

RESEARCH PAPER



A study on willingness and influencing factors to receive COVID-19 vaccination among Qingdao residents

Feng Yang^{a*}, Xiaofan Li^{a*}, Xiaoting Su^{b*}, Tingting Xiao^a, Yang Wang^a, Ping Hu^a, Han Li^a, Jing Guan^a, Haizhen Tian^c, Peng Wang^d, and Wencheng Wang^{ID a}

^aQingdao Municipal Center for Disease Control and Prevention, Qingdao Institute of Preventive Medicine; ^bQingdao Women and Children's Hospital; ^cDisease Control Center of Shibei District; ^dQingdao Chengyang District Disease Control Center

ABSTRACT

This study investigated the willingness of Qingdao residents to receive COVID-19 vaccination in 2020 and any factors that might influence them. All data were collected by telephone questionnaires and were utilized for analyzing the potential factors of willingness to be vaccinated through descriptive analysis and logistic regression analysis. Of the 2,802 respondents, 2,284 (81.5%) said they would agree to receive the vaccine against COVID-19. People who earned high incomes, who carefully followed media news on COVID-19 vaccine, who looked forward to successful vaccine research, and who closely followed vaccine protective efficacy expressed more interest in being vaccinated than other people did. In addition, people who paid attention to protective efficacy of vaccine, vaccine price, and expert opinion were more likely to accept COVID-19 vaccination than people who focused on vaccine safety. When vaccine price was ≥ 201 RMB, people were less likely to accept vaccination than ≤ 200 RMB. 1,842 respondents (65.7%) wished that government could provide COVID-19 vaccination for free. This study suggests that the government should increase vaccination compliance by strengthening publicity efforts and decreasing vaccine price.

ARTICLE HISTORY

Received 27 April 2020
Revised 6 August 2020
Accepted 25 August 2020

KEYWORDS

COVID-19 vaccine;
willingness; influencing
factors; free vaccination

Introduction

In late December 2019, a series of unexplained pneumonia cases were reported in Wuhan, Hubei Province, China.¹ Previous studies have suggested that this type of disease is caused by an unknown beta-coronavirus, which is a type of coronavirus with a genome highly identical to that of the bat coronavirus; patients affected by the disease exhibited clinical symptoms including fever, cough, and fatigue and had radiological findings of viral pneumonia.^{1–4} In January 2020, Chinese scientists successfully obtained the complete genome sequences of this virus and notified the World Health Organization (WHO).⁵ WHO officially named this disease Corona Virus Disease 2019 (COVID-19). COVID-19 has rapidly spread around the world since late February, with more than 200 countries and regions affected by localized outbreaks of severe infection. Almost 20 millions people have been infected and more than half a million have died.⁶

At present, no specific antiviral drug exists for COVID-19, and the protective efficacy of the drugs used in the treatment of patients still require further evaluation clinically.⁷ However, vaccination should be the one of the most effective measures to protect the susceptible population.⁸ Therefore, scientists are actively developing a COVID-19 vaccine to contain the outbreaks as soon as possible.

No study has addressed the willingness of people to receive COVID-19 vaccination until now. In addition, many Chinese people actively choose to not undergo vaccination at their expense. Ma et al.⁹ reported that only 18.16% of participants

received the seasonal influenza vaccine in South China in the last 3 years. According to the vaccination information system, 9.3 million residents underwent approximately 0.8 million doses of vaccines at their expense every year in Qingdao. In 2019, the rate of vaccination for the seasonal influenza vaccine in Qingdao was 1.42%. Thus, this study investigated Qingdao residents' willingness to undergo COVID-19 vaccination and the influencing factors to provide scientific evidence to inform future immunization strategies.

Materials and methods

Study design and sampling method

This cross-sectional survey used a sample size formula, according to which the minimum required sample size was 2642 respondents when the following conditions were met: (1) the allowable error was 2%, (2) the confidence coefficient was 95%, (3) the nonresponse rate was 10%, and (4) the acceptance rate of a COVID-19 vaccine was 50%. No study has investigated the willingness to receive COVID-19 vaccination. Therefore, we assumed that 50% of the residents accepted COVID-19 vaccination for calculating the minimum sample.

In this survey, a multistage stratified sampling method was used. We divided 10 districts into three layers according to different levels of economic development. Two districts were chosen from each layer at random. Five streets were selected from each district, and from each street, 95 residents aged 20–49 years were investigated randomly. This sampling

method is simple and quick; in particular, it can avoid errors caused by the inclusion of different districts.

We contacted potential participants by telephone, and they completed the survey through the telephone to protect all investigators' and respondents' health during the COVID-19 outbreak. The questionnaire included 13 single-choice questions. The Ethics Committee of Qingdao Center for Disease Control and Prevention approved our study. All volunteering respondents were informed of the purpose of the study. A total of 2850 people were investigated from March 15 to March 28, 2020. Forty-eight people refused to participate in this study, and a total of 2802 qualified questionnaires were finally obtained.

Study variables

A selective questionnaire was used to investigate the socio-demographic characteristics of the residents, with 13 questions on COVID-19 vaccination involving attitude and the type of the vaccine most desired to be made available for free. The questionnaire collected three types of data:

- (1) Basic sociodemographic information such as gender, household registration, age, education, average monthly income, and occupation.
- (2) Attitudes toward receiving COVID-19 vaccination, degree of carefully following news on the COVID-19 vaccine, degree of urgency of the need for the vaccine, and acceptable price range. A fixed-choice (yes/no) question "Once the COVID-19 vaccine will be available, are you willing to receive it?" was used to judge the respondents' willingness to receive COVID-19 vaccination.
- (3) The type of vaccine most desired to be made available for free. This part was assessed from two aspects: before and after the COVID-19 vaccine is available in the market.

Quality control

Before we started our investigation, we embarked on a pilot project wherein we randomly chose three districts as our sample to rectify any potential errors. After that, we added the option of "Housework and unemployment" to "Occupation." All investigators were trained in using standardized investigation methods to ensure the quality of the investigation. The entire investigative process was verified by special quality control personnel and included checking missing values and outliers of the questionnaire. Parallel double input of data was performed for ensuring the accuracy of data entry.

Statistical analysis

Descriptive analysis was used to describe the following: respondents' sociodemographic characteristics, willingness to undergo vaccination, attitude toward the COVID-19 vaccine, and factors influencing residents' willingness to receive COVID-19 vaccination. Univariate binary logistic regression was used to analyze all the potential factors related to

willingness for receiving COVID-19 vaccination and to identify statistically significant variables. Then, multivariate binary logistic regression was used to further analyze the statistically significant variables. The adjusted odds ratio (aOR) was used to report the results for establishing a stable model. SPSS18.0 software was used to perform all statistical analyses; statistical significance was set at $P < .05$.

Results

Sociodemographic characteristics of participants and correlation with their willingness to undergo vaccination

Of 2802 respondents, 2280 (81.37%) were women, 1701 (60.71%) were 30–39 years old, and 2204 (78.66%) were local registered residents. Forty-eight people refused to take part in this study (men: 13; women: 35). None of the questionnaires had missing values or outliers after being verified by quality control personnel. Most participants had completed a bachelor's degree (1557 [55.57%]). According to the statistical yearbook issued by Qingdao Municipal Statistical Bureau in 2018, the average monthly wage of an employed person was approximately 5683 RMB (average hourly wage was approximately 32 RMB).¹⁰ The monthly incomes of 1233 (44.00%) and 857 (30.59%) respondents were 2000–4999 RMB and 5000–9999 RMB, respectively. The majority of participants were enterprise business personnel (631 [22.52%]) and individual employees (436 [15.56%]).

In univariate binary logistic analyses, the willingness for undergoing COVID-19 vaccination was the dependent variable, and the characteristics of different populations were independent variables. The variables gender, household registration, age, and occupation had no effect on the willingness to receive vaccination, whereas education and average monthly income affected the willingness, as shown in Table 1. Respondents with a bachelor's degree (unadjusted OR = 1.48, 95% CI: 1.12–1.95) were more likely to accept vaccination than those with an education of up to junior high school or less. Respondents with a high monthly income were more likely to receive vaccination than those with low monthly income (unadjusted OR = 1.33, 95% CI: 1.04–1.71; unadjusted OR = 1.60, 95% CI: 1.22–2.10; unadjusted OR = 1.93, 95% CI: 1.22–3.06).

Attitudes of participants toward COVID-19 vaccination and correlation with their willingness to undergo vaccination

According to the survey, 2284 people (81.51%) were willing to be vaccinated if the COVID-19 vaccine would be available. Moreover, 2692 people (96.07%) carefully followed news on the COVID-19 vaccine, and 2653 people (94.68%) were looking forward to successful vaccine research. The vaccine's safety was the most concerning aspect of the vaccine among respondents, with a total of 967 people (34.51%). The second focus was the protective efficacy of the vaccine, with a total of 687 people (24.52%). Regarding the price range of the COVID-19 vaccine, 2334 people (83.30%) replied that ≤200 RMB was more acceptable than other prices.

Table 1. Sociodemographic characteristics of participants and correlation with their willingness to accept vaccination.

Variable	Total N(%)	Willing to be vaccinated (%) N = 2,284	Unwilling to vaccinate (%) N = 518	Unadjusted OR	95%CI	P
Gender						
Male	522 (18.63)	438 (19.18)	84 (16.22)	1.00		
Female	2,280 (81.37)	1,846 (80.82)	434 (83.78)	0.86	0.63–1.05	0.1186
Household registration						
Local	2,204 (78.66)	1,793 (78.50)	411 (79.34)	1.00		
Field	598 (21.34)	491 (21.50)	107 (20.66)	1.05	0.83–1.33	0.6732
Age						
20~29	909 (32.44)	737 (32.27)	172 (33.20)	1.00		
30~39	1,701 (60.71)	1,389 (60.81)	312 (60.23)	1.04	0.85–1.28	0.7166
40~49	192 (6.85)	158 (6.92)	34 (6.56)	1.09	0.72–1.63	0.6953
Education level						
Junior high school and below	361 (12.88)	278 (12.17)	83 (16.02)	1.00		
High school	710 (25.34)	573 (25.09)	137 (26.45)	1.25	0.92–1.70	0.1575
Bachelor degree	1,557 (55.57)	1,295 (56.70)	262 (50.58)	1.48	1.12–1.95	0.0062
Master's degree or above	174 (6.21)	138 (6.04)	36 (6.95)	1.14	0.74–1.78	0.5488
Average monthly income						
<2,000 RMB	523 (18.67)	400 (17.51%)	123 (23.75)	1.00		
2,000~4,999 RMB	1,233 (44.00)	1,002 (43.87)	231 (44.59)	1.33	1.04–1.71	0.0226
5,000~9,999 RMB	857 (30.59)	719 (31.48)	138 (26.64)	1.60	1.22–2.10	0.0007
≥10,000 RMB	189 (6.75)	163 (7.14)	26 (5.02)	1.93	1.22–3.06	0.0052
Occupation						
Medical staff	234 (8.35)	194 (8.49)	40 (7.72)	1.00		
Civil servant	192 (6.85)	162 (7.09)	30 (5.79)	1.11	0.66–1.897	0.6840
Enterprise business personnel	631 (22.52)	507 (22.20)	124 (23.94)	0.84	0.57–1.25	0.3944
Individual employment	436 (15.56)	360 (15.76)	76 (14.67)	0.98	0.64–1.49	0.9124
Agricultural laborers	109 (3.89)	91 (3.98)	18 (3.47)	1.04	0.57–1.92	0.8938
Housework and unemployment.	405 (14.45)	310 (13.57)	95 (18.34)	0.67	0.45–1.02	0.0586
Other	795 (28.37)	660 (28.90)	135 (26.06)	1.01	0.68–1.49	0.9678

n (%), number (percentage) of participants who were willing or un willing to be vaccinated in each category; the unit of measurement for age is years; unadjusted OR, unadjusted odds ratio; 95% CI, 95% confidence interval; local household registration = people who are born in Qingdao and are living in Qingdao; field household registration = people who are not born in Qingdao but are living in Qingdao

Then, in univariate binary logistic regression analyses, the attitudes of participants toward COVID-19 were considered an independent variable. Table 2 shows that people who carefully followed news on the COVID-19 vaccine (unadjusted OR = 2.76, 95% CI: 1.85–4.11) and looked forward to successful vaccine research (unadjusted OR = 4.91, 95% CI: 3.51–6.88) were more likely to receive COVID-19 vaccination compared with those who did not. In addition, people who focused on the vaccine's protective efficacy (unadjusted OR = 15.19, 95% CI: 0.36–22.26), vaccine price (unadjusted OR = 13.13, 95% CI: 7.93–21.74), expert opinions (unadjusted OR = 10.35, 95% CI: 6.53–16.41), and other concerns (unadjusted OR = 7.19, 95% CI: 5.16–10.02) were more likely to be vaccinated than those who were concerned about vaccine safety. The survey also revealed that

compared with a vaccine cost of ≤200 RMB, respondents were less willing to be vaccinated when the price was 201–399 RMB (unadjusted OR = 0.49, 95% CI: 0.39–0.62) or ≥400 RMB (unadjusted OR = 0.45, 95% CI: 0.30–0.68).

Multivariate binary logistic regression analysis

Statistically significant variables were chosen based on the results of univariate binary logistic regression analyses. They were then analyzed using multivariate binary logistic regression analyses. Table 3 shows that people with monthly incomes of 2000–4999 RMB (aOR = 1.44, 95% CI: 1.08–1.93), 5000–9999 RMB (aOR = 1.83, 95% CI = 1.31–2.55), and ≥10,000 RMB (aOR = 2.82, 95% CI = 1.61–4.95) were more

Table 2. Attitudes of participants toward COVID-19 vaccine and correlation with their willingness to accept vaccination.

Research content	Classification	Total N(%)	Willing to be vaccinated (%) N = 2,284	Unwilling to be vaccinated (%) N = 518	Unadjusted OR	95%CI	P
Whether pay attention to the progress of vaccines	No	110 (3.93)	69 (3.02)	41 (7.92)	1.00		
	Yes	2,692 (96.07)	2,215 (96.98)	477 (92.08)	2.76	1.85–4.11	0.0000
Degree of urgency of need for vaccine	Not urgent	149 (5.32)	75 (3.42)	74 (14.29)	1.00		
	Urgent	2,653 (94.68)	2,209 (96.72)	444 (85.71)	4.91	3.51–6.88	0.0000
The most concerned aspect	Vaccine safety	967 (34.51)	563 (24.65)	404 (77.99)	1.00		
	Protective efficacy of vaccine	687 (24.52)	656 (28.72)	31 (5.98)	15.19	0.36–22.26	0.0000
	Vaccine price	328 (11.71)	311 (13.62)	17 (3.28)	13.13	7.93–21.74	0.0000
	Expert opinion	324 (11.56)	303 (13.27)	21 (4.05)	10.35	6.53–16.41	0.0000
Acceptable vaccine price (RMB).	Other aspects	496 (17.70)	451 (19.75)	45 (8.69)	7.19	5.16–10.02	0.0000
	≤ 200	2,334 (83.30)	1,879 (82.27)	455 (87.84)	1.00		
	201~399.	370 (13.20)	320 (14.01)	50 (9.65)	0.49	0.39–0.62	0.0000
	≥ 400	98 (3.50)	85 (3.72)	13 (2.51)	0.45	0.30–0.68	0.0001

n (%), number (percentage) of participants who were willing or un willing to be vaccinated in each category; unadjusted OR, unadjusted odds ratio; 95% CI, 95% confidence interval

Table 3. Final model of factors associated with participants' willingness to be vaccinated.

Parameter	Adjusted OR	95%CI	P
Education level (junior high school and below)	1.00		
High school	1.18	0.83–1.68	0.3558
Bachelor degree	1.23	0.88–1.72	0.2313
Master's degree or above	0.71	0.40–1.24	0.2262
Average monthly income (2,000 RMB)	1.00		
2,000~4,999 RMB	1.44	1.08–1.93	0.0134
5,000~9,999 RMB	1.83	1.31–2.55	0.0004
≥ 10,000 RMB	2.82	1.61–4.95	0.0003
Whether pay attention to the progress of vaccines (no)	1.00		
Yes	2.33	1.43–3.79	0.0007
Degree of urgency of need for vaccine (not urgent).	1.00		
Urgent.	4.97	3.28–7.53	0.0000
The most concerned aspect (vaccine safety)	1.00		
Protective efficacy of vaccine	15.04	10.18–22.23	0.0000
Vaccine price	13.78	8.19–23.18	0.0000
Expert opinion	10.29	6.42–16.48	0.0000
Other aspects	6.90	4.91–9.71	0.0000
Acceptable vaccine price (≤ 200 RMB)	1.00		
201~399 RMB.	0.49	0.37–0.65	0.0000
≥ 400 RMB.	0.47	0.29–0.77	0.0025

adjusted OR, adjusted odds ratio; 95% CI, 95% confidence interval

willing to be vaccinated against the novel coronavirus than those with a monthly income of <2000 RMB. It also revealed that people who carefully followed news on the COVID-19 vaccine (aOR = 2.33, 95% CI: 1.43–3.79) and who looked forward to successful vaccine research (aOR = 4.97, 95% CI: 3.28–7.53) were more likely to undergo vaccination than those who did not. In addition, people who paid attention to the vaccine's protective efficacy (aOR = 15.04, 95% CI: 10.18–22.23), vaccine price (aOR = 13.78, 95% CI: 8.19–23.18), expert opinion (aOR = 10.29, 95% CI: 6.42–16.48), and other concerns (aOR = 6.90, 95% CI: 4.91–9.71) were more likely to accept COVID-19 vaccination than people who focused on the vaccine's safety. People were less likely to accept vaccination when the vaccine price was 201–399 RMB (aOR = 0.49, 95% CI: 0.37–0.65) or ≥400 RMB (aOR = 0.47, 95% CI: 0.29–0.77) than when the price was ≤200 RMB.

The type of vaccine most desired to be made available for free after the outbreak of COVID-19

Table 4 shows that after the outbreak of COVID-19, the vaccines most desired to be made available for free among 835 (29.80%) and 547 (19.52%) participants were the pneumococcal and influenza vaccines, respectively. After the COVID-19 vaccine will be available in the market, the vaccines most desired to be made available for free among 1842 (65.74%) and 266 (9.49%) participants were the COVID-19 and pneumococcal vaccines, respectively.

Discussion

As an emerging infectious disease, COVID-19 is highly infectious and demonstrates rapid transmission. COVID-19 has greatly impacted people's attitudes and practices. A Chinese study performed during the rapid rise of the outbreak observed

Table 4. The type of vaccine most desired to be made available for free among participants after the outbreak of COVID-19 in Qingdao, in March 2020.

	Before COVID-19 vaccine was put on the market		After COVID-19 vaccine will be put on the market	
	Amount	Constituent ratio (%)	Amount	Constituent ratio (%)
Increasing variety				
Pneumococcal vaccine	835	29.80	266	9.49
Influenza vaccine	547	19.52	169	6.03
Human papillomavirus vaccine	300	10.71	113	4.03
Diphtheria tetanus pertussis poliomyelitis vaccine and Haemophilus influenzae type B vaccine	489	17.45	205	7.32
Enterovirus type EV71 vaccine	324	11.56	91	3.25
Other vaccines	198	7.07	63	2.25
No need to increase	109	3.89	53	1.89
COVID-19 Vaccine			1,842	65.74

amount, number of participants who preferred to choose as free-vaccine; constituent ratio(%), percentage of participants who preferred to choose as free-vaccine

that the vast majority of the participants had not visited any crowded place (96.4%) and wore masks when going out (98.0%) a short time after the COVID-19 outbreak started.¹¹ In this study, 81.51% people were willing to receive COVID-19 vaccination if they had no specific targeted treatment drugs, and if it was beneficial for establishing herd immunity. Steven et al.¹² also indicated that for herd immunity to stop transmission, >82% of the population must be immune through either vaccination or prior infection. Once the vaccine is formally licensed, the government should increase its awareness for improving immunization rates through various publicity efforts.

Vaccine safety has been the most important focus among participants, especially in recent years, because China frequently saw several scandals regarding vaccines that probably led to hesitancy among residents in undergoing vaccination.^{13,14} In 2019, WHO listed vaccine hesitancy as one of the top 10 threats to global health.¹⁵ Our survey also revealed that respondents concerned about vaccine safety showed low willingness to receive vaccination. Vaccine safety will still be the key factor affecting the willingness of the public to undergo vaccination after COVID-19 vaccines are available in the market. High immunization rates will be achieved only when people have sufficient confidence in vaccine safety.

In China, the government provides a few free vaccinations that people compulsorily receive, including hepatitis B vaccine; polio vaccine; diphtheria, pertussis, and tetanus vaccine; measles, mumps, and rubella vaccine; Japanese encephalitis vaccine; meningococcal vaccine; and hepatitis A vaccine. Conversely, self-paid vaccines are those that people receive voluntarily at their expense, including diphtheria, tetanus, pertussis, poliomyelitis, *Haemophilus influenzae* type B conjugate (600 RMB/dose), human papillomavirus (1000 RMB/dose), influenza (100 RMB/dose), pneumococcal (200 RMB/dose), and enterovirus 71 (200 RMB/dose) vaccines. This research showed that people with higher incomes preferred to receive vaccination, and the price that most people accepted was ≤200 RMB, which was similar to the results of other articles.¹⁶⁻¹⁸ Therefore, after a COVID-19 vaccine is licensed, the government should either provide it for free or decrease its price.

These measures can reduce vaccine hesitancy caused by economic reasons, improve vaccination compliance, and establish a high immune barrier in a short period.

Respondents who were concerned about the protective efficacy of vaccine and those who paid attention to the vaccine price and expert opinion had the highest willingness to receive vaccination. This suggested that the majority of respondents looked forward to receiving COVID-19 vaccination as soon as possible; vaccine developers still tried to ensure that the vaccine has a high protective efficacy. Otherwise, it will considerably affect people's willingness to receive vaccination. Expert opinions also significantly influenced the public's choice of vaccination. Therefore, opinions given to the public must have sufficient scientific basis.

One of the critical clinical manifestations of COVID-19 was the varying degrees of consolidation of the lungs, most of which comprised bilateral ground-glass opacities of the subpleural lungs.¹⁹ It had aroused public concern about vaccines related to preventable lung diseases. This survey found that after the COVID-19 outbreak started, the two vaccines most desired to be made available for free were the pneumococcal and influenza vaccines. If COVID-19 vaccines were available in the market in the future, people most preferred the COVID-19 and pneumococcal vaccines to be made available for free. However, relevant studies have shown that before the outbreak of COVID-19, the public preferred to receive vaccinations for varicella, hepatitis B, *H. influenzae* type B, and meningococcus.^{20,21} Therefore, the outbreak of COVID-19 has been observed to change the public's willingness to receive vaccination.

Strengths and limitations

No study has thus far investigated the willingness of people to undergo COVID-19 vaccination. Therefore, this study has some original and advanced characteristics. In addition, it analyzed the potential factors influencing the willingness of people to receive COVID-19 vaccination and provided a basis for prospective immunization strategy. However, this survey only investigated the willingness to receive COVID-19 vaccination among people in Qingdao between the ages of 20 and 49 years. The reason we chose this age group was that the majority of the Chinese youth are dominated by their parents, who also influence their willingness, and old people may not understand the meaning of the question. Moreover, every family must register personal information in their neighborhood committee, including birth data, sex, and telephone number. Because women are mostly responsible for family affairs in China, the percentage of women registered in the neighborhood committee is high. Therefore, this study may inevitably demonstrate possible selective bias in respondents, especially given the lack of data of other age groups and men. In this survey, 38.22% of participants had studied up to high school, junior high school, or below. They could not understand the questions on the questionnaire; therefore, it increased information bias. Age and sex were not stratified; this also increased confusion bias.

Conclusion

This study observed that people who earned high incomes carefully followed news on COVID-19 vaccine, looked forward

to successful vaccine research, and closely followed vaccine protective efficacy showed more interest in undergoing vaccination than other people. It also suggested that the government should increase vaccination compliance by strengthening publicity efforts and decreasing the vaccine price after the COVID-19 vaccine is available in the market.

Acknowledgments

The authors would like to thank all volunteers who participated in this study and thank the investigators who contributed to the site work of the study.

Authors' contributions

Conception and design: F Yang, XF Li, XT Su.

Acquisition of data: H Li, P Hu.

Collecting data: J Guan, HZ Tian, P Wang.

Analysis and interpretation of data: XF Li.

Writing, review, and/or revision of the manuscript: WC Wang, XF Li, F Yang.

All authors read and approved the final manuscript.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

ORCID

Wencheng Wang  <http://orcid.org/0000-0003-3782-521X>

References

- Guo YR, Cao QD, Hong ZS, Tan YY, Chen SD, Jin HJ, Tan KS, Wang DY, Yan Y. The origin, transmission and clinical therapies on Coronavirus Disease 2019 (COVID-19) outbreak – an update on the status. *Mil Med Res.* 2020;7(1):11. doi:10.1186/s40779-020-00240-0.
- Kanna S, Shaik Syed Ali P, Sheeza A, Hemelatha K. COVID-19 (Novel Coronavirus 2019) – recent trends. *Eur Rev Med Pharmacol Sci PMID:* 321415. 2020;24(4):2006–11. doi:10.26355/eurrev_202002_20378.
- Sun P, Lu X, Xu C, Sun W, Pan B. Understanding of COVID-19 based on current evidence. *J Med Virol.* 2020 Feb 25 [accessed 2020 Apr 3]; 92(6):548–51. PMID: 32096567. doi:10.1002/jmv.25722.
- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *N Engl J Med.* 2020;382(8):727–33. doi:10.1056/NEJMoa.
- The 2019-nCoV Outbreak Joint Field Epidemiology Investigation Team, Qun Li. Notes from the Field: an Outbreak of NCIP (2019-nCoV) Infection in China – wuhan, Hubei Province, 2019–2020. 2020 Jan 22. [accessed 2020 Apr 05]. <http://weekly.chinacdc.cn/en/article/id/e3c63ca9-dedb-4f b6-9c1c-d057adb77b57>.
- World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-28 February 2020. Geneva (Switzerland): Website Operator; 2020 Feb 27 [accessed 2020 Apr 6]. <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-28-february-2020>.
- National Health Commission of the People's Republic of China. COVID-19 diagnosis and treatment plan (trial version 7). China(Beijing): Website Operator; 2020 Mar 3 [accessed 2020 Apr 7]. <http://www.nhc.gov.cn/xcs/zhengcwj/202003/46c9294a7dfe4cef80dc7f5912eb1989.shtml>.

8. Le T T, Andreadakis Z, Kumar A, Gómez Román R, Tollefsen S, Saville M, Mayhew S. The COVID-19 vaccine development landscape. *Nat Rev Drug Discov.* 2020 Apr 9; [accessed 2020 Apr 7]. PMID: 32273591. doi:10.1038/d41573-020-00073-5.
9. Yu M, Li T, Chen W, Chen J, Meixia L, Yang Z. Knowledge, Attitudes and Practices (KAP) toward seasonal influenza vaccine among young workers in South China. *Hum Vaccin.*
10. Qingdao Municipal Statistics Bureau, NBS Survey Office in Qingdao.
11. Zhong B-L, Luo W, Hai-Mei L, Zhang -Q-Q, Liu X-G, Wen-Tian L, Yi L. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci* PMID: 32226294. 2020;16(10):1745–52. doi:10.7150/ijbs.45221.
12. Sanche S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. High contagiousness and rapid spread of severe acute respiratory syndrome Coronavirus 2. *Emerg Infect Dis.* 2020;26(7). doi:10.3201/eid2607.200282. PMID: 32255761.
13. Dongyi Z, Zhaoqiu L, Nianmin S, Jin D, Jiao Z, Xi W. Investigation and analysis of parents' willingness to vaccinate the second kind of vaccine and its influencing factors. *Chin J Biol.* 2018;31(2):220–24. doi:10.13200/j.cnki.cjb.002087.
14. Wenzhou Y, Saisai J, Jing L, Bo C, Yuqing Z, Xuan Z, Fuqiang C, Huaqing W. Continuous monitoring of parental confidence on vaccination following the shandong illegal vaccine selling event. *Chin J Vaccin Immun.* 2016;22:601–05.
15. World Health Organization. Ten threats to global health in 2019.
16. Jingyi S, Yitian L, Yanhui C, Zheng X, Xiaoxiao L, Qingzheng K, Fuyu Q. Investigation on cognition and vaccination willingness of EV71 Vaccination among parents of children in Xicheng District, Beijing. *Chin J Health Edu.* 2018;34(9):820–23. doi:10.16168/j.cnki.1002-9982.2018.09.013.
17. Jie C, Zhiyuan H, Dahai Y, Qiong W, Hai F, Qingyue M. Factors related to self-paid vaccination and its related factors among children aged 0-3 years in China. *Chin J Public Health.* 2014;30(5):579–82. doi:10.11847/zgggws2014-30-05-12.
18. Jie C. Parents' Willingness to Pay and Immunization Service Providers' Willingness to Provide of Category II Vaccines in three provinces of China [dissertation]. Jinan (China): Shandong University; 2014.
19. Heshui S, Xiaoyu H, Yanqing F, Bo Y, Fan Y, Ping H, Chuansheng Z. Radiologic Features of Patients with 2019-nCoV Infection. *J Clin Radiol.* 2020 Feb 6. doi:10.13437/j.cnki.jcr.20200206.002. [accessed 2020 Apr 23].
20. Qin W, Weiye P, Junlei C, Zhiqiang L, Ruihong W. Analysis on Surveillance data of Category □ Vaccination, Fujiang province, 2017. *Prev Med Trib.* 2018;24(9):645–47. doi:10.16406/j.pmt.1672-9153.2018.09.003.
21. Linlin W, Jiechen L, Huiyong S, Xiaodong S. Vaccination utilization with non-Expanded Program on Immunization vaccines in Shanghai, 2011-2018. *Chin J Vaccine Immun.* 2020 Mar 16 [accessed 2020 Apr 24].