

# Using the '4Ps' social marketing strategy to overcome vaccination hesitancy

## COVID-19 vaccine coverage in a Chinese college as an example

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### ABSTRACT

**الأهداف:** لاستكشاف دور استراتيجية التسويق الاجتماعي '4Ps' في تردد أخذ اللقاح وتأثيره على التغطية العامة للقاح. تعد استراتيجية '4Ps' (المكان، السعر، المنتج، والترويج) أداة للتسويق الاجتماعي تناولت العديد من القضايا العامة واللقاحات.

**المنهجية:** أجريت هذه الدراسة بأثر رجعي قبل الدراسة واللاحقة. اشتملت الدراسة على مجموعه 10795 شخصًا. تم استخدام طريقة التحصين الروتينية ضد COVID-19 لجرعات التطعيم الأولى خلال الفترة من 23 مارس إلى 11 أبريل 2021. ثم قمنا بتنفيذ استراتيجية التسويق الاجتماعي '4Ps' للتحصين من 12 أبريل إلى 1 مايو 2021. تردد اللقاح والتغطية تم جمع معدل الجرعة الأولى من لقاح COVID-19 في السكان المستهدفين ومقارنتهم قبل وبعد استراتيجية التسويق الاجتماعي '4Ps'.

**النتائج:** بلغت نسبة التغطية 6.19% فقط خلال التحصين الروتيني. ومع ذلك، انخفض تردد أخذ اللقاح لدى السكان المستهدفين (52% مقابل [مقابل] 3.1%، قبل استراتيجية '4Ps' مقابل بعد تنفيذ الاستراتيجية) وزادت درجة التغطية (94.8% مقابل طريقة التطعيم الروتينية،  $p < 0.001$ ) بشكل ملحوظ بعد اتخاذ استراتيجية التسويق الاجتماعي '4Ps'. علاوة على ذلك، عززت استراتيجية التسويق الاجتماعي '4Ps' أيضًا إكمال الجرعة الثانية من لقاحات COVID-19.

**الخلاصة:** قللت استراتيجية التسويق الاجتماعي '4Ps' بشكل كبير من تردد أخذ اللقاح وعززت تغطية التطعيم ووفرت طريقة ترويجية أكثر فعالية وموثوقة في مواجهة الطفرات الفيروسية الحالية والتلقيح الجديد في المستقبل.

**Objectives:** To explore the role of the '4Ps' social marketing strategy on vaccine hesitancy and its impact on public vaccine coverage. The '4Ps' strategy (place, price, product and promotion) is a social marketing tool that had addressed many public issues and vaccinations.

**Methods:** This study was a retrospective before-after study. A total of 10795 people were enrolled. The

routine COVID-19 immunization method was used for the first vaccination doses from 23 March to 11 April, 2021. Then we carried out a '4Ps' social marketing strategy for vaccination from 12 April to 1 May 2021. The vaccine hesitancy and the coverage rate of the first dosage of COVID-19 vaccine in the target population were collected and compared before and after the '4Ps' social marketing strategy.

**Results:** The coverage reached only 6.19% during routine immunization. However, vaccine hesitancy of the target population decreased (52% versus [vs.] 3.1%, before vs. after '4Ps' strategy) and degree of coverage (94.8%, vs. routine vaccination method,  $p < 0.001$ ) significantly increased after taking '4Ps' social marketing strategy. Furthermore, the '4Ps' social marketing strategy also consolidated the completion of the second dosage of COVID-19 vaccines.

**Conclusion:** The '4Ps' social marketing strategy greatly reduced vaccine hesitancy and enhanced vaccination coverage and provided a more effective and reliable promotion method in the face of current virus mutations and new vaccination in the future.

**Keywords:** vaccine hesitancy, vaccination coverage, '4Ps' social marketing, health promotion

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Coronavirus disease 2019 (COVID-19) is rapidly spreading worldwide, and prompt vaccination with a safe and efficient COVID-19 vaccine will be critical in curbing the global pandemic.<sup>1</sup> Despite the fact that China made good efforts to control the outbreak, the possibility of local transmission caused by imported cases remained, which resulted in economic losses and social unrest. When the R0 number for COVID-19 was set to 3.0, it was anticipated that at least 67% of the population needed to be vaccinated.<sup>2</sup> As a result, achieving high immunization coverage is critical for the containment of COVID-19. However, vaccine hesitancy and vaccination willingness had a greatly negative impact on public vaccine coverage. According to a survey of Turkish and British nationals, 31% and 14% of participants were unsure or unwilling to receive the COVID-19 vaccine, respectively, with a total of 3% refusing immunization.<sup>3</sup> Another survey showed that 57.6%, 31.6%, and 10.8% of American adults reported readiness to, uncertainty, and reluctance to be vaccinated,<sup>4</sup> Wang et al<sup>5</sup> found that 35.5% of the interviewees were vaccine-hesitant, and 48.8% were suspicious of vaccination. Unfortunately, vaccine hesitancy undoubtedly hinder vaccination behaviour and interfere with the development of individual and herd immunity, raising the risk of another COVID-19 outbreak. Therefore, it is especially important to develop an effective public promotion method to reduce vaccine hesitancy and increase immunization coverage.

The '4Ps' strategy (place, price, product, and promotion) is a well-known social marketing instrument that has been widely used in the public realm. In the past 20 years, many countries have utilized '4Ps' strategy social marketing to address a variety of social problems, including AIDS prevention, birth planning, vaccination, and environmental protection, with varying degrees of success.<sup>6,7</sup> Based on its successful history and ease of implementation, the '4Ps' social marketing strategy might be a viable option for reducing vaccination apprehension and increasing vaccine coverage among the general public.<sup>8</sup>

On 23 March 2021, the authorities in Zhuhai, China, launched the first COVID-19 vaccine programme for the 18 to 59-year-old age group (hereafter referred to as the 'target population'). The Department of Health Management Center at The Fifth

Affiliated Hospital of Sun Yat-sen University, one of the designated institutions for COVID-19 vaccination, was responsible for vaccination in a college. A survey questionnaire was developed based on the "3Cs" model to determine vaccine willingness.<sup>9</sup> Given that it includes three categories for analysis—confidence, complacency, and convenience—and is intuitive and simple to understand and apply, the "3Cs" model is regarded as one of the most useful models.<sup>10</sup> Routine COVID-19 immunization procedures were used for the first dose of the target population from March 23 to April 11, however the results showed low coverage in the 20-day period. Then, from April 12 to May 1, we began to apply the '4Ps' social marketing strategy to the vaccination efforts and acquired positive outcomes, which also facilitated Zhuhai city to become the first city in China by reaching an 80% vaccine coverage rate. Prior to this, few publications had specifically discussed the use of the '4Ps' social marketing approach and implementation for COVID-19 immunization.

Therefore, the aim of the study is to assess vaccine hesitancy and apply the '4Ps' social marketing strategy, in order to further explore the effect of '4Ps' in decreasing vaccine hesitancy, then provide a scientific basis to promote vaccination.

**Methods.** This was a retrospective before-after study. A total of 10795 people were enrolled aged between 18 and 59 (1251 teaching staff and 9544 students) on a university campus (not included in the medical faculty) in Zhuhai, China, who were about to receive their first dose of the COVID-19 vaccine. The inclusion criteria were suitable for vaccination and being able to understand Chinese. Exclusion criteria were the medical students because they might interfere with the measurement of vaccine hesitancy due to their expertise. Those who were allergic to any of the vaccine's ingredients or had a previous severe allergic reaction to the vaccine also were excluded. The vaccine was the COVID-19 inactivate vaccine (Sinovac Life Sciences, Beijing, China) composed of 2 doses and uniformly distributed by the Centers for Disease Control (CDC) of Zhuhai. Ethical approval was obtained from the ethics committee of The Fifth Affiliated Hospital of Sun Yat-sen University (No. 2021-K87-1).

**Measurement of vaccine hesitancy.** Vaccine willingness was tested by the following question: 'Please choose your willingness to vaccinate according to your actual situation.' The options were 'willing to vaccinate', 'unsure whether to vaccinate' and 'refuse to vaccinate'. Six further 'yes or no' questions based on the '3Cs' (confidence, complacency, convenience) were developed

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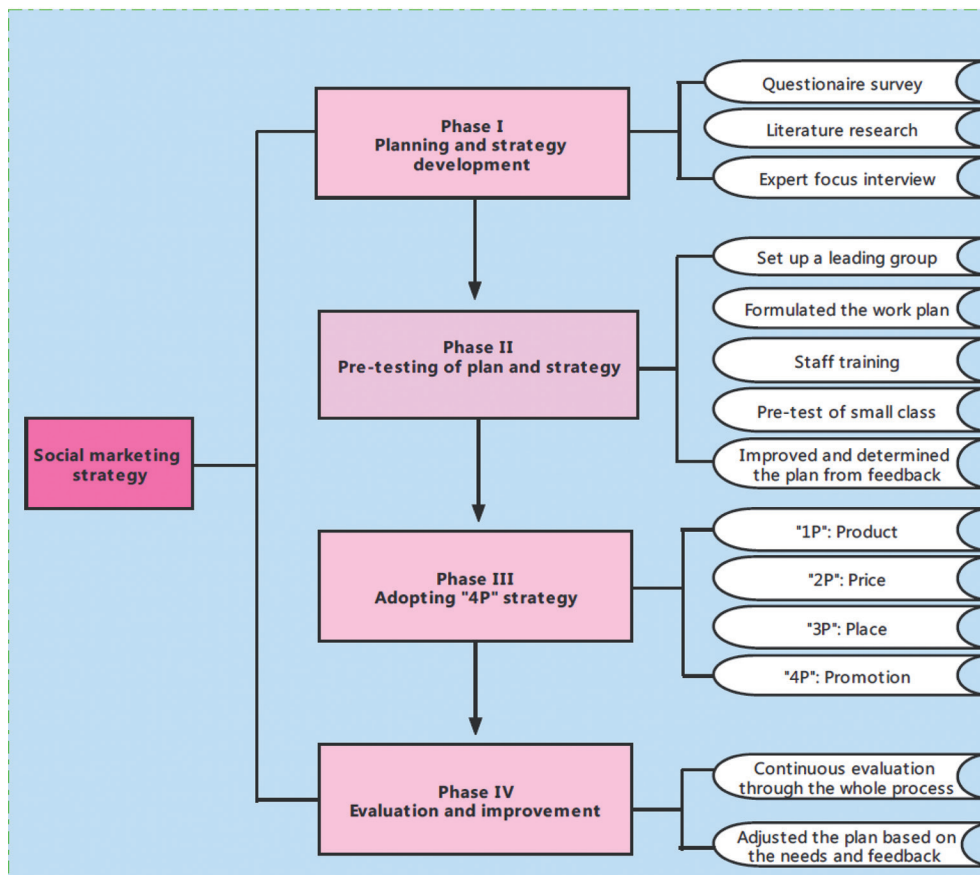
to further assess vaccination hesitancy. The perceived safety and efficacy of the vaccination were used to gauge vaccine confidence, the perceived importance and necessity of the vaccine were used to gauge complacency, and perceived price and convenience were used to gauge convenience. Questionnaires were collected before and after the '4Ps' social marketing strategy.

**Routine COVID-19 vaccination methods.** Routine COVID-19 vaccination methods, including routine health education and opening the temporary vaccination clinic in the campus medical office, were applied to the target population from 23 March to 11 April 11, 2021.<sup>11</sup> The vaccination coverage rate, willingness to vaccinate and reasons for unwillingness or uncertainty regarding vaccination were observed during the 20-day period.

**Implementation process of the '4Ps' social marketing strategy (Figure 1).** The '4Ps' social marketing strategy was implemented for the target population from 12

April to 1 May, 2021, and the effectiveness of the implementation within these 20 days was observed.

**Phase I: Planning and strategy development.** First, a questionnaire survey based on the '3Cs', a literature search and expert focus interviews were used to determine the target population's willingness to get vaccinated and the elements that influenced COVID-19 vaccination. The vaccination campaign dubbed 'Let's Get Vaccinated Together' was organized by using the '4Ps' social marketing method. The preliminary plan was designed as follows: the campaign was divided into 2 main parts: health promotion and the arrangement of convenient vaccination. The role of health promotion was to increase awareness of the COVID-19 vaccine through a variety of online and offline methods, so that individuals could fully comprehend the importance of COVID-19 prevention and control, as well as the vaccine's safety and effectiveness, thus establishing confidence in the vaccine. The convenient vaccination



**Figure 1 -** The flow of '4Ps' social marketing strategy applied in the COVID-19 vaccination. '4Ps' social marketing strategy was divided into four phases. Each phase had its own tasks and projects, and continuous evaluation and improvement were conducted at any time throughout the whole process.

settings involved the flexible scheduling of vaccinations based on the schedules of staff and students, as well as the provision of several batches of convenient measures. The campaign was plan was between 12 April and 1 May 2021.

**Health promotion.** The health promotion campaign focused on the necessity, safety, effectiveness and other aspects of the COVID-19 vaccine, using the 12 questions presented in **Table 1** and was carried out both online and offline simultaneously. The campaign was disseminated using online multimedia methods, such as electronic posters, micro-classes, micro-videos or micro-animations and WeChat tweets. On the other hand, health guides, exhibition boards, slogans and pamphlets were used for on-site distribution (**Appendix 1**). Positive language was used for the health promotion programme (all communication was in Chinese).

**Phase II: Pre-testing the plan and strategy.** A leadership group was formed and specific steps were developed to guide the COVID-19 vaccination campaign. Furthermore, a professional team comprising medical personnel, information technicians and logistical personnel was created, and qualified staff received rapid COVID-19 vaccination training. A class of 50 students was chosen for pre-testing. We prepared the screening area, the registration area, the vaccination area, the observation area and the emergency response area for abnormal vaccine reactions strictly in accordance with the vaccination requirements. After the pre-test, we confirmed the implementation steps.

**Table 1 -** Total of 12 questions about vaccination for health promotion offline and online.

Items	Question
Q 1	Is was necessary to vaccinate against COVID-19?
Q 2	How safe was the COVID-19 vaccine?
Q 3	How long was the protection period and effectiveness of the COVID-19 vaccine?
Q 4	What vaccine was being vaccinated this time?
Q 5	Why should I stay for 30 minutes after receiving the COVID-19 vaccine?
Q 6	What impact would the mutation of COVID-19 had on the effect of vaccination?
Q 7	Were the following special circumstances (including pregnancy, female menstrual period, gout attack period, diabetes, hypertension, coronary heart disease, coronary atherosclerosis) suitable for COVID-19 vaccination?
Q 8	Could I get COVID-19 vaccine if I had received other vaccines?
Q 9	What was the COVID-19 vaccination process?
Q 10	How to make an appointment and vaccinate against COVID-19 conveniently?
Q 11	Was there a charge for this vaccination?
Q 12	How to form herd immunity among the population through vaccination?

**Phase III: Adopting the '4Ps' social marketing model for vaccination.** The '4Ps' social marketing model was established and confirmed, then applied to COVID-19 immunization through pre-design evaluation and pre-test feedback (**Table 2**). COVID-19 vaccine information was promoted though a variety of mediums, including vibrant and engaging popular science videos, pamphlets, posters, micro-classes, prize-winning question and answer sessions and other formats. To conduct the health promotion, we made extensive use of mass communication, interpersonal communication (including by medical personnel and campus volunteers) and other channels. New media network marketing, health service announcements and newsletters were all used as product sales channels. Furthermore, when the first dose was administered, we informed the target population regarding the time of the second dose and encouraged them to get the second vaccination timeously. Additionally, official public WeChat accounts and press releases were used to provide timely vaccination status notifications.

**Phase IV: Effectiveness evaluation and improvement.** The fourth phase was the evaluation and improvement phase.<sup>12</sup> As of 23:59 on 1 May 2021, the number of people who had completed vaccination in this school was counted. The formula was as follows:  $a = (b/c) \times 100\%$ , where a= the coverage rate of vaccine, b= the actual number of people vaccinated in a certain period, the number of people who should have been vaccinated during the same period. The number of COVID-19 vaccinations of the target population from 23 March to

**Table 2 -** The "4Ps" of social marketing in the "Let's Get Vaccinated Together" campaign".

"4P" strategy	Definition and methods
"1P"	"Product": Getting COVID-19 vaccine could reduce the risk of disease for yourself and your family.
"2P"	"Price": The Government provided free vaccines and vaccination agency provided home facilitation of vaccination without regard to financial and time costs.
"3P"	"Place": Convenient vaccination sites were set up in the gymnasium on campus. And the convenient appointment was flexible and multi-option for the target population.
"4P"	"Promotion": Titled " Let's Get Vaccinated Together " to increase awareness, and the campaign name was shown by designing as a banner, display board, logo and other eye-catching images. The content of health communication and its spreading method should take the characteristics and needs of the targeted population into account. Multi-media health communication was carried out and official public WeChat account and government press releases were used to enhance the credibility of the campaign.

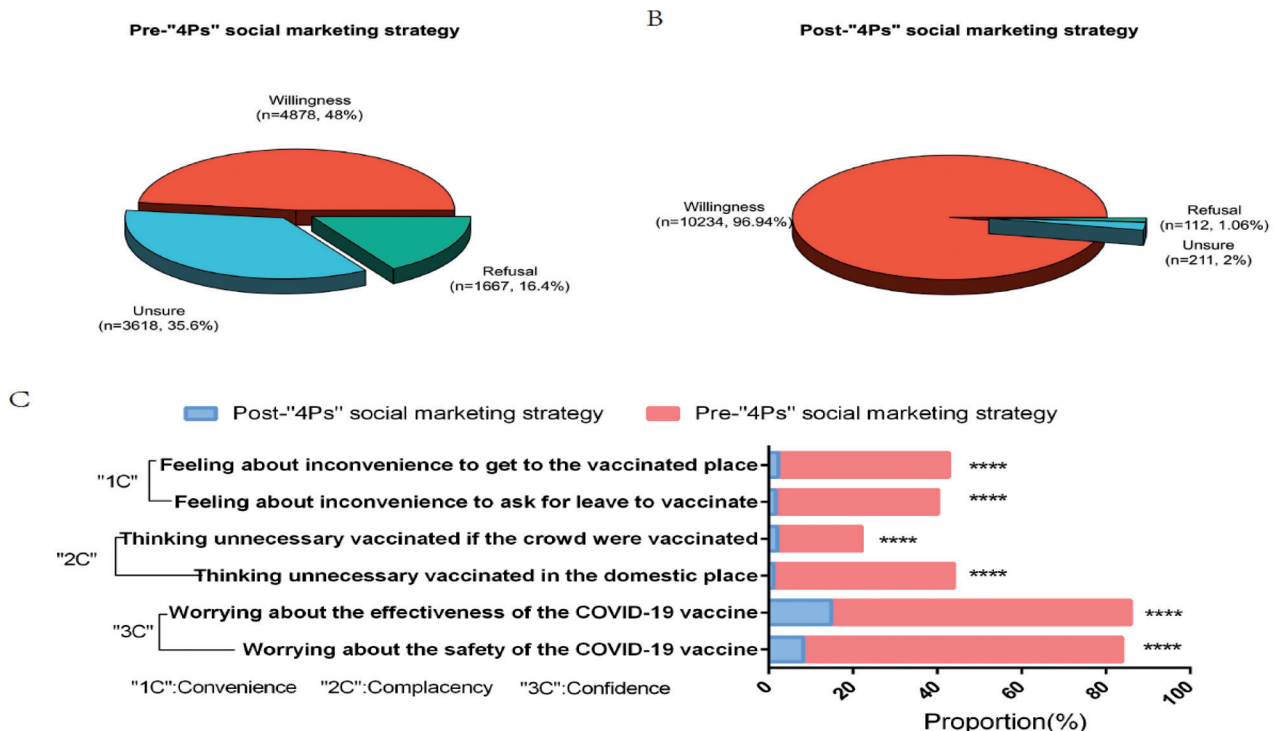


11 April, 2021 was taken as pre-intervention data, and the number of COVID-19 vaccinations of the target population from 12 April to 1 May, 2021 was taken as post-intervention data. The coverage of the first dosage of COVID-19 vaccines and the incidence of suspected severe abnormal vaccination reactions were compared before and after the intervention of the 4Ps social marketing strategy.

**Statistical analysis.** All statistical analyses were performed using IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y., USA). The primary outcome was vaccination hesitancy and the secondary outcome was vaccination coverage rate. The vaccine hesitancy and the coverage rate of the first dosage of COVID-19 vaccine in the target population before and after the '4Ps' social marketing strategy were compared using the Chi-square test. Statistical significance was set at  $p < 0.05$ .

**Results.** *The '4Ps' social marketing strategy decreased the vaccine hesitancy of the target population.* Prior to implementing the '4Ps' social marketing

strategy, a total of valid electronic questionnaires to investigate the vaccination willingness and hesitancy were collected from 10631 (98.5%) individuals. As shown in **Figure 2A**, 4878 (48%) said they were willing to be vaccinated, while 3618 (35.6%) said they were unsure and 1667 (16.4%) said they would refuse vaccination. After the '4Ps' social marketing campaign, 10557 questionnaires were collected again and found that 10234 people (96.9%) said they were willing to be vaccinated, 211 (1.9%) said they were unsure and 112 (1.2%) refused vaccination (**Figure 2B**). Moreover, as shown in **Figure 2C**, the survey based on the '3Cs' (confidence, complacency and convenience) found that a majority of the target population were concerned about the safety (n=8047; 75.7%) and effectiveness of the vaccine (n=7559; 71.1%), followed by those who thought that it was unnecessary to be vaccinated in the domestic place (n=4550; 42.8%) and those who were concerned about the convenience of getting to the vaccination site (n=4104; 40.4%) before intervention. However, the proportions of the 6 items of the '3Cs' were all significantly decreased compared with the pre-

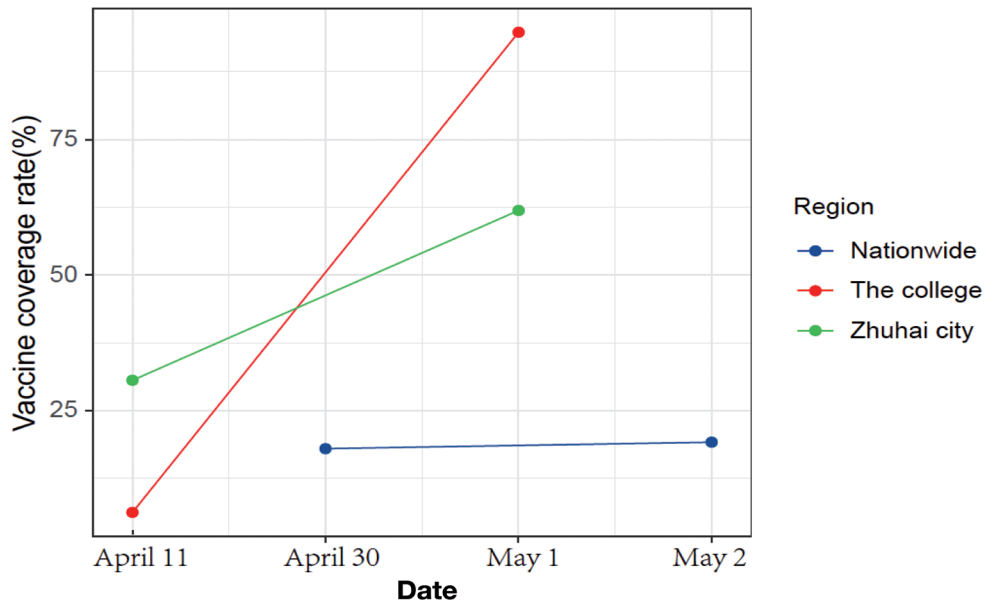


**Figure 2** - Implementation of '4Ps' social marketing strategies rapidly reduced the vaccination hesitancy of COVID-19 vaccines in target populations. **A)** The Pie showed the vaccination hesitancy among the target population before "4Ps" social marketing strategy. **B)** The Pie showed the vaccination hesitancy among the target population after implementing '4Ps' social marketing strategy. **C)** Regarding the changes in the proportions of the six items relating to confidence, complacency and convenience based on "3Cs" model before and after '4Ps' social marketing strategy. \*\*\*\*\*,  $p < 0.0001$ .

**Table 3 -** The coverage rate of the first dosage of COVID-19 vaccine before and after the application of social marketing strategy.

	Pre-intervention	Post-intervention	P value
Total number (persons)	10795	10795	NA
Number of people unable to be vaccinated for medical reasons (persons)	561	561	NA
Number of vaccinations with indications (persons)	10234	10126	NA
Vaccination cycle (days)	20	20	NA
Completion of first vaccination Number of people (persons)	669	9565	0.001
Suspected severe abnormal vaccination reactions (cases)	0	0	NA
First shot of vaccine coverage (%)	6.19%	94.8%	0.001

NA: not significance



**Figure 3 -** Comparison of national and local vaccination coverage before and after the implementation of '4Ps' social marketing. The vaccination coverage rate of the intervention group through '4Ps' social marketing strategies was higher than that of Zhuhai city and nationwide.

intervention ( $p < 0.001$ ). More details are presented in Figure 2C.

*Implementation of the '4Ps' social marketing strategies rapidly increased the coverage of the first dose of COVID-19 vaccines in the target population.*

As shown in Table 3, 669 people completed the first dose of COVID-19 vaccine during the conventional vaccination period, and the coverage rate was 6.19%. However, between 12 April and 1 May 2021, 9565 people completed the first dose of COVID-19 vaccine following the '4Ps' social marketing strategy, and the coverage rate in the target population was 94.8% ( $p < 0.001$ ). None of the patients had suspected severe abnormal vaccination reactions before or after the implementation of the social marketing intervention. We then acquired COVID-19 vaccination coverage

data from the National Health Commission of the People's Republic of China and the Zhuhai Municipal Health Bureau for comparison of vaccine coverage of different districts (Figure 3).<sup>13,14</sup> As of 30 April, the number of vaccinations nationwide was 25.463 million, and the vaccine coverage rate was 18%; by 2 May, the number of vaccinations had reached 27.040 million, and the vaccine coverage rate was 19.2%. In Zhuhai, as of 11th of April, the number of vaccinations was 745874, with a vaccine coverage of 30.6%; by 1 May, the number of vaccinations was 151.0355 million, and the vaccine coverage rate was 61.9%. In our study, the vaccine coverage rate of the college was 6.2% as of 11th of April, and increased to 94.8% as of 1st of May after the '4Ps' social marketing strategy was implemented.

*The '4Ps' social marketing strategy consolidated the completion of the second dose of COVID-19 vaccines.*

After the first dose of vaccine, the target population was told that it was better to receive the second dose within the next 28 days, longer efficacy might be anticipated because the 0 to 28 day immunization schedule had been shown to produce a more powerful antibody response.<sup>15</sup> As shown in **Appendix 2**, we found that 90.8% (n=10234) of the population received the second dose within eight weeks, among of 19.2% (n=1965) were vaccinated on the 28th day, and 71.6% (n=7328) were vaccinated between 28 and 56 days after the first dose.

**Discussion.** Vaccine hesitancy unquestionably poses risks to both the individual and the community because exposure to an infectious disease, and those who do not get vaccinated are considerably more likely to transfer the disease to others.<sup>16</sup> We found that 52% of the target population experienced vaccination hesitancy to vaccinate before '4Ps' social marketing strategy, which was higher than the percentage reported in a nationwide COVID-19 vaccine hesitancy survey.<sup>17</sup> The rate of vaccination hesitancy was similar in America in mid-October 2020, due to people who thought the COVID-19 vaccine was risky and were less likely to get it.<sup>18</sup> So far, we have not seen the implementation of '4Ps' social marketing in the new crown vaccine for the time being. In contrast to the usual vaccine hesitation method studies, study with small sample had limitations in supervising our big sample.<sup>19</sup> Furthermore, most current vaccine hesitation strategies focused solely on education, ignoring financial support or the combination of information technology and outreach.<sup>20</sup>

In 1971, '4Ps' social marketing emerged as a way to address social problems, including health and the environment.<sup>21</sup> The success of '4Ps' social marketing in disease prevention and nutrition intervention has been a topic of study.<sup>22-25</sup> In our study, we found that using the '4Ps' social marketing strategy greatly reduced vaccine reluctance with regard to the first dose of COVID-19 vaccine among the target group, resulting in a higher coverage rate. Furthermore, '4Ps' social marketing methods increased willingness and compliance with the second dose, implying that '4Ps' social marketing is a viable alternative for promoting COVID-19 vaccination and helping to achieve herd immunity and epidemic control. The following were our experiences and precautions during implementation:

**Project planning.** It was critical to conduct preliminary surveys to determine the existing state of

vaccination needs for COVID-19 at an early stage. After determining the overall goals, the 'audience-led' concept was incorporated throughout the process, and the health promotion communication programme was developed based on the results of surveys, a literature search, and expert focus interviews. The concerns on the safety and effectiveness of the vaccine from a large proportion of participants were the important content of health dissemination. Social marketing can be successfully used in the context of health promotion to get the intended result: Target population's commitment to health.<sup>26</sup> Therefore, it is important to determine the communication techniques and content of health promotion communication in social marketing strategies depending on the requirements of the intended audience and the attributes of easy access.

**Pre-test of project.** Pre-testing of health information dissemination and vaccination processes prior to project implementation also helped to identify potential difficulties and timely changes to the project could be made to ensure the effectiveness and accuracy of health information dissemination.

**Project implementation.** Social media played a vital role during the project implementation. For adults, general social networking services are less essential than these sources, but for the more than 70% of adolescents and young adults who use them online, they are significant information sources.<sup>27</sup> Taking advantage of social media was essential for health promotion and vaccine status broadcasting based on the characteristics of the target population. Social media, more than any other kind of communication, has the power to impact and change public attitudes toward vaccination in both positive and negative ways.<sup>28-30</sup> Therefore, the effective use of social media plays a critical role in strengthening public trust in vaccines and, as an outcome, benefiting public health. Electronic posters, micro-classes, micro-videos or micro-animations, and WeChat tweets were used in our study to modify the target population's views and behavior through online promotions. Furthermore, on-site displays of health manuals, exhibition boards, slogans and booklets consolidated the outcomes of the behavior modification. The rapid development of technology has facilitated online communication, and the widespread use of software apps such as TikTok or WeChat has also brought new channels for health education. Furthermore, convenience measures such as flexible vaccination appointment times and handy locations on campus increased voluntary behavior changes within the target group, all of which boost vaccination willingness and behavior.

**Evaluation and improvement.** Continuous evaluation and improvement were performed

throughout the process. The pre-testing phase evaluated the health communication approach, content and on-site implementation before the campaign was implemented. Furthermore, the '4Ps' social marketing strategy emphasized process evaluation during the implementation of the health promotion, and the '4Ps' social marketing strategy's end phase was also in effect an evaluation. Simultaneously, the focus of the entire assessment was always on the target population, leading to considerable alteration of each phase of the campaign by considering the demands and feedback of the target population, based on the 'audience-led' concept. Knowledge accumulation and vaccination experience from the first dose directly affected the vaccination scenario of the second dose. The continuous improvements to the social marketing strategy also contributed to the readiness to obtain the second dosage and general vaccination compliance being raised. A total of 90.8% of the target population completed the second vaccine within 8 weeks, indicating that an efficient immune group had been established. However, we found that the proportion of the second dose of vaccination only reached 20% in 28 days among the target population, indicating a knowledge gap in our health promotion content. Future health communications must address this by disseminating information about peak times for antibody formation.

In order to achieve the desired effect, the implementation of the '4Ps' social marketing strategy required the following. i) A sufficient vaccine supply prior to the activity needed to be secured. ii) The official press had to be used to release public information, such as timely announcements of vaccine specifications, indications, contraindications and reservation information of vaccination institutions, in order to improve public trust. iii) It was necessary to obtain the support of the relevant administrative leaders, including the leaders of the vaccination agency and the unit where the target population was located before applying this strategy; iv) The target population in this study was between the ages of 18 and 59, that is, they were active Internet users; therefore, the full use of multimedia to carry out health communication was extremely beneficial in increasing the campaign's effectiveness. v) Health information from the government's public WeChat account, expert guides and official press releases were authoritative and credible, and effective use of such health information helped achieve twice the result with half the effort.

**Study limitations.** The respondents were mainly those with higher education levels on one campus,

which might interfere with the estimation of vaccination hesitancy. Studies have shown that higher education levels are associated with lower vaccination hesitancy.<sup>31</sup> However, we found that nearly half of the target population experienced vaccination hesitancy, which was similar to the finding of a nationwide study, indicating that it still had reference value in our study.<sup>17</sup> Furthermore, it could not be ruled out that some people did not use social media and failed to receive health promotion communication, but it did not affect the result of high vaccination coverage in our study.

In conclusion, the '4Ps' social marketing strategy not only adopted appropriate measures based on the characteristics and needs of the vaccine recipients, but it also contributed to the most effective use of human, material and financial resources by facilitating the optimal allocation of health promotion resources.

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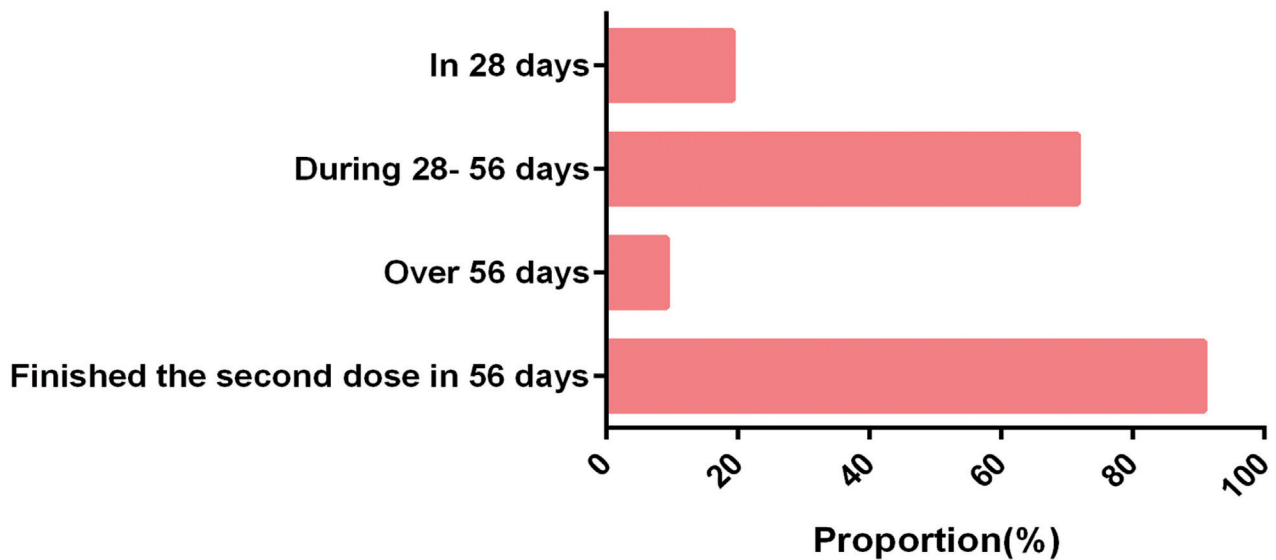
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**Appendix 1** - Display of part of '4Ps' social marketing mix. (A) The Chinese theme card that "Let's Get Vaccinated Together" was placed at the entrance of the vaccination site to attract the attention of the target population and raise awareness. (B) Promotional pictures of the live webcast about COVID-19 vaccination. The target population were able to scan the QR code to engage in the live broadcast at a certain time. (C) An animation micro-class of COVID-19 vaccination was posted on the official WeChat or website, and the target population could watch it at any time for free. (D-E) Part of the poster exhibition of 8 questions about health promotion communication. (F) The QR code of online vaccination appointment for the target population, they could scan the code directly to choose the injection location and time period based on their schedule.



**Appendix 2** - '4Ps' Social marketing strategy consolidated the completion of the second dosage of COVID-19 vaccines. The histogram showed the different proportions of the second dose administration in 28 days, during 56 days and over 56 days.