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A Quick, Deployable, Online Health Survey in Public Health Research: Emerging Horizons of mHealth during Disasters

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Abstract

Background: A nationwide lockdown in response to the ongoing coronavirus disease 2019 pandemic has disrupted various health surveys. Limited movements due to restricted public-transports, and the need to maintain social-distancing, make data collection at the field site through conventional methods such as face-to-face interviews challenging. **Objectives**: The objective of the study was to overcome such issues, we document a complete online survey, using mobile technologies, for public health research, and deployable during disasters. **Methods:** The survey form was uploaded online, and for the 1st time in India, the participant information page, consent, and assent forms were also deployed online. Informed consent forms from participants were captured electronically as hand-drawn signatures. A structured, electronic-questionnaire was shared to the participants' smartphones, and the collected data were stored in a server using Research Electronic Data Capture, real-time. **Results**: Within a short span of 10 days, 1985 participants from 31 states and union territories took part in the survey. Among those, 79% had completed the survey, and the rest quit the survey mostly during the "consenting" phase, especially when they were asked to sign the consent/assent forms (16%). About 62.5% of the participant graded the online survey as "much better" followed by 19.5% suggesting "somewhat better," indicating a positive public perception regarding the online survey. **Conclusion:** The real-time online survey in health research was perceived to be better than the conventional method. In the digital era, employing mHealth technologies in health research will be a cost-effective methodological approach to obtain the expected research outcome, in a resource and time-limited setting.

Keywords: Data collection, Electronic data capture, Health information management, Information sharing, mHealth, Online survey methodology

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Introduction

Data collection is inevitable in any health surveys and research, and the method of data collection is a significant determinant of the cost and data quality.[1] The conventional pen-paper-based means, earlier used for data capture has been gradually replaced by the electronic data capture (EDC) methods, with the advent of digital technologies.[2] Advancements in information technology, access to high-speed internet, and the availability of wireless networks and mobile phones at affordable costs in developing countries, have changed the paradigm of health surveys.[3] The conventional paper-based method is a time-consuming and resource-intensive procedure, involving manual maintenance of large volumes of case report forms and datasheets. The data collected on the paper-based forms are then entered into the databases as electronic records. This method of double data entry is often error-prone and subsequently undergoes the process of data cleaning and verification.[4] With the advent of portable electronic gadgets (laptops and tablets) and smartphones, EDC was a fascinating option, wherein the data is captured in real-time eliminating the need for double data entry. The method is cost-effective and efficient, with the capacity to enter and validate the data in real-time.[5] Globally, reports demonstrate the application of web-based surveys using mobile phones for household surveys.[6] An EDC method, typically used in India is the Computer Assisted Personal Interview (CAPI) system, wherein a portable device such as smartphones/tablets are used by the interviewer to conduct face to face interviews.[7] Any health survey involving the collection of participant data requires an informed consent/assent form (ICF), signed by the participant or the parent/guardian as per the guidelines of the institutional ethical committees along with the presenting participant information page. These forms are often filed as paper-based records, even when EDC was used to collect the data by visiting the participants. However, due to restricted mobility during the nationwide lockdown, there was no possible means to conduct face-to-face interviews, and to manually collect ICFs from the participants, as conventionally done. To overcome such issues, we document the complete methodology of an online health survey using mobile technologies, applied in our study that aimed to assess the lifestyle changes of the people during the lockdown, due to the ongoing pandemic, coronavirus disease 2019 (COVID-19).

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Methods

An EDC concept was developed using the Research Electronic Data Capture (RedCap) application to collect the data from consenting participants. The ICF and assent forms (wherever required) were also designed as online forms that facilitate the electronic capture of the participants' hand-signature. The survey webpage was circulated through mobile phones via messaging apps such as WhatsApp. The collected data were stored centrally at the server end, real-time.

Data Collection Procedure

The online cross survey form includes a Participant Information Form, an ICF with an electronic signature capture method, and a structured questionnaire that contained questions related to socio-demographic information (age, gender, place of residence, education, dependent status, and current employment); information on dietary habits (daily intake of certain foods, and changes in meal timings if any); lifestyle habits information (grocery shopping, sleep habits, screen timing, hobbies, and physical activity); and visit to health care centers. The online survey was a cross-sectional study, conducted from the June 24, 2020 to July 3, 2020. Anyone aged 12 and above was included in the survey.

The Participant Information page had details of (1) Title and Purpose of the study, (2) Risk of Participation, (3) Benefits of participation, (4) Participant's Rights, (5) Confidentiality of data collected, (6) Compensation, and (7) Contact details of the Researchers who conduct the study. Once the participant reads and acknowledges their willingness to participate in the survey; the participant needs to fill their age in completed years. Age is the validation checkpoint, and only participants aged 12 and above were eligible for the study. After validation, an ICF was presented. On agreeing to participate in the survey, the participants' name and signature were collected for consent purposes only and were not considered as a part of the participants' data. Participant's name and their e-signature were stored in a separate file along with the text of consent/assent form. After registering their electronic signature, the participant can start filling the questionnaire. Questions pertaining to lifestyle of individuals during COVID-19 impact. At the end of the survey, which takes an average of 10–15 min, an exit question regarding the participant's feedback about the online data collection tool was asked. The form was validated for any missing values and if any required question was unattended the participants were intimated by a pop-up message. The participants can revisit the missed questions to mark their responses if they were missed accidentally. Nevertheless, the participant was allowed to submit the form with missing values for questions unanswered intentionally, as they hold the right to skip uncomfortable questions. The entire workflow of the EDC procedure is schematically represented in Figure 1. Furthermore, a sample signature window is illustrated in Figure 2.

At the end of the survey, an exit-question was included to evaluate the perception of the participants about this online-survey. The question was "What do you feel about this online data collection compared to the conventional paper-based data collection method?" with the options "Much better", "Somewhat better", "Nearly the same", "Somewhat worse", "Much worse," and "No idea".

The Process

The survey was designed such that it could be accessed on mobile devices such as smartphones, tablets and laptops, with network connectivity. The designed survey was made available on the server, which was then rendered to the field device (smartphones or tablets). Once the survey was completed, the collected data were transmitted to the back-end server through mobile or wireless networks and were stored in the database. The stored data were then collated and cleaned before analysis [Figure 3].

Results

In total, 1985 participants from 31 states and union territories took part in the survey during a span of 10 days. Among those, 1567 (79%) had completed the survey, which also included data forms with missing values. The remaining 418 (21%) individuals had quit the survey at various points of time as represented in Figure 4. A major proportion of the participants had quit during the "consenting" phase, especially when they were asked to input their signature (16%). A small proportion of participants quit after reading the participant information page (2%) and (3%) had quit when asked to enter their age. Among the 1567 participants, who had completed the survey, 77.6% were aged between 25 and 60 years, 65.2% were working professionals employed in government or private sectors, 73.9% were graduates, and 19.3% were students in schools or colleges [Table 1]. Majority of them (62.5%) graded the online survey as "much better," followed by 19.5% suggesting "somewhat better" [Table 1].

Table 2 lists the variables collected on socio demographic factors, dietary habits, infotainment activities, physical activities, and health-care seeking behavior during the lockdown period. A sub-group analysis on select variables was analyzed and published elsewhere.[8]

Discussion

The web-based survey was developed using the RedCap, a secure web application that has been widely used to create and manage online surveys and databases for health research studies and operations. Being a metadata-driven software application, its novel metadata-gathering workflow has successfully supported numerous health-research projects with minimal efforts and training.[9] The large scale, multi-centered surveillance activities, and health research surveys in India, are generally conducted through face-to-face interviews coupled with EDC systems such as CAPI computer-assisted self-interviews (CAPI/CASI), audio CASI (ACASI), and color-coded ACASI (C-ACASI).[7,10] In practice, the patient data are electronically captured, but the ICF, hand-signed by the respondents, are manually collected by the interviewee and stored as paper-based records or scanned copies as done in any face-to-face interview, which also requires lots of travel to the field site to collect the responses.

Contrary to these methods, our survey was entirely developed and launched online through messaging apps such as WhatsApp, fulfilling all the requirements of key-ethical guidelines replicating the face-to-face interview. The survey was designed to be accessible on a smartphone/tablet with real-time transmission and storage of data in the database, irrespective of any weather conditions. The consent and assent forms were presented online and the signatures of participants and the parental consents were captured

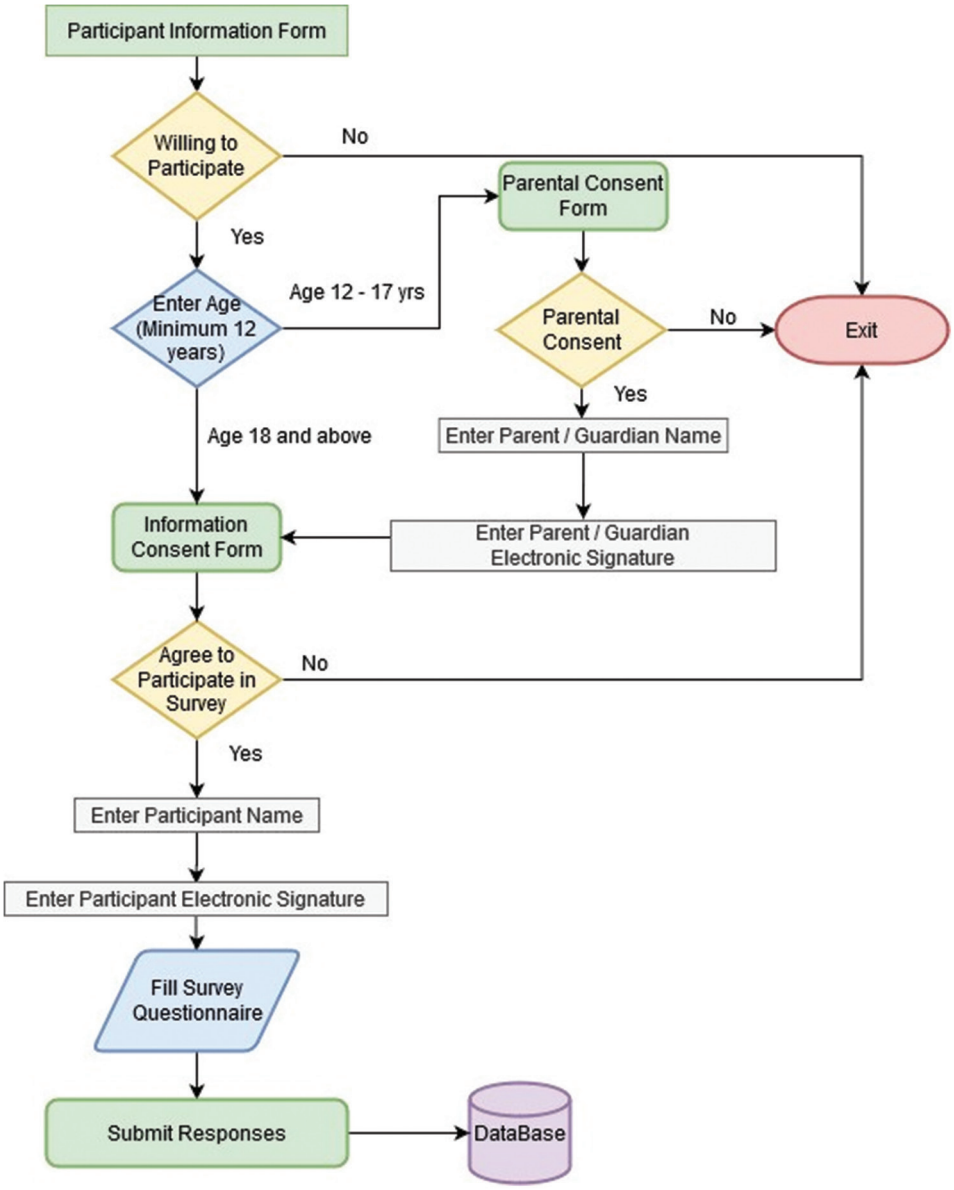

Figure 1: Flow chart illustrating the electronic data captures system

Table 1: Distribution of grading of participant's perception about the online survey system

Variable	*Total*	*Distribution*	*Much better*	*Somewhat better*	*Nearly same*	*Somewhat worse*	*Much worse*	*No idea*
	n	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*
Over all	1567	100	62.5	19.5	6.4	0.5	0.5	8.2
Age Group								
<25	293	18.7	56	20.8	6.1	1	1	12.6
25–60	1217	77.7	63.6	19.4	6.7	0.4	0.4	7.2
>60	57	3.6	71.9	15.8	1.8	0	0	7
Education								
6–12 Student	29	1.9	62.1	6.9	3.4	0	0	27.6
UG/PG Student	274	17.5	55.5	20.1	5.8	0.4	1.1	13.5
6–12 Completed	98	6.3	64.3	19.4	0	1	2	11.2
UG/PG Completed	1158	73.9	64.1	19.8	7.2	0.5	0.3	6.2
Employment								
Government/Private	1023	65.3	65.7	18.8	6.8	0.4	0.3	6.3
Self-employed/Business	82	5.2	54.9	22	12.2	1.2	1.2	4.9
Others#	430	27.4	57.2	21.2	4.2	0.7	0.9	12.8

Others included – House wife/student/retired/unemployed, The total may not be add-up to 100% due to non-response or no answer

electronically. Obtaining participants' consent is mandatory in any health survey, according to the guidelines of the ethics committee and cannot be overlooked. The ICF provides sufficient details of the study to the participants, and a signed ICF legally indicates that the participants have made an informed, voluntary and rational decision to participate in the study. An assent form was presented to participants aged below 18 years, following parental consent. Assent form was similar to the consent form, but contains details of the study in a simple language, age-appropriate, and an easily understandable format.[11] The electronic capture of signature was convenient and evades manual collection and storage of the forms. However, the rejection rate was the highest when the participants were asked to enter their signature, for the fear of misusing the signature. This was probably because the concept of electronic signature capture was novel and this led to questions on the authenticity of the webpage link due to data security and phishing issues from neighboring countries. A rapport needs to be created by way of strengthening the participant information page indicating the availability of in-built security features, the prohibition of unauthorized access, and data confidentiality in the system. Displaying the survey link on the official website of the organizing institute or authentic public domains will improve the authenticity of the survey.

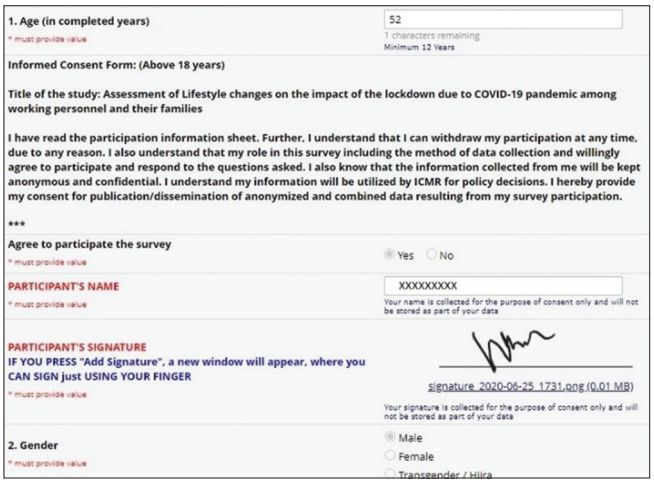

Figure 2: A snap shot of the electronic consent form with participant's signature

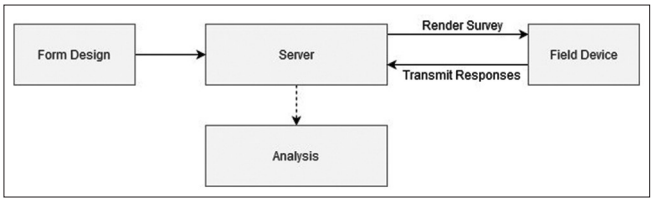

Figure 3: Information on travel between the field and back-end server

On the developer side, the overall process was completed with minimal efforts, which was highly cost-effective with minimum time. No human resources for data collection or travel costs were incurred and no training was required to conduct the survey. As the records were transmitted and stored real-time, the data validation and retrieval were easier. Skip pattern logics were incorporated wherever necessary, for instance, work-related questions were skipped for participants below 18 years. Since no unique identifiers such as the participants' mobile number or e-mail were collected so as to maintain the participant's anonymity, the data cleaning and removal of duplicate entries were not automated and hence done manually.

The response to the exit question was an indicator to compare the online survey tool with that of the conventional paper-based system concerning the privacy, comfort-level, ease of use,

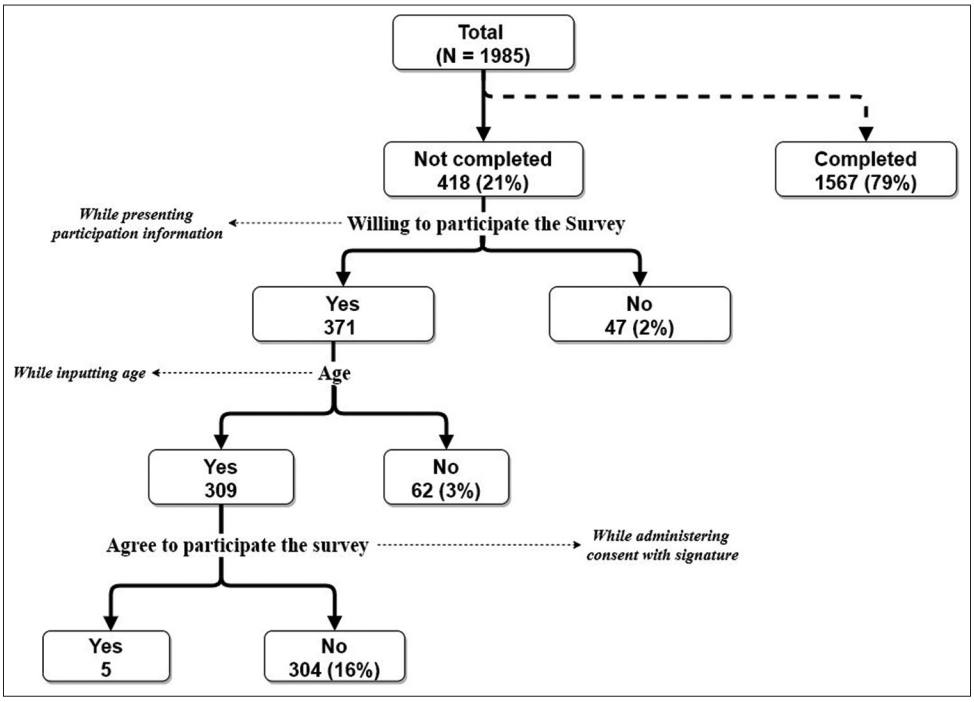

Figure 4: Schematic representation of participants "exit" pattern from the study

Table 2: Profile of participants according to the lifestyle related variables collected during the lockdown period

Variables	*n*	*%*
Age group		
<25	293	18.7
25–39	726	46.3
40–54	389	24.8
≥55	159	10.1
Gender		
Male	744	47.4
Female	823	52.5
Working status		
Business/self-employed	82	5.3
Others	430	28.0
Work at Office	639	41.7
Work from Home	383	25.0
Morning wake-up time (during lockdown compared to pre-lockdown)		
1 h later	343	22.0
2 h later	244	15.7
3 h and above	98	6.3
Early (before routine time)	156	10.0
No changes	718	46.1
Breakfast time		
1 h later	360	23.0
2 h later	212	13.6
3 h and above	77	4.9
Early (before routine time)	84	5.4
No changes	718	45.9
Skipped	112	7.2
Lunch time		
1 h later	357	22.9
2 h later	239	15.3
3 h and above	78	5.0
Early (before routine time)	77	4.9
No changes	756	48.5
Skipped	51	3.3
Dinner time		
1 h later	270	17.3
2 h later	139	8.9
3 h and above	44	2.8
Early (before routine time)	120	7.7
No changes	954	61.2
Skipped	32	2.1
Bed time (night)		
1 h later	296	19.0
2 h later	283	18.2
3 h and above	237	15.2
Early (before routine time)	102	6.5
No changes	641	41.1
Food intake		
Decreased	313	20.1
Increased	542	34.9
No changes	699	45.0
Outdoor food		
Decreased	459	29.5
Do not take outdoor foods	427	27.4
Increased	47	3.0
No changes	144	9.2
Temporarily Stopped	480	30.8
Vegetable intake		
Decreased	144	9.3
Increased	776	49.9
No changes	634	40.8
Seafood/meat intake		
Decreased	477	30.7
Increased	190	12.2
No changes	358	23.1
Not Applicable (for vegetarians)	304	19.6
Stopped time being	143	9.2
Unavailable	81	5.2
Dairy/milk products		
Decreased	211	13.6
Increased	443	28.5
Never consumed dairy products	76	4.9
No changes	826	53.1
Snacks/junk food		
Decreased	609	39.1
Increased	320	20.6
No changes	336	21.6
No habit of Snacking	291	18.7
Fruit intake		
Decreased	286	18.4
Increased	673	43.3
No changes	596	38.3
Weight changes		
No changes	757	48.6
Weight gained	526	33.8
Weight loss	274	17.6
Mobile/tablets usage		
5 h and above	235	15.1
Don't have Mobile/Tablets	6	0.4
No changes	414	26.7
Within 0–2 h	439	28.3
Within 2–4 h	319	20.6
Within 4–5 h	139	9.0
Watching TV		
5 h and above	42	2.7
Don't have TV	181	11.7
No changes	666	42.9
Within 0–2 h	463	29.8
Within 2–4 h	159	10.2
Within 4–5 h	42	2.7
Walking/jogging/running in a week		
3–7 h	173	11.1
Did not do any Activity	710	45.6
More than 7 h	79	5.1
Within 3 h	595	38.2
Other physical activity (workout/dancing/skipping/ domestic activities)		
3–7 h	200	12.9
Did not do any Activity	578	37.4
More than 7 h	85	5.5
Within 3 h	682	44.1
Exposed to sunlight in a week		
3 to 7 h	167	10.8
Did not get exposed to sunlight	421	27.1
More than 7 h	90	5.8
Within 3 h	873	56.3
Went out to buy essentials		
Daily	163	10.5
Didn't Step out	257	16.5
Once in a month	175	11.3
Once in a week	581	37.4
Twice a week	379	24.4
Health care visit		
Could not visit due to restricted movement	95	6.1
Did not visit	1161	74.9
More than Thrice	32	2.1
Once	179	11.5
Thrice	22	1.4
Twice	61	3.9
Tele-consultation		
Did not consult	1266	82.3
More than Thrice	21	1.4
Once	179	11.6
Thrice	20	1.3
Twice	53	3.4

(Contd...)

and consenting procedure. More than 80% of the participants suggested that the online survey method was better than the paper-based system, indicating greater acceptability of the online survey system.

Salient Features of our EDC

The online survey mimics a typical health research survey, covering all necessary key ethical components such as populating participant information page, consent form, assent form (as applicable), and e-signature (hand-drawn); a first-of-its-kind in India. All collected documents were stored electronically and securely, such that it can be retrieved by authorized personnel when needed, thus saving the cost of obtaining and maintenance of hard copies of all forms. The survey can be modified for various health research settings, with multi-lingual accessibility. The survey can be designed to be accessed by any electronic gadgets. Moreover, the format designed can be tailor-made for any health research surveys and will evoke responses from many researchers/scientists in future to develop and undertake similar cost-effective health research surveys.

Limitations

Apart from the advantages, the method does come with its challenges and limitations. Based on the participant profile, the majority of them were graduates and working professionals aged between 25 and 60 years. Designed to be accessed on smart devices, only those with the ability to operate smart devices were able to attend the survey without any assistance. The survey was presented only in English and hence limited to those who were familiar with the language. The illiterate proportion or those not well versed in the language other than their native language might not have undertaken the survey. These challenges can be overcome by exploring and incorporating advanced features in the online surveys, which can be revised as need-based. For a multilingual country like India, the survey needs to be presented in different languages for improving the participation rate. Furthermore, color coded and audio/video-assisted methods might be considered for including the special populations such as the illiterates, elderly citizens.[12] Given the nature of the survey, its accessibility was thus limited to the English-literates and technology-friendly participants. Hence, generalization or extrapolating the interpretation of findings to the general community must be made with caution. A higher non-response rate has to be considered while calculating the sample size for online surveys.

Conclusion

Weighing on its advantages and limitations, the real-time EDC method using mobile technologies appears to be far better than the conventional paper-based method, with minimal efforts at a negligible cost. Advances in technology, affordability and familiarity of usage of smart devices and wireless networks will soon "communize" the online health surveys, which, in turn, will facilitate higher participation rate. Exploring and improvising the mobile technologies further, for large-scale, multicenter health surveys will have a greater impact in Health research due to its automated, cost-cutting and time-saving technologies.

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