

AI based satisfaction survey of patients in fever clinics during the outbreak of COVID-19

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Research Article

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Abstract

Background: We assessed patient by automated survey method in understanding and satisfaction with the use of fever clinic, and observed the effectiveness of this method.

Methods: Total 873 patients in fever clinic at Jiangsu Province Hospital (JSPH) from 20 January 2019 to 18 June 2020 were investigated by an automated survey method combined by Wechat, Short Message Service (SMS) and AI voice call. Responses were assessed for overall positivity or negativity and further compared according to patients types (isolated patients and non-isolated patients). Responses were also described and compared for each type of survey.

Results: A total of 379 patient surveys were returned, for a total response rate of 43.4%. Isolated and non-isolated patients responses were similar and all with more than 90% satisfaction. Most isolated patient represent that the medical staff had explained to them the reason for the isolation and know that can helps prevent COVID-19. AI voice calls had the highest percentage of all response types, followed by WeChat and SMS.

Conclusion: The patient has a positive response to the use of fever clinic. The automated survey method combine by different survey types can bring great convenience to the investigation while ensuring good investigation efficiency.

Introduction

The spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which caused Coronavirus disease 2019 (COVID-19) has already caused huge economic losses worldwide and seriously affected the development of the world^[1]. There were 31174627 confirmed COVID-19 cases of which more than 962613 deaths in 235 Countries, areas or territories over the world as of 25 August 2020 ^[2]. COVID-19 is mainly transmitted through the respiratory droplets and contact routes and with highly infectious, which also poses a huge challenge to the control of the disease^[3,4]. Fever clinic is a efficient prevention mechanism initiated after severe acute respiratory syndrome (SARS) outbreak in China in 2003^[5]. Based on the experiences of SARS, the principal strategy in relation to the control and prevention of the spread of COVID-19 is to build effective fever clinics for triaging patients^[6]. The use of fever clinics has made a huge success in the control of COVID-19. On September 23, China had just 405 confirmed cases, including 18 new cases^[7].

Jiangsu Province Hospital (JSPH) located in one of the most prosperous and populous areas of Nanjing capital of Jiangsu province, has provided medical services to many patients from in and out of Jiangsu Province (Figure 1). In order to the control, prevention, and possibly eradication COVID-19, the hospital decided to build a fever clinic quickly. On January 21, 2020, the hospital began to upgrade the fever clinic facilities, and completed the capital construction within 2 days, and continued to improve. Fever clinics is located in relatively separate areas and suspected patients need to be isolated until they are identified as

non-COVID-19 patients. For the smooth operation of the fever clinic, JSPH has improved the procedures of registration, payment, examination, laboratory, and other aspects of the fever clinic. However, the patients' understanding of the fever clinic and the acceptance of the relevant procedures of the fever clinic are not clear. Currently, there are conflicting data on potential negative effects of these additional isolation precautions on patients with some studies showing deleterious effects^[8-11], whereas other studies show no adverse effects^[8-11]. Fever clinics like any other health care intervention, requires systematic evaluation of possible untoward effects.

With the continuous development and upgrading of information technology, the internet and mobile internet have entered every family and displayed incomparable advantages. The informatization construction plan of the hospital also follows closely. The functions of the hospital application program (APP) and WeChat platform are constantly improved to provide patients with whole-process intelligent services and greatly improve service efficiency^[13,14]. Medical institutions at home and abroad are strengthening the information construction, telemedicine has ushered in the 2.0 era^[15]. During the epidemic period, Internet information technology has been widely used^[16]. In medical surveys, electronic questionnaires have played an increasingly important role in clinical use and scientific research. The validity and reliability of specific health-related questionnaires that were administered online have also been demonstrated in previous studies^[17,18]. At present, network questionnaire, WeChat, and other electronic questionnaires have been widely used in surveys^[17,18]. However, due to the different characteristics of various survey methods, the telephone is still an irreplaceable survey method.^[23] Recently, AI technology has been widely applied and researched in all aspects of medicine^[24,25]. We see artificial intelligence voice calling as a new alternative to manual dialing. A combination of electronic questionnaire and AI voice call may be an automated solution that completely replaces traditional survey methods.

The main objective of this study is to perform a survey which was conduct automated by combine electronic questionnaire with AI voice telephone of a large number of patients in the fever clinic. Determine patients understanding and satisfaction with the fever clinic and observe the effectiveness of this new survey method.

Methods

On January 20, 2019, JSPH set up fever clinic which including isolation wards for the prevention and control of COVID-19. The fever clinic and isolated wards are located in a separate building. All staff in the building were also quarantined until the end of their work. All persons entering the hospital will pass through the fever triage point, be asked about their epidemiological history and have their body temperature checked. People who have a fever (higher than 37.3°C) or suspicious epidemiological history would be guided to the fever clinic. The standard of epidemiological history was updated continually according to the latest "Treatment protocols for COVID-19" issued by the National Health Commission^[26]. Patients in fever clinic were screened by physicians. Patients excluded from COVID-19 after the screen of

physicians were referred to the general clinic, which is defined as non-isolation patients in this study. Patients who were suspected of COVID-19 would be sent to an isolation ward for quarantine precautions which are defined as isolation patients in our study. After a nucleic acid test of SARS-CoV-2 and expert consultation, negative patients would be removed from isolation, and positive patients will be transported to the designated hospital for treatment. Patients in isolation wards are placed in private rooms. The explanation of the rationale for isolation is generally explained by either nurses or physicians in isolation wards.

The whole process of the survey was completed automatically through the Intelligence Cloud Follow-up Platform (ICFP) which was built by JSPH based on artificial intelligence and cloud technology for automated investigation and follow-up. This platform is connected to the hospital database, sharing the basic information and medical data of patients (examination, examination, surgery, doctor's order, etc.), and has the functions of automatic patient screening, automatic scheduling, form editing, multi-channel survey (Short Message Service (SMS), WeChat, Artificial voice call and AI voice call) and data management. In this study, all patients of fever clinic from 20 January 2019 to 18 June 2020 were automatically recognized, enrolled, and surveyed by ICFP. Patients were first surveyed by sending questionnaires through the official WeChat platform of JSPH. Patients who did not join the WeChat platform or the WeChat survey received no response will be surveyed one day after by sending short messages. In the end, if there is no reply one day after sending short message questionnaire, the ICFP will make a voice call through the AI robot. As a result, basic information such as sex, and age was not included throughout the investigation and was acquired through ICFP.

The survey, administered separately to non-isolated patients, isolated patients (include COVID-19 patients) with two more questions (showed in Table 1). We assessed the respondent's level of satisfaction of all patients in the fever clinic with a series of statements relating to medical staff, medical service, procedure, and the understanding of the isolation policy of isolated patients, using a 5-point Likert scale (1 = disagree strongly, 5 = agree strongly). Statements in the survey were selected to specifically assess participant satisfaction with the medical staff and service in the fever clinic and isolation wards.

Baseline characteristics of the groups were collected and described by using means and proportions, as well as SDs. A Kruskal-Wallis 1-way analysis of variance test was conducted to compare age, each question scores, and total scores based on patient groups (non-isolated patients, isolated patients (Non-COVID-19 and COVID-19 patients)). Different survey methods, overall positivity (agree or strongly agree), overall negativity (disagree or strongly disagree), and genders in different patient groups were compared by Pearson's χ^2 test.

Results

A total of 873 patients who visit the fever clinic were recruited, of which 654 were non-isolated patients and 219 were isolated patients, with total 12 patients of isolation patients were COVID-19 patients (Table

2). A total of 379 patient surveys were returned, for a total response rate of 43.4%. Most survey respondents were non-isolated patients (n=298) and the other survey respondents were isolated patients, of which 5 were COVID-19 patients. There were 4 patients who responded to the questionnaire with missing questions, of which 2 were from non-isolated patients and 2 were from isolation patients.

Baseline distributions between the 3 groups were similar in terms of age, gender, and survey methods (Table 2). In each patient groups, AI voice calls accounted for the highest response proportion (more than 50%), followed by WeChat and SMS messages (Figure 2).

The responses to the questionnaire are summarized in Table 1. In general, most of the patients are satisfied with the service of the hospital. The average score of all the questions in the questionnaire was over 4.6. We found no difference in scores and the proportion of agree or strongly agree between patients group (data not shown). In the non-isolated patients group, more than 95% patients are satisfied (Agree or strongly agree) with the nurses, imaging, and laboratory departments (97.0%, 95.9%, 97.7%). However, the satisfaction of doctor, medical procedure, and overall service were lower than 95% (94.6%, 93.6%, and 93.0%). In the isolated patients group, more than 95% patients satisfied (Agree or strongly agree) with the doctor, nurses, imaging, and laboratory departments (96.3%, 98.8%, 96.2%, 97.5%). Relatively, the medical procedure and overall service had a little lower satisfaction (91.4% and 90.1%). More than 96% patients agree or strongly agree that observation in the fever clinic is helpful to prevent COVID-19 infection. 93.8% of the patients thought that the hospital staff had explained the reason for the observation.

Discussion

As far as we know fever clinic was first organized at Jos University Teaching Hospital, Nigeria, to which patients with febrile illness for a history, physical examination, and an immediate blood smear examination for malaria parasites in 1985^[27]. During the SARS epidemic in 2003, fever clinics were widely used in China as an effective means intervention to the epidemic^[6,28]. During the outbreak of COVID-19, establish fever clinics for triaging patients was considered to be an effective tool for prevention and control^[29], which widely use in large tertiary hospitals in China^[30]. It was reported that the workload of the fever clinics increased significantly after the COVID-19 outbreak. The use of fever clinics likely prevented the spread of COVID-19 within the hospital as well as reduced the burden on the emergency departments^[30].

Isolation precautions was thought like any health care intervention, require systematic evaluation of possible untoward effects^[31]. The associated effects such as mental well-being, patient satisfaction, patient safety, or time spent by healthcare workers in direct patient care of isolation measures have been documented in the literature ^[8,9,11,31-35]. Some research reported that providers spent less time as well as the number of contact with isolated compared with the non-isolated patients whatever it was in the ward or ICU^[31-33]. Among a cohort study, statistical differences in inpatient care did not be found between the responses of patients in isolation and patients not in isolation^[34]. The satisfaction of isolation patients

was also adversely affected by whether patients were kept uninformed of their healthcare^[35,36]. Stelfox H.T. et al reported that patients in isolation had more errors in their care processes and an increased likelihood of adverse events than patients in isolation^[37]. For all we know, however, there was no research attention to the satisfaction and understanding for the fever clinic.

As we know, our study was the first to explore the satisfaction and cognitive for the fever clinic. In our study, both isolated and non-isolated patients reported high satisfaction (> 90%) with hospital services and there was no significant difference in terms of 7 patient satisfaction questions between isolated and non-isolated patients. Satisfaction in our study was much higher than in other isolation-related studies. This indicates that the use of fever clinics and even isolation wards have been fully recognized by patients. We believe that higher patient satisfaction may be caused by two aspects. On the one hand, for the outcome of COVID-19 nucleic acid tests could be available in a short time, it is not necessary for patients to stay in the isolation ward for a long time. On the other hand, The hospital provides many convenient services for patients. We have set up eye-catching signs along the way to facilitate patients to find fever clinics are set up in separate buildings. In order to ensure the unimpeded flow of medical treatment and good medical services, the fever clinic provides self-service registration and payment services as well as corresponding guidance personnel. In addition, the fever clinic is equipped with complete medical equipment and a newly developed dedicated CT room.

Although the satisfaction of both isolated and non-isolated patients with the hospital's medical treatment process and overall service is over 90%, it is still a little low compared with other aspects. This indicates that even though we provide convenient services, the fever clinic set up independently still brings some inconvenience to patients.

The majority of isolated patients (93.8%) felt that the medical staff had given an adequate explanation of the reason for their quarantine. By contrast, one study of exposure isolation found that more than 60% of patients reported having been fully explained to them^[38]. Additionally, 96.2% of isolated patients are aware that quarantine observation is beneficial for the prevention and control of the COVID-19. In the context of COVID-19 outbreak, the government and all sectors of society have greatly increased the publicity of the knowledge related to COVID-19 prevention and control, which has to some extent improved patient compliance and patients' understanding of hospital prevention and control measures^[39,40]. This may be the main reason for high rate of understanding.

In this study, we innovatively used the way that combination of the AI telephone call, WeChat, and SMS for surveys, and no one participated in the whole survey process. Now self-administered survey questionnaires are an important data collection tool in clinical practice and epidemiology. To maximize the scalability and speed of data collection and reduce the cost, many surveys are now sent electronically^[14,41,42]. App, email, and WeChat are common electronic survey methods at present. WeChat is widely used in daily life in China, with 1.15 billion monthly active accounts which promoted a variety of new clinical applications^[43]. Sun et al reported that the WeChat-based questionnaire has been widely accepted and has good data quality and reliability^[14]. On the other hand, telephone surveys are critical for

examining cross-sectional characteristics of population subgroups, tracking trends in the prevalence of conditions and risk behaviors over time, identifying risk factors associated with multiple health conditions, and assessing the effects of interventions^[44]. Considering the response rate, effectiveness, result bias, and so on, different investigation methods have advantages and disadvantages. Hollier et al suggest combining several investigation methods to offset the pros and cons of different survey methods^[45]. To the best of our knowledge, this is the first study use AI voice call to conduct a satisfaction survey, which without using human entirely throughout the survey process. Considering the economy, we first send the WeChat questionnaire, then send the SMS questionnaire, and finally, we call the AI voice phone which that each survey was conducted 24 hours apart. Under this model, each survey method had patients response indicates that each survey method has a corresponding applicable population, and the combination of multiple survey methods can achieve the effect of improving the response rate balance deviation. Also, our study found that the response rates of the three survey ways were AI phone calls and WeChat and text messages from high to low for both isolated and non-isolated patients. We think that AI voice calls have the highest response rate of all the survey approaches because, for patients, there is no difference in the display of calls made by AI and calls made by human beings on the smartphone. However, we found that when calculated separately, the response rate for AI phones was lower than the telephone survey in other studies^[38,46,47]. This is partly because the WeChat and SMS survey excluded some patients with high compliance. On the other hand, artificial intelligence phones use a landline number, which is more difficult to be accepted by patients than a mobile number. Our study also confirms that WeChat is more accepted than SMS which consistent with the research by Sun et al^[14]. Compared with the response rate of WeChat reported in other researchs, the response rate in our study was lower^[14,48]. Our questionnaire was sent through the official platform after patients followed the public account of the hospital. Many patients did not follow the account, so they could not receive the questionnaire, which may be the main reason for the low response rate. In this study, we not only used artificial intelligence phones but also innovatively combined various investigation methods. In contrast, the total response rates of our study were close to other studies which about 50%^[38,46,47]. This indicates that the automated survey can completely replace the manual survey.

Our study has several limitations. In the analysis of influencing factors of satisfaction and response rate, we did not take into account the influence of basic conditions such as age and gender. The effect of the base case on satisfaction and response rate is ignored. In addition, the three survey methods in this study were sent in sequence, so the number of replies to SMS and AI voice call follow-up was actually underestimated.

Our survey found an overall favorable impression for the fever clinic patients whatever isolate or non-isolate. Which indicated that fever clinic as an effective means of epidemic prevention and control did not affect the quality of patients. However, a meta analysis reported that the rates of anxiety in the general population could be more than 3 times higher during the COVID-19 pandemic than normally^[49]. Thus, the hospital should focus on patients satisfaction and give the patients a positive impact on the mental health. Improve the overall service quality of the hospital, optimize the medical treatment process, and

improve the awareness of interpretation of medical staff. During the COVID-19 outbreak, medical resources were heavily occupied^[50]. Greater efficiency could better help the response to the COVID-19 pandemic. It has been observed that the automated method can bring great convenience to the investigation while ensuring good investigation efficiency. Furthermore, we also should strengthen the application of automation in an investigation or survey to improve work efficiency.

Declarations

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

All methods were carried out in accordance with ethical guidelines and regulations in Nanjing medical University (Jiangsu province hospital). Ethical clearance for the study was obtained from the Ethics Committee of Nanjing medical University (Jiangsu province hospital) (2020-QT-12). We have applied and been granted an exemption from informed consent by the Ethics Committee of Nanjing medical University (Jiangsu province hospital) (IRB-GL1-AF08).

Competing interests

The authors declare that they have no competing interests.

Author's contributions

YL, HZ and WG conceptualised this study. WM drafted the manuscript. WM, WW and YQZ were responsible for the data analysis. YL, HZ and WG critically revised the manuscript and approved the final version. All authors reviewed the manuscript.

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Tables

Table 1. Survey statements and results of analysis of responses

Questionnaire type/questions	Mean±SD	Agree or strongly agree (n,%)	Disagree or strongly disagree (n,%)	Missing value
Fever clinic (n=298)				
Were you satisfied with the doctor you contacted during your visit to the fever clinic?	4.83±0.59	282, 94.6	6, 2.0	0
Were you satisfied with the nurses you had contact with during the fever clinic?	4.89±0.44	289, 97.0	3, 1.0	0
Are you satisfied with the procedure during your visit to the fever clinic?	4.77±0.69	279, 93.6	11, 3.7	0
Are you satisfied with the overall service of the hospital during your visit to the fever clinic?	4.77±0.69	277, 93.0	10, 3.4	0
During your visit to the fever clinic, are you satisfied with the service attitude of the staff in the imaging department (B ultrasound, CT, radiography, etc.)?	4.86±0.49	284, 95.9	3, 1.0	2
During your visit to the fever clinic, are you satisfied with the service attitude of the laboratory staff?	4.90±0.42	291, 97.7	3, 1.0	0
Isolation observation wards (n=81)				
Were you satisfied with the doctor you contacted during your visit to the fever clinic?	4.85±0.62	78, 96.3	2, 2.5	0
Were you satisfied with the nurses you had contact with during the fever clinic?	4.91±0.39	80, 98.8	1, 1.2	0
Are you satisfied with the procedure during your visit to the fever clinic?	4.73±0.81	74, 91.4	4, 4.9	0
Are you satisfied with the overall service of the hospital during your visit to the fever clinic?	4.69±0.90	73, 90.1	5, 6.2	0
During your visit to the fever clinic, are you satisfied with the service attitude of the staff in the imaging department (B ultrasound, CT, radiography, etc.)?	4.82±0.57	76, 96.2	2, 2.5	2
During your visit to the fever clinic, are you satisfied with the service attitude of the laboratory staff?	4.89±0.45	78, 97.5	1, 1.2	1
During your visit to the fever clinic, did the hospital staff give an adequate explanation of the reason for your isolation?	4.63±0.96	75, 93.8	5, 6.2	1
During your visit to the fever clinic, do you know that isolation is helpful for preventing COVID-19 infection?	4.83±0.78	77, 96.2	3, 3.8	1

Table 2. Basic information of the investigation

	Non-isolated Patients (n=298)	Isolated patients (Non COVID - 19 patients) (n=76)	Isolated patients (COVID - 19 patients) (n=5)	p value
Age (median, IQR)	33, 24-50	34, 26-50	46, 37.5-53.5	0.148
Gender (n, %)				0.85
Male	151, 50.67	40, 52.63	2, 40.00	
Female	147, 49.33	36, 47.37	3, 60.00	
Survey methods (n, %)				0.60
AI voice calls	173, 58.05	44, 57.89	3, 60.00	
WeChat official platform	75, 25.17	20, 26.32	0, 0.00	
Short Message (SM)	50, 16.78	12, 15.79	2, 40.00	
Missing (n, %)	2, 0.67	2, 2.63	0, 0.00	-

Figures

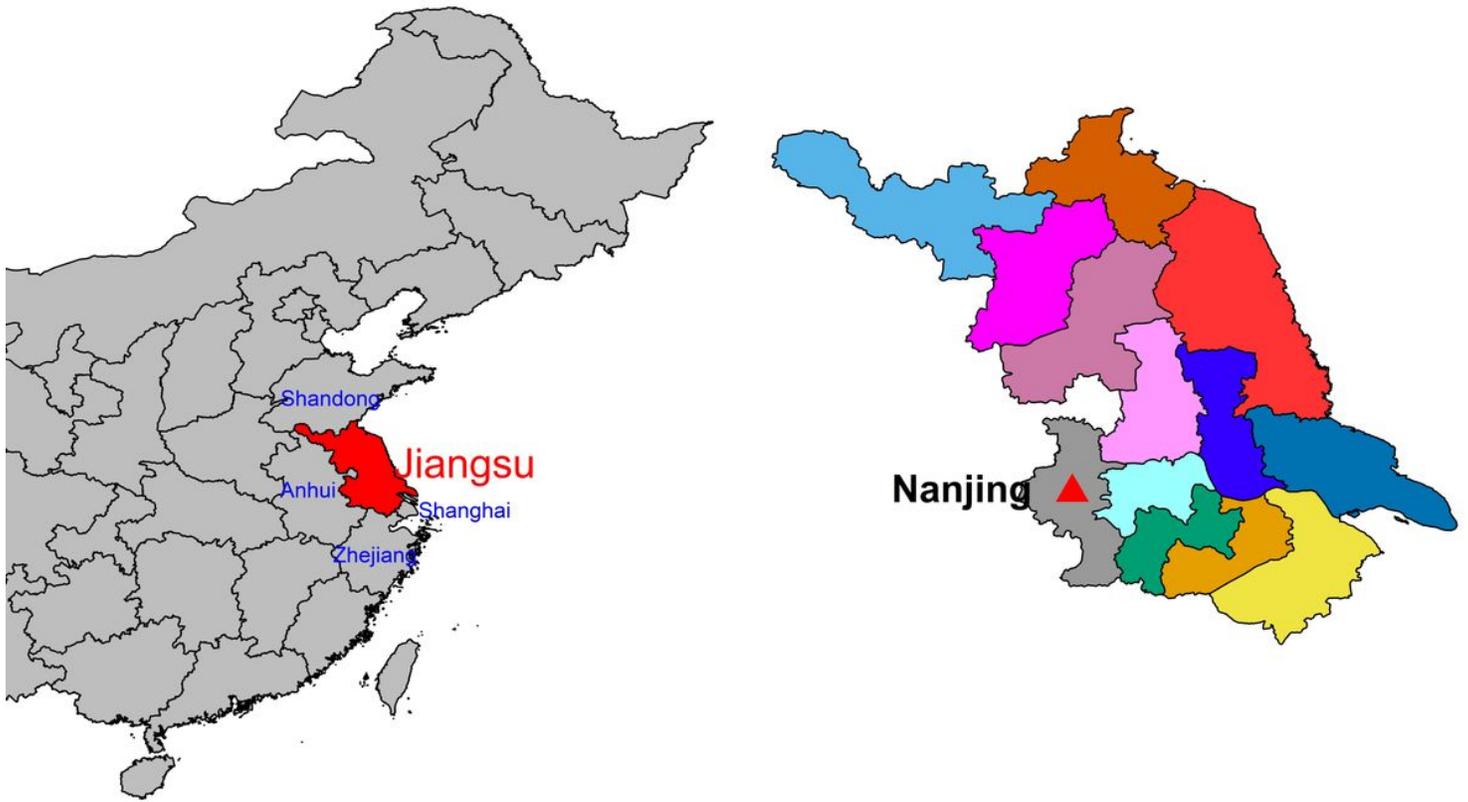


Figure 1

The geographical location of Nanjing Jiangsu in eastern coastal China. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

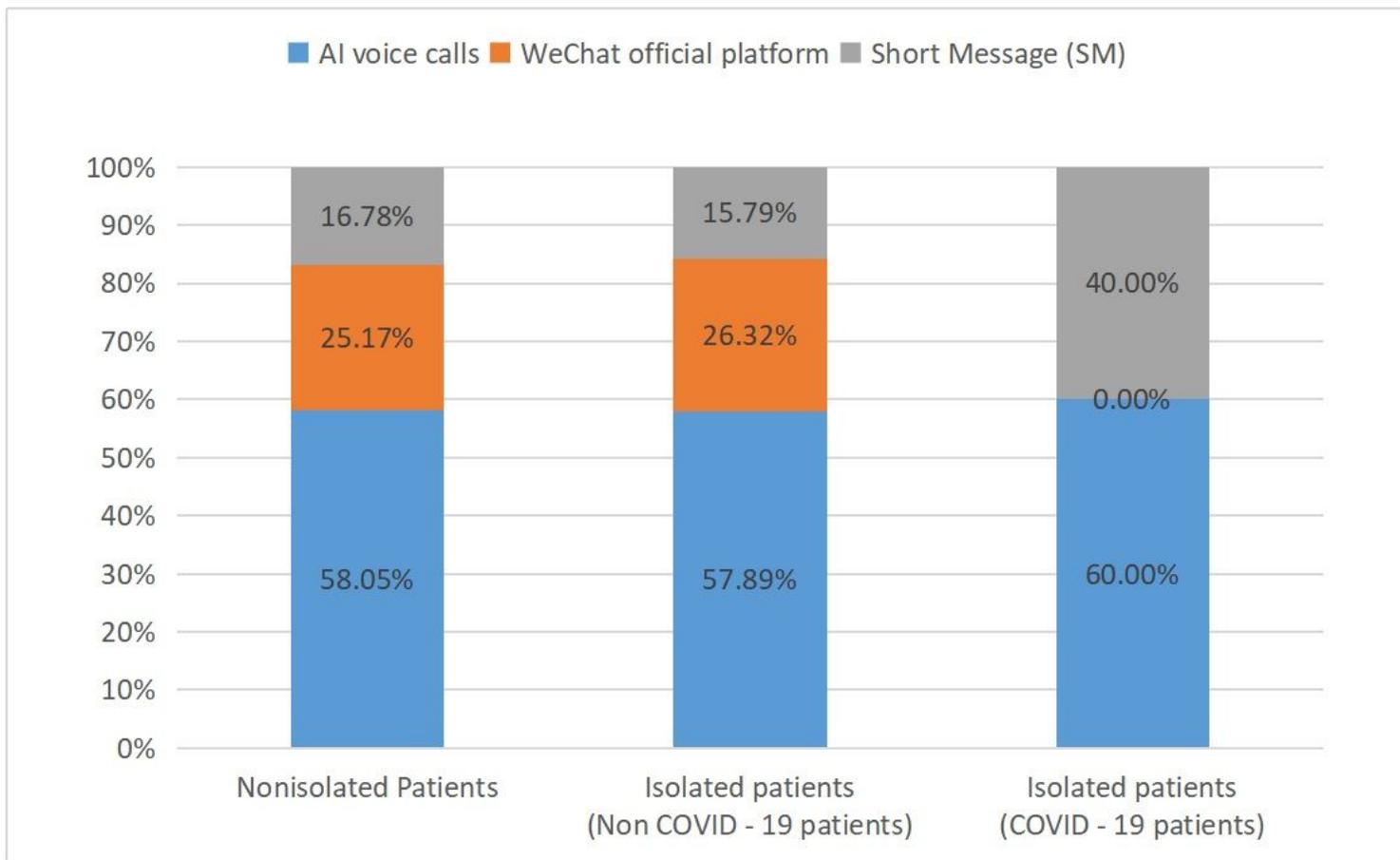


Figure 2

The distribution of survey methods for different patient types