.3)
	Bachelor's degree	2826 (27.6)
	University degree above bachelor's level	1119 (10.9)
	Trade certificate	596 (5.8)
	Rather not say/don't know	425 (4.2)
Marital status	Single, never married	2629 (25.7)
	Common-law	1141 (11.2)
	Married	4922 (48.1)
	Separated	351 (3.4)
	Divorced	501 (4.9)
	Widowed	175 (1.7)
	Rather not say/don't know	510 (5.0)

3.2. Incentives and push notifications

Fig. 2 illustrates the flow of participants through the Carrot Flu Campaign. From the total sample, 70.3% (21,469/30,538) were in the sponsored pharmacy group, and 41% (8766/21,469) of this group clicked on the map to show the nearest sponsored pharmacy (received incentive 2).

Over three-quarters of users (16,689/21,469; 77.8%) enabled their smartphone's locations feature, allowing them to be eligible to receive the push notifications. A total of 21,509 push notifications were sent during the 4-week campaign (an average of 1.3 per user). A small number of users (n = 96) went into the sponsored pharmacy, spoke to a pharmacist, and completed the follow up quiz (received incentives 3 and 4). Included in this group were 20 new Carrot users who downloaded the app after observing the Carrot promotion at the sponsored pharmacy during the Flu Campaign, and therefore, as new users they did not receive the Flu Campaign quiz (incentive 1) or click on the map/receive push notifications (incentive 2), but they did receive incentives 3 and 4. Of those who spoke to the pharmacist, 38 (38/96; 39.6%) reported receiving the influenza vaccine, and one third of these individuals (32/96; 33.3%) did not know that they could get the influenza vaccine at the sponsored pharmacy. The majority of Carrot users correctly identified the best way to prevent influenza was to receive the annual vaccine (n = 28,173/30,558; 92.2%). Despite this, those who spoke to the pharmacist reported barriers to the influenza vaccine, as described in Table 2.

Table 2
Perceived barriers to receiving the influenza vaccine (n = 96).

Perceived barrier*	n (%)
Afraid or uncomfortable	17 (17.8)
Afraid of what the flu shot contained	12 (12.5)
Did not have time	11 (11.5)
Did not see the benefit of receiving the flu shot	18 (18.8)
Bad reaction to flu shot	6 (6.3)
Bad reaction to other vaccine	8 (8.3)
Other	10 (10.4)
None, usually get the shot	57 (59.4)

* Users could select more than one response.

Table 3
Influenza vaccine uptake behaviours pre- and post-campaign (n = 3693).

Received the flu shot	Baseline (n;%)	Follow-up (n;%)
Never	999 (27.1)	958 (25.9)
Less than 1 year ago	1177 (31.9)	1376 (37.3)
1 to 2 years ago	608 (16.5)	533 (14.4)
2 or more years ago	909 (24.6)	826 (22.4)

3.3. Flu shot behaviours

Just over 12% of the sample (3693/30,538) received the Flu Campaign between their baseline and follow-up HRA. Table 3 displays their influenza vaccine behaviours pre- and post-campaign.

Approximately 5% more users received the influenza vaccine during the 2016 influenza season than in 2015. Exploratory chi square tests revealed the proportion of users who received the influenza vaccine at follow up was significantly greater than the number at baseline (χ^2 (1) = 1190.76, $p < .001$, $\phi = .57$).

4. Discussion

This study showed that a novel incentive-based smartphone application could deliver influenza vaccine educational material and use geolocation technology to promote awareness of near-by pharmacy locations to a large number of people in a real-world setting. The Flu Campaign quiz completion rate was fairly high (38%) and many users also completed the second step of the campaign (41%), the map views, although only a small number (0.4%) visited the pharmacy. It was promising that more people reported receiving the influenza vaccine after completing the Flu Campaign quiz, compared to the year previous.

To our knowledge, this study was one of the first to use push notifications in a smartphone app to promote influenza vaccine uptake. As proof-of-principle, the study was successful in using geolocation to send push notifications to users when they were in the vicinity of the sponsored pharmacy. A strength of this study was the large number of users already engaged with the app in one province, which demonstrates the potential scalability for using the app for public health campaigns across the rest of Canada. The push notifications did not translate into many pharmacy visits; however, even if the percentage of users changing their behaviour is modest, it may translate to a larger public health impact in the future given the app's easy scalability [21,22]. Geolocation technologies are being used to increase awareness and improve access of other health services [23], as well as address health behaviours, such as smoking cessation; however, as the concept is in its infancy, the efficacy to change behaviour has yet to be determined [24]. Carrot users received on average 1.3 push notifications during the month-long Flu Campaign, which indicated that many users

did not go near the sponsored pharmacy frequently. Receiving one or two push notifications over a month may not have been a sufficient prompt to visit the pharmacy for an influenza vaccine, even when offered loyalty point incentives.

For incentives to influence behaviour, the amount of the incentive must be meaningful to the user [25]. To control app operating costs, the monetary value of the Carrot incentive was small; however, research has shown loyalty point collectors tend to overvalue loyalty points as the true value is not immediately clear [17]. The Carrot incentive amount may have been too small or unclear to drive pharmacy visits, which was a significant task compared to completing a short health quiz. It is also unknown how many bonus codes were handed out by the pharmacists compared to the number of codes entered into the app, and this extra step of entering the code could have been a source of attrition.

Conversely, another study showed that financial incentives could promote influenza vaccine uptake among workers, where participants earned $5 for receiving a free flu shot [26]. A potential financial barrier in this study was that the vaccine was not free for many users, as residents of BC aged five to 64 years old, who do not have a risk factor, typically must pay for the vaccine [27]. Free vaccines have been shown to effectively overcome financial barriers and improve uptake [28]. The cost of the influenza vaccine was not listed as a potential barrier in the Carrot incentive 4 follow up quiz, and therefore we could not determine if cost was a barrier for this sample. It is possible that the amount of the incentive was too small to offset the cost of the vaccine. It is also important to note that the aim of the Flu Campaign was to promote awareness and visits to the pharmacy, not to incentivize actually receiving the vaccine. Offering users an incentive to receive the vaccine may have led to a greater uptake of the influenza vaccine, which is worthy of further study.

The incentives did appear to keep users engaged with the app. The Flu Campaign quiz completion rate of 38% indicated a large retention of users compared to many m- or e-health interventions that suffer from high rates of attrition [29]. Loyalty point incentives have previously shown to be effective in encouraging initial enrolment in an e-health intervention, but not in retaining participants and encouraging further engagement with the intervention [30]. Our contrasting findings were perhaps due to the short duration and engaging nature of the quizzes, and that they are delivered to the user "in their pocket," all benefits of mobile microlearning [16].

From an education/public health perspective, this study appeared to have led to greater awareness about receiving the influenza vaccine at the pharmacy, which is more cost-effective than receiving the vaccine from the doctor [31], and this could influence behaviour in subsequent influenza seasons. Carrot users were aware that the influenza vaccine was the best way to prevent influenza, but misconceptions around the influenza vaccine remained. Education-based influenza vaccine interventions are most effective when the content was tailored to the knowledge and attitudes of participants [28] or addressed specific concerns underlying vaccine hesitancy [9]. Adding to this, another study found those with perceived barriers to the influenza vaccine were three times less likely to receive the vaccine, while those who perceived the influenza vaccine as beneficial were twice as likely to receive the vaccine [32]. Future iterations of Carrot may be more effective at increasing influenza vaccine uptake if the content targets users' beliefs for those with vaccine hesitancy and uses simple prompts/reminders for those who already plan to get the vaccine. A benefit of mobile technologies is that once a platform is developed, the content can be easily adapted based on preliminary findings to create more effective programs [33].

4.1. Limitations

Only one-third of the sample completed demographic questions, although results were similar to the Carrot process evaluation [17]. Notably, there was a relatively equal distribution based on income. The intervention used a chain of pharmacies found in metropolitan areas (and was limited to eight cities in this study), therefore results may not be transferable to other settings or other demographics. Due to the small number of Carrot users over the age of 65 years, it is not known if this type of intervention would appeal to this age group, which is an important consideration as they have been identified as a high-priority group to receive the influenza vaccine [34].

It was promising that more people in the eligible sub-sample reported receiving the influenza vaccine within the past year after completing the Flu Campaign quiz, and this number (37%) was higher than the self-reported Canadian average uptake of 28% [4]; however, due to the nature of the data captured, we could not report that completing the quiz led to an increase in influenza vaccine uptake. Future studies with robust evaluations, including cost-effectiveness, are needed to determine whether using geolocation technology, combined with incentives and education, will result in influenza vaccine uptake. We recommend that health behaviour app developers consider how the effectiveness of the app will be evaluated as part of the development process.

Carrot Rewards is currently implementing changes to their Flu Campaign, based on our findings. The influenza behaviour question is now worded "Did you get the flu shot last season (November 2016 to April 2017)?" The barrier to receiving the influenza vaccine question will be asked to all Carrot users in Quiz 1, to gain a better understanding of barriers to getting the vaccine in Canada. The question has also been amended to include the cost of the influenza vaccine as a potential barrier. These steps are necessary prior to tailoring content to users' misconceptions around the vaccine.

Despite the design limitations, early mobile health studies such as this one, provide important findings as to the acceptability and potential scalability of apps, as well as how to improve the app's usability, content, and message framing. The rapidly evolving nature of mobile technology can make conducting high-quality research challenging, as the technology may no longer be relevant in the time it takes to conduct a randomized controlled trial [35]. Implementation of behaviour change mobile interventions should be continuously evaluated, using the most rigorous methods possible, as changes are made to the app [35]. Thus, we recommend ongoing evaluation of future iterations of the Flu Campaign.

5. Conclusions

Carrot Rewards provided a novel way to educate the general population about the benefits of the influenza vaccine and to overcome access barriers by promoting and incentivising visiting a sponsored pharmacy. This study clearly showed that using mobile technologies is feasible and may have large population reach. Future iterations could improve content and evaluation methods to determine how effective the app can be at improving uptake of the influenza vaccine, and then serve as a basis for dissemination to other jurisdictions beyond Canada.

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Conflict of interest

All authors have approved the final version of this manuscript. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Leila Pfaeffli Dale reports consulting income, unrelated to the study, from Carrot Insights Inc. Lauren White is a Carrot Insights Inc. employee and also reports stock options in Carrot Insights Inc. Marc Mitchell reports grant support from the Canadian Institutes of Health Research, the University Health Network, Green Shield Canada Inc., as well as in-kind research support from Cookson James Loyalty Inc. Furthermore, he reports consulting income from Carrot Insights Inc. and stock options in Carrot Insights Inc. Guy Faulkner holds a Canadian Institutes of Health Research-Public Health Agency of Canada (CIHR-PHAC) Chair in Applied Public Health and reports no conflicts of interest.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.vaccine.2018.04.018.

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