Using mobile technologies for immunization: Predictors of uptake of a pan-Canadian immunization app (ImmunizeCA)

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Substandard vaccination compliance in many areas of North America has resulted in outbreaks of vaccine-preventable diseases such as measles (1). Mobile technologies offer an opportunity for public health to improve vaccination rates by providing accurate information and reminding individuals of immunization appointments (2). However, mobile apps are limited by the willingness of the public to download them.

ImmunizeCA is a pan-Canadian immunization app, which provides users with a mechanism to store their family's immunization records, access accurate immunization information, schedule appointments and be notified of vaccine-preventable diseases in their vicinity. We sought to measure uptake and use of ImmunizeCA over a six-month period, and to assess the effectiveness of various promotional strategies in driving uptake and use of the app (Table 1). Strategies examined included: government and hospital press releases, Apple (Apple Inc, USA) App Store placement in "Best New Apps" section at launch, direct-to-household flyers enclosed in federal universal child benefit cheques (flyers), as well as online and print news articles and mentions in social media (Twitter [Twitter Inc, USA] and Facebook [Facebook Inc, USA]).

METHODS

Media monitoring was conducted using MediaMiser SNAP (MediaMiser Ltd, Canada), a media monitoring and analysis platform, which collects search result data from digital news, blogs, Twitter, YouTube (Google, USA), Facebook and reddit (reddit Inc, USA) (3). Articles were retrieved according to the following inclusion criteria: #immunizecanada, OHRI, immunization, Immunize Ontario, ImmunizeON, Ottawa Hospital Research Institute, Kumanan Wilson, ImmunizeCanada app, ImmunizeON, ImmunizeCA, yellow card app, vaccine app. A research assistant manually reviewed all content collected to confirm that the article mentioned or referred to the "ImmunizeCA app". All content that did not mention or refer to the app was manually removed from results before analysis.

Data regarding downloads were collected through iTunes Connect (Apple Inc, USA), Google Play (Google, USA) and BlackBerry World (BlackBerry, Canada) (4-6). Google Analytics (Google, USA) provided a variety of aggregate use metrics for iOS (Apple Inc, USA) and Android (Google, USA) platforms, as well as website traffic in both English and French languages (immunize.ca/app). Daily total download data were available from March 20 to September 20, 2014. An autoregressive integrated moving average time-series model was initially considered to analyze daily download frequency, which revealed no evidence of autocorrelation (correlation between serial observations) or temporal trends. Therefore, a simple ANOVA model was used, with total daily downloads as the response variable and week of the year as the classification variable; mean number of downloads for each week of the study were compared with the overall mean of the total daily downloads. Changes in frequency of downloads due to events of interest (ie, media mentions/App Store Feature) were evaluated by comparing the mean daily downloads in the week in which the event occurred with the overall mean.

RESULTS

In the first six months following release, ImmunizeCA was downloaded a total of 54,610 times. Of these, 41,066 (75.2%) were for iOS, 12,560 (22.9%) for Android and 984 (1.8%) for BlackBerry (BB). The app was mentioned 781 times in the media (48 print articles, 68 online news articles, 152 Facebook posts and 494 tweets) and the website had 55,656 visits (Table 2).

The most downloads occurred in March (launch) and July (government mailouts), with 20,835 (38.1%) and 11,945 (21.9%), respectively (Figure 1). March downloads included 85.0% for iOS, 14.5% for Android and 0.5% for BB. In July, downloads included 61.6% for iOS, 35.5% for Android and 2.9% for BB. The app received 359 (46.0%) media mentions in March and, 31 (3.8%) media mentions, two news articles, 23 tweets and six Facebook posts in July.

App use metrics

During the first six months, ImmunizeCA had a total of 174,038 sessions, producing 909,257 screen views, an average of 5.22 screens per session. The average session duration was >3 min (03:02 min). Information was accessed 82,126 times, and the most views occurred in March (23,242 views) (Figure 1).

Across 54,610 users, 45,157 individual records were created. The most were created in March (12,347 records), followed by July (12,215 records). Of the records created, the minimum age was zero years and the maximum was 90 years of age. Fifty-five percent (24,836) of records were created for children ≤5 years of age. Of those, 52% (13,003) were zero to one year of age.

The "add to calendar" feature for vaccination encounters was activated 7691 times by 5548 unique users.

The ANOVA model demonstrated that there were two instances of a statistically significant increase in total daily downloads: during the four weeks following launch of the app and while it was featured in the App Store; and during the two weeks following mail-out flyers. These periods were highly significant in the model ($P<0.0001$), confirming that app downloads sharply increased during these times, whereas no other factors (social media, press releases, etc) had any significant influence. An analysis of log(total_downloads), used to reduce the impact of extreme outliers, yielded similar findings. The log transformation pulled extremely high daily

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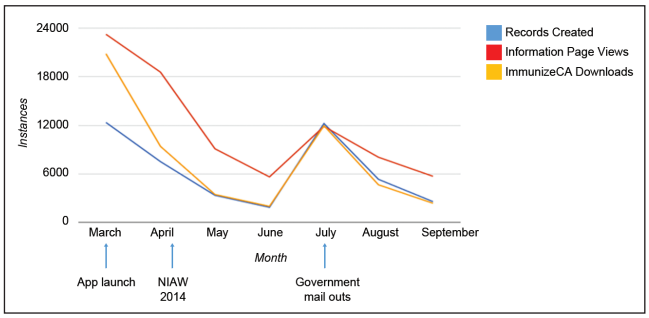

Figure 1) *Total downloads, records created and information accesses for ImmunizeCA March 20 to September 20, 2014. NIAW National Immunization Awareness Week*

TABLE 1
Period of investigation and critical events during the study period March 20 to September 20, 2014

Date(s)	Event of interest	Comments
March 20, 2014	App launch on iOS and Android platforms	Government press release and media conducted
March 26, 2014	App launched on BlackBerry platform	
March 20, 2014 to March 27, 2014	Apple App Store placement "Best New Apps"	By Apple Canada
April 26, 2014 to May 3, 2014	National immunization awareness week	General promotional activities conducted by Immunize Canada
July, 2014 (staggered) week of the 21st	Flyers distributed with universal child benefit cheques	National distribution

TABLE 2
Downloads, website visits and media mentions for ImmunizeCA for six months following launch, March 20 to September 20, 2014

	Month							
	March	April	May	June	July	August	September	Six-month total
Downloads	20,835	9394	3445	1986	11,945	4644	2361	54,610
iOS	17,723	7756	2415	1364	7370	2919	1519	41,066
Android	3006	1508	817	576	4242	1613	798	12,560
Blackberry	106	130	213	46	333	112	44	984
Website visits	17,643	10,200	6713	5236	6581	5207	4076	55,656
English	12,232	9410	6347	4924	6045	4844	3809	47,611
French	5411	790	366	312	536	363	267	8045
Media	359	242	78	28	31	24	19	781
Written News	16	26	5	0	1	0	0	48
Online News	34	31	0	0	1	2	0	68
Facebook	53	65	20	3	6	5	11	163
Twitter	256	120	53	25	23	17	8	502

Data presented as n

downloads closer to the remainder of the data, reducing the impact of these observations on the overall variance, which could obscure important findings.

DISCUSSION

The two major drivers of app downloads were activities surrounding the app launch at the end of March, and the distribution of government flyers in July (the exact date of flyer delivery by post is not known). However, there was a higher proportion of iOS downloads in March compared with July (85% versus 61.6%, respectively), which may be secondary to placement in the iOS App Store's "Best New Apps" section or capturing early adopters. Despite there being almost twice as many downloads in March compared with July, both months reported approximately the same number of app records created (12,347 versus 12,215). This may indicate that how the product is marketed can influence how it will be used, with direct-to-consumer marketing exhibiting a higher use/download ratio.

While app use analytics are valuable, proper interpretation requires a knowledge and understanding of the analytic tag structure. We recommend working closely with your software development team when implementing in-app analytics for health applications.

Social media strategies did not have a detectable independent effect on uptake. Further adoption of the app may be encouraged by having the app serve as both an official record, and a mechanism by which public health can communicate accurate immunization information to individuals. Based on our experience, successful uptake of public health apps focused on child health would benefit from app store endorsements and using direct-to-consumer marketing strategies.

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