Short Communication

Use of SMS-linked electronic surveys for COVID-19 case investigation and contact tracing — Marin County, CA, USA

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ABSTRACT

Objectives: We sought to quantify the proportion of contacts reported by persons with COVID-19 through a short message service (SMS)-linked survey in comparison to the proportion of contacts reported during a follow-up phone-interview. We also sought to assess improvement in contact tracing timeliness associated with sending SMS-linked surveys.
Study design: During December 4–15, 2020, persons identified as COVID-19 cases whose data was entered into Marin County's contact tracing database on even days received a SMS-linked survey and persons whose data was entered on odd days did not; all were called for case investigation and contact tracing. Chi-square test and Fisher's exact test were used to compare demographic data. Chi-square test was used to contrast categorical outcomes, and Wilcoxon's rank-sum test was used for continuous outcomes.
Results: Among 350 SMS-linked survey recipients, 85 (24%) responded and 4 (1%) reported contacts using the survey; an additional 303 contacts were reported during phone interviews. Without phone interviews, 99% of reported contacts would have been missed. There was no meaningful difference between study arms in the proportion of contacts notified within 48 h.
Conclusions: This SMS-linked survey had low participation and was not useful for identifying contacts. Phone interviews remained crucial for COVID-19 contact tracing.

1. Introduction

Contact tracing is a core infectious disease control measure [1]. During the coronavirus disease 2019 (COVID-19) pandemic, health departments (HDs)[1] implemented COVID-19 contact tracing systems [2]. Assessments of these systems revealed opportunities for improving timeliness [3,4]. The California Department of Public Health, in collaboration with partners of Accenture, developed CalCONNECT, California's contact tracing data management system. CalCONNECT includes a 36 question (10 required) electronic case investigation and contact tracing survey, with 7 additional questions (5 required) per each reported close contact. A link to the survey can be sent by short message service (SMS) to persons with COVID-19. Recipients can click the link, open the survey on their mobile phone, complete the survey, and submit answers. Submitted response data populate into CalCONNECT.

SMS-linked surveys may improve contact tracing timeliness by providing persons with COVID-19 a way to report contacts instead of or before being contacted by the HD and by improving phone case investigation interview efficiency.

We sought to quantify the number of contacts reported through the SMS-linked survey compared to the number of contacts reported during a follow up phone interview, and assess the proportion of close contacts notified within 48 h in the SMS-linked survey arm (SMS-linked surveys sent prior to phone-interview based contact tracing) compared to the control arm (phone-interview based contact tracing alone).
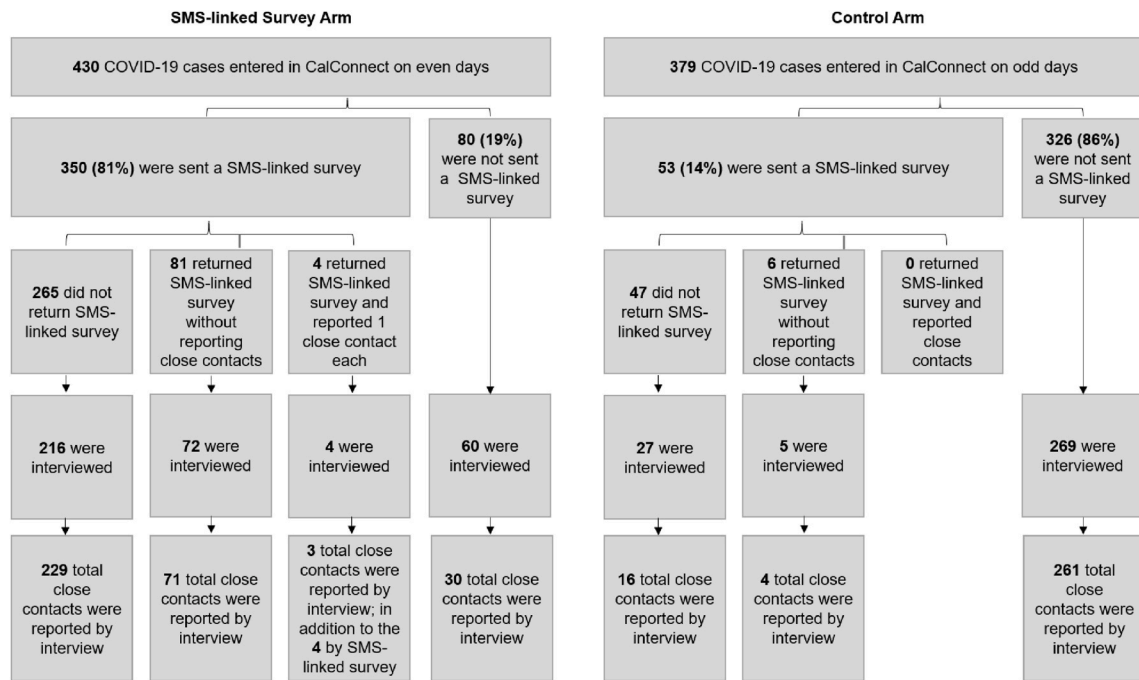

Fig. 1. Flowchart of contact tracing, December 4–15, 2020, Marin County, CA, USA.

2. Methods

2.1. Analytic design

During December 4–15, 2020, all residents of Marin County, CA with COVID-19 whose data were entered into CalCONNECT were included in the analysis. Close contacts reported within 7 days of case entry were also included. Persons residing in congregative living facilities[2] or not residing in Marin County were excluded. We defined close contact as a person who was within 6 feet of a person with COVID-19 for 15 min or more within a 24-h time-period starting 2 days before symptom onset (or specimen collection if asymptomatic) [5]. This was a quasi-randomized study. Cases whose data were entered into CalCONNECT on even days (December 4, 6, 8, 10, 12, and 14) were assigned to receive a SMS-linked survey, available in English or Spanish (Survey 1 and 2 in Supplement); cases whose data was entered into CalCONNECT on odd days were assigned to not receive a SMS-linked survey. Initial data entry into CalCONNECT was considered time 0 for all timeliness metrics. HD staff made at least three attempts to interview by phone all persons in both arms to conduct case investigation and contact tracing. SMS-linked survey respondents had to complete a minimum of 8 required fields, otherwise they were a non-respondent. This activity was reviewed by the Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy.[3]

2.2. Statistical analysis

We estimated that 406 close contacts per arm would provide 80% power to detect a 10 percentage-point difference in the proportion of

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[2] Congregative living facilities included: correctional institutions, skilled nursing facilities, assisted living facilities, residential substance use treatment programs, sober living homes, group homes for adults with developmental disabilities or mental illness, residential care for youth with emotional or behavioral disturbances, domestic violence shelters, and shelters for persons who are unhoused.

[3] See e.g., 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

close contacts notified within 48 h (control arm: 39% vs. SMS-linked survey arm: 49%), with a two-sided alpha of 0.05. With an estimated fidelity rate of 80% in both arms, 974 close contacts (487 per arm) were needed. Chi-square test and Fisher's exact test were used to analyze demographic data. Chi-square test was used to contrast categorical outcomes, and Wilcoxon's rank-sum test was used for continuous outcomes. Statistical analysis was performed using R version 4.0.2.

3. Results

During the study period, 430 persons were assigned to receive the SMS-linked survey and 379 persons were assigned to not receive it. SMS-linked surveys were sent by HD staffers who were also conducting other duties, resulting in the following fidelity: 350 (81%) persons in the SMS-linked survey arm received a SMS-linked survey and 326 (86%) in the control arm received no SMS-linked survey (Fig. 1). More persons reported English as their primary language in the SMS-linked survey arm. There were no other meaningful differences in demographic characteristics by study arm (Table 1).

Among 350 SMS-linked survey recipients, 85 (24%) responded; 4 of these respondents reported 1 close contact each on the SMS-linked survey. All 4 participated in phone interviews, during which 2 reported at least 1 additional close contact. Among 137 SMS-linked survey recipients who reported close contacts, 97% did so only during the phone interview. Among 307 close contacts, 303 (99%) were identified by phone interview alone and 4 (1%) were identified by SMS-linked survey prior to phone interview. Nine persons completed the SMS-linked survey but could not be reached for phone interview; none reported close contacts via the survey.

Among persons with COVID-19, the proportion who were interviewed was similar between study arms, as was the proportion who reported close contacts (82% of survey arm vs. 79% of control arm were interviewed, $p = 0.11$; 32% of both arms reported close contacts, $p = 0.98$). The median time to report of close contact(s) was statistically sooner in the SMS-linked survey arm (SMS-linked survey arm: 25 h vs control arm: 40 h; $p < 0.01$). There was no statistical difference in the median time to contact notification (SMS-linked survey arm: 4.5 days vs. control arm: 3.3 days; $p = 0.88$) or in the proportion of contacts notified

Table 1
Demographic characteristics of COVID-19 cases, December 4–15, 2020, Marin County, CA, USA.

Characteristics	SMS-linked Survey Arm (n = 430)		Control Arm (n = 379)		p-value
	N	%	n	%	
Age (years)					
< 18	72	17%	54	14%	
18 - 29	94	22%	79	21%	0.68
30 - 49	80	19%	66	17%	(Chi-squared)
50-64	152	35%	145	38%	
65+	32	7%	35	9%	
Sex					
Male	213	50%	177	47%	0.36
Female	214	50%	202	53%	(Fisher's Exact)
Unknown	3	1%	0	0%	
Race[a]					
White	210	49%	184	49%	
Asian	10	2%	12	3%	0.55
Black or African American	9	2%	7	2%	(Fisher's Exact)
Native Hawaiian or other Pacific Islander	1	0%	0	0%	
American Indian or Alaska Native	5	1%	0	0%	
Biracial	5	1.2%	4	1.1%	
All Other Races	99	23%	93	25%	
Unknown	91	21%	79	21%	
Ethnicity[a]					
Hispanic or Latino	174	40%	175	46%	0.31
Non-Hispanic or Latino	174	40%	142	37%	(X-squared)
Unknown	82	19%	62	16%	
Primary Language					
English	268	62%	201	53%	**0.02**[b]
Spanish	126	29%	133	35%	(Fisher's Exact)
Other	2	0%	8	2%	
Unknown	34	8%	37	10%	

c. Boldface indicates statistical significance ($p < 0.05$).

[a] Race and ethnicity data were obtained during case investigation phone interviews. 'Biracial' includes persons who identified with 2 listed racial categories. 'All Other Races' includes persons who did not identify with listed racial categories.

[b] The p-value includes all groups (3 degrees of freedom).

within 48 h (SMS-linked survey arm: 32% vs. control arm: 28%; $p = 0.29$) (Table 2).

4. Discussion

Prior to and during the COVID-19 pandemic, public health entities have used SMS technology to collect data and communicate important

messaging, with varying success rates based on the topic, population, and setting [6,7]. However, no studies on the use of SMS by public health entities for contact tracing or on the use of SMS technology for contact tracing compared to an alternate modality, such as phone or in person interviews, were found. During and after the COVID-19 pandemic, it is critical to characterize the use, outcomes, and limitations of SMS technology as many health jurisdictions leveraged this technology for COVID-19 contact tracing and may seek to use SMS technology again during future outbreaks and pandemics [8,9]. In this study, participation in the SMS-linked survey was low and those who did participate rarely reported contacts. Low participation and low reporting of close contacts may have resulted from a number of reasons, including lack of access to a phone with SMS or internet browser capabilities, survey length, use of medical terminology, or privacy concerns. While few contacts were reported in the SMS-linked survey, many contacts were reported during the follow up phone interview, indicating a willingness of participants to share information.

Additionally, while close contacts in the SMS-linked survey arm were reported earlier, there was no statistical difference between arms in contact notification timing. Receiving information about an upcoming call could prompt earlier answering of the phone and thus earlier contact reporting, though it is not clear why contacts were not then notified earlier.

4.1. Limitations

This study had limitations. First, the study was stopped early due to a surge in COVID-19 cases. During the surge, because a proportion of persons with COVID-19 would not be reached in a timely manner due to the workload, the study was stopped and surveys were sent to all persons with COVID-19 to maximize any potential benefit. Thus, the estimated sample size was not reached. However, this did not affect the conclusion that few persons participated in the SMS-linked survey and few persons reported contacts. And second, HD staff were not blinded to the study arms, potentially introducing information bias.

5. Conclusions

This SMS-linked survey was rarely used to report close contacts. Replacing phone-based contact tracing with an electronic reporting tool that was user dependent would have led to an inadequate response rate and limited the effectiveness of contact tracing efforts. Elucidating the reasons for low reporting of contacts through SMS-linked surveys may help inform the future use of SMS-based technologies for contact tracing. Further studies are needed to determine if sending SMS-linked surveys, or sending SMS's alone without a survey, may improve contact tracing timeliness.

Table 2
Contact tracing metrics among COVID-19 cases and contacts, December 4–15, 2020, Marin, CA, USA.

Contact tracing metrics	SMS[a]-linked Survey Arm	Control Arm	p-value
Outcomes among COVID-19 cases			
Interview completed, *n (%)*	352/430 (82%)	301/379 (79%)	0.11
Persons identified as COVID-19 cases reporting 1 or more close contact, *n (%)*	137/430 (32%)	121/379 (32%)	0.98
Close contacts identified per interview, *mean (SD)*	0.94 (1.52)	0.93 (1.47)	0.86
Hours until interview completed, *median [IQR]*[b]	34 [20–142]	44 [20–142]	0.16
Outcomes among close contacts			
Close contacts reported within 24 h, *n (%)*[b]	151/337 (45%)	98/281 (35%)	**0.01**[c]
Hours until contact reported, *median [IQR]*[b]	25 [18–47]	40 [20–64]	**<0.01**[c]
Close contacts notified within 48 h, n (%)[b]	108/337 (32%)	79/281 (28%)	0.29
Days until close contact notified, *median [IQR]*[b]	4.54 [1.85–10.12]	3.29 [1.95–8.84]	0.88

[a] SMS = short message service.

[b] Time metrics were measured from when a COVID-19 case became available in the COVID-19 contact tracing database, CalCONNECT.

[c] Boldface indicates statistical significance ($p < 0.05$).

Author contributions

Janssen – Conceptualization, Methodology, Formal analysis, Writing – Original Draft. McGrath – Validation, Investigation, Writing – Review & Editing. Ereman – Investigation, Writing – Review & Editing. Moonan – Conceptualization, Methodology, Supervision, Writing – Review & Editing. Oeltmann – Conceptualization, Methodology, Supervision, Writing – Review & Editing. Willis McCurdy – Conceptualization, Methodology, Supervision, Writing – Review & Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi. org/10.1016/j.puhip.2021.100170.

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