

# BMJ Open Attitudes and willingness toward out-of-hospital cardiopulmonary resuscitation: a questionnaire study among the public trained online in China

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## ABSTRACT

**Objectives** The incidence of bystander cardiopulmonary resuscitation (CPR) is low in China. CPR training could improve public attitudes and willingness, but at present, the attitudes of the public after online training are unclear. This study investigated individual attitudes towards CPR, the willingness to perform it in emergencies along with the main obstacles and the overall effects of online training.

**Design** Questionnaires were distributed to investigate the public attitudes and willingness towards performing bystander CPR.

**Setting** Questionnaires were accessible after the online course 'First Aid'.

**Participants** 1888 students who attended 'First Aid' from December 2019 to 1 January 2020 and then completed the questionnaire voluntarily.

**Results** The majority understood CPR (96.7%) and displayed a willingness to learn (98.4%) and to disseminate CPR knowledge (82.0%). Characteristics associated with more positive attitudes included women, the 26–35-year olds and those in medical-related occupations ( $p<0.05$ ). Only 34.8% had CPR training before. Most people would willingly perform CPR on a close family member. Compared with the standard CPR (S-CPR), the public preferred chest compression-only CPR (CO-CPR) ( $p<0.01$ ). The top three obstacles to performing CO-CPR were lack of confidence (26.7%), fear of harming the victim (23.4%) and causing legal trouble (20.7%), while regarding S-CPR, fear of disease transmission (22.9%) ranked second. Women, those in poor health and in medical-related occupations, were more likely to perform CPR ( $p<0.05$ ). The confidence to perform CPR was improved remarkably after online training ( $p<0.05$ ).

**Conclusions** The overwhelming majority of respondents showed positive attitudes and willingness towards CPR. In some cases, there is still reluctance, especially towards S-CPR. Obstacles arise mainly due to lack of confidence in administering CPR, while online CPR training can markedly improve it. Therefore, we should focus on disseminating CPR knowledge, targeting those who are less willing to perform CPR and helping overcome their obstacles by online training.

## Strengths and limitations of this study

- We conducted a questionnaire study to investigate the public attitudes and willingness towards cardiopulmonary resuscitation (CPR) after online training.
- Our questionnaire advanced the understanding of the influencing factors and obstacles of performing CPR.
- We provided a three-level ordinal variable in evaluating willingness and used ordinal regression to analyse the correlation between demographic characteristics and willingness to perform CPR.
- Our online training and questionnaire focused on theoretical knowledge, rather than on the practical skills of CPR.
- This survey was released through the internet only to the public that attended our online course, who usually paid more attention to CPR, which may lead to more optimistic results.

## BACKGROUND

Out-of-hospital cardiac arrest (OHCA) remains a major cause of mortality worldwide. The mean incidence worldwide of OHCA is estimated to be 55/100 000 person-years.<sup>1</sup> In China, according to the national cardiovascular disease centre statistics, about 550 000 cardiac arrests happen every year, while the survival rates in OHCA are less than 1%. The sudden death of a public figure in 2019 pushed this topic to the forefront again, with many more online hits for 'cardiopulmonary resuscitation' (CPR).<sup>2</sup> Early initiation of CPR improves survival rates from OHCA,<sup>3</sup> but the average rate for bystanders performing CPR in eight large and medium-sized cities in China is just 4.5%,<sup>4</sup> while in the USA and in Europe, it is around 40.2% and 47.4%, respectively.<sup>5,6</sup>

CPR training is a pivotal factor in improving the performance rate of CPR and has been

developed around the world according to the guidelines of the American Heart Association (AHA).<sup>7</sup> Unfortunately, the training rate in China is less than 26%, while there is legislation mandating CPR training in some schools in the USA and in several European countries.<sup>4,8,9</sup> In addition, due to the limitations of training location, instructor and equipment, live CPR training is not as accessible as it is online.<sup>10</sup> Thus, in order to disseminate first-aid knowledge including CPR to a wider public, we developed 'First Aid', an online course. It has been stated that trained people will be more likely to perform CPR without much hesitation,<sup>11</sup> yet we have little data about the effects of online training in China. Consequently, the aim of this study was to explore attitudes and willingness towards CPR among the public in China who had taken online CPR training as well as to evaluate the effects of this training.

## MATERIALS AND METHODS

### Study design

The data for this survey were acquired via questionnaires distributed to the public through the internet from December 2019 to 1 January 2020, from those who had taken our online training (<http://www.icourses.cn/cuoc/>). The survey was carried out after the public had finished the online CPR training, and the link to the questionnaire was attached at the end of the course. Before filling the questionnaire, all participants were informed about the aim of the study and were assured that participation was voluntary and results would be anonymous. And the refusal to participate would be without any consequences. Only persons attached to the research team had access to the data.

### Questionnaires

The research team developed the survey questions and precoded answer options after reviewing the literature as well as after consulting two Emergency Medicine Specialists in our hospital. The questionnaire consisted of four parts with 54 questions (see online supplemental file 1). The first part asked for personal demographic characteristics (age, gender, education level, occupation, health condition, family members with diseases, whether witnessed OHCA). The second section contained questions regarding the attitudes and willingness towards CPR, asking whether they knew the meaning of CPR, their willingness to learn and disseminate CPR knowledge as well as their motives, opinions on developing CPR training courses in university, the importance of chest compression (CC) and mouth-to-mouth ventilation (MMV) in cardiac arrest, their history of training in CPR, for those with none, their reasons for not receiving CPR training. The next section assessed the participants' willingness to perform CPR in eight hypothetical scenarios involving cardiac arrest that we programmed according to a previous study (see online supplemental table S1).<sup>12</sup> Additionally, respondents were asked to select the reason

if they were reluctant to perform either compression-only CPR (CO-CPR) or standard CPR (S-CPR). Finally, to quantify the confidence level before and after our online CPR training, we used scores from '1' (completely not confident) to '10' (very confident), in order to evaluate the overall effects of online CPR training.

### Data analysis

Data were analysed by IBM SPSS V.20.0 (IBM Corporation, New York, USA). Some questions permitted the respondents to give more than one answer, resulting sometimes in percentages that add to more than 100%. Qualitative variables were reported as absolute frequencies and proportions, while quantitative variables were presented as the median. The difference between groups was analysed with  $\chi^2$  tests or Fisher exact tests. It produced a three-level ordinal variable, with a zero indicating not willing to perform CPR in any scenario, and two indicating being likely to perform in all scenarios. Ordinal regression was used to analyse the correlation between demographic characteristics and willingness to perform CPR. Variables with p values <0.1 at the univariate level were incorporated into the model. The level of significant difference was set at p<0.05.

### Patient and public involvement

Public were not involved in the development of the methodology for the current study. However, academic discussion with two Emergency Medicine Specialists in our hospital have jointly promoted the design of the questionnaire. There are currently no plans to involve public in dissemination. Study objectives, benefits and mandatory information were explained to the public and the participants were voluntary to fill the questionnaire after taking online training.

## RESULTS

### Respondent demographic characteristics

We received a total of 1899 questionnaires, of which 1888 were valid, and the effective rate was 99.4%. Respondents were composed of 1091 women (57.8%) and 797 men (42.2%). Most respondents (65.4%) were between 18 and 25 years old, with bachelor's degree (67.4%) and in non-medical-related occupations (78.5%). 5.3% estimated their own health as poor, while 9.1% (n=171) confirmed their family members had life-threatening diseases. Only 139 of the respondents (7.4%) claimed they had witnessed someone collapse (table 1).

### Attitudes towards CPR

Most of the respondents had positive attitudes towards CPR. 96.7% understood CPR. 98.4% and 82.0% of the respondents were willing to learn and to disseminate CPR knowledge, respectively. A great majority wanted to study CPR to avoid unnecessary death (87.6%) as well as to help others (86.4%). More participants (98.8%) attached great significance to timely CC in cardiac arrest, in

**Table 1** Demographic characteristics of the respondents (n=1888)

Characteristics	Sample size, N (%)
<b>Gender</b>	
Male	797 (42.2)
Female	1091 (57.8)
<b>Age, years</b>	
<18	159 (8.4)
18–25	1234 (65.4)
26–35	314 (16.6)
>35	181 (9.6)
<b>Education level</b>	
<Associate's degree	395 (20.9)
Bachelor's degree	1273 (67.4)
Master's degree or above	220 (11.7)
<b>Occupation</b>	
Medical related	407 (21.5)
Non-medical related	1481 (778.5)
<b>Health condition</b>	
Good	1041 (55.1)
General	748 (39.6)
Poor	99 (5.3)
<b>Family members have life-threatening diseases</b>	
Yes	171 (9.1)
No	1717 (90.9)
<b>Have you ever encountered someone in need of CPR performance?</b>	
Yes	139 (7.4)
No	1749 (92.6)

CPR, cardiopulmonary resuscitation.

contrast with 81.9% to MMV. Moreover, 1213 participants (64.2%) had never received CPR training before, among which 50.9% did not know where to take the training, 37.6% claimed there would be a cost and 16.2% indicated that they had no time owing to a busy schedule (see online supplemental table S2). Women, younger people between 26 and 35 years old, and those in medical-related occupations were more positive towards CPR ( $p<0.05$ ). The training rate differed by age and occupations. Those whose family members had life-threatening diseases had a higher rate of previous training ( $p<0.05$ ) (table 2).

### Willingness to perform CPR in different scenarios

Across all eight hypothetical scenarios of OHCA, people were more likely to perform CO-CPR instead of S-CPR ( $p<0.01$ ). Most people reported a higher likelihood of performing CPR on a family member, a relative or a friend. It showed that when the victim was a close family member, the rate of willingness to perform CO-CPR was 98.8%, and S-CPR was 97.0%, whereas the public was least likely to perform CPR on an elderly person, with

the rates 84.0% for CO-CPR and 69.5% for S-CPR. (see figure 1 and online supplemental table S3). Analysing the effects of demographic characteristics on willingness by ordinal regression, we found statistical differences in gender, in occupation and in health condition groups. Women were more willing to perform CO-CPR than men. Those in medical-related occupations, in poor health and those who had had the experience of witnessing someone collapse had stronger motivation ( $p<0.05$ ) (see figure 2 and online supplemental table S4).

### Reasons for not performing CO-CPR or S-CPR

Lack of confidence (26.6%), fear of harming the victim (23.4%) and fear of causing legal trouble for themselves (20.7%) were the top three reasons for not performing CO-CPR. There existed a significant difference between men and women concerning motive in all eight scenarios ( $p<0.05$ ). As shown in table 3, when analysing the major barriers to performing CO-CPR, male respondents mostly reported fear of causing legal trouble (23.8%), whereas female respondents mainly reported lack of confidence (29.0%). Regarding S-CPR, the major obstacle was lack of confidence (28.7%), which varied by gender ( $p<0.05$ ). The next two reasons were fear of disease transmission (22.9%) and fear of harming the victim (21.5%) (see table 3 and online supplemental table S5).

### The effects of online CPR training

We investigated the confidence to perform CPR in emergencies both pre and postonline training, assigning a '1' to the least confidence and '10' to the greatest confidence. The mean score was 1.89 points before, in comparison with 4.47 points after it, a difference of about 2.4 times. Of note was that participants scoring 1 point dropped as a proportion of the whole from 56.0% to 1.3%, accompanied by respondents scoring 6 points increasing from 2.8% to 22.1%. Although no one got more than 6 points, it showed their confidence improved markedly after online CPR training ( $p<0.05$ ) (figure 3).

## DISCUSSION

### Positive attitudes towards CPR among the online-trained public

Early effective CPR plays a vital role in saving patients with OHCA, promoting their survival rate. However, the worldwide rate of bystander CPR is below 50% on average and is below 6% in China.<sup>4,13</sup> In this study, we determined that the majority of the Chinese public understood the meaning of CPR after online training. Their desire to learn CPR (98.4%) stemmed from positive attitudes towards avoiding unnecessary death and helping others. Compared with the past, public attitudes have improved significantly after online training.<sup>14</sup> Our result showed that 7.4% respondents had witnessed someone collapse, higher than in the study of Huang *et al* (4.3%).<sup>15</sup> This may be because the tragedy of OHCA now draws more attention from people in this country. Women seem to

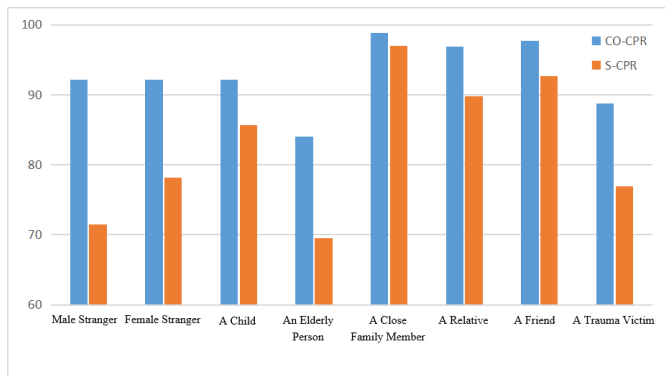


**Table 2** Attitudes towards CPR and previous training experience in relation to demographic characteristics

	Gender		Age			Education level				Family members with life-threatening diseases				Occupation		Ever trained in CPR				
	Total	Male	Female	<18	18-25	26-35	>35	<Associate's degree	Associate's degree	Bachelor's degree	Master's degree or above	Yes	No	Yes	No	Medical-related	Non-medical-related	Yes	No	
	N																			
All respondents (1888)	1888	797	1055	159	1234	314	241	395	1273	220	171	1717	407	1481	657	1231				
Ever trained in CPR (%)	34.8	36.1	33.8	27	36.8	33.4	30.4*	31.1	36.6	30.9	37.3	31.4†	62.2	27.3†	N/A	N/A				
Understanding what is CPR (%)	96.7	96.7	96.7	95	97.3	96.8	93.9	93.9	97.4	97.7†	97.4	95.7†	99	96.1†	99.1	95.4†				
Would like to learn CPR knowledge (%)	98.4	97.2	99.2†	94.3	98.6	100	97.2†	96.5	99.1	97.3†	99.1	97.4	98.5	98.3†	98.3	98.4				
Would like to disseminate CPR knowledge (%)	82	79.2	84.0†	69.8	82.2	85.7	85.1†	73.7	83.4	89.1	83.4	80.0†	87.2	80.6†	86.9	79.4†				

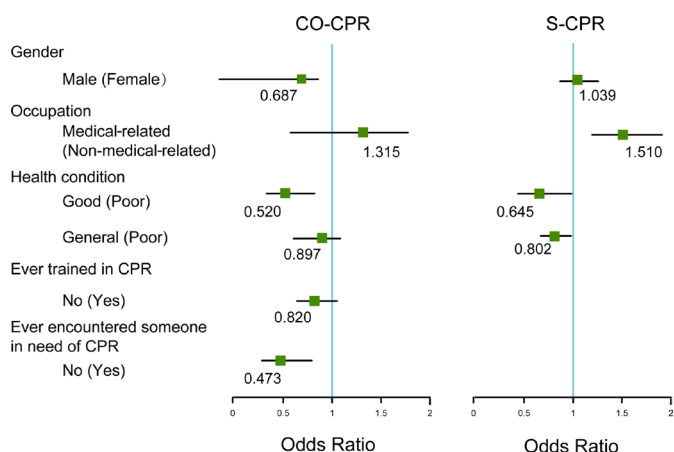
\*p<0.05.

†p<0.01, the  $\chi^2$  test were between each of the groups respectively. CPR, cardiopulmonary resuscitation.



**Figure 1** Proportions (%) of public being willing to perform chest compression-only cardiopulmonary resuscitation (CO-CPR) and standard CPR (S-CPR) in different scenarios. ‘CO-CPR’ means CO-CPR will be applied to the victim and so on. The difference was statistically significant between each group ( $p < 0.01$ ).

attach more importance to CPR,<sup>16</sup> which may be they had inadequate knowledge and skills of CPR. Because young people are good at obtaining wider information including the serious consequences of OHCA, they can recognise the importance of CPR earlier, which may be why 26–35-year olds were more eager to learn CPR. In this regard, many training courses are aimed at the young community, and while the elderly may have been trained before, their confidence and skills have eroded with time since their last training. This highlights an ongoing need for CPR refresher training.<sup>17 18</sup> People in non-medical-related occupations attach less importance to CPR, which could be attributable to the fact that CPR training is not recommended as a compulsory curriculum, except in medical schools in China. Moreover, previous training experience does help improve their attitudes. Taken together, CPR training can be enhanced and directed towards specific groups, including the elderly and the non-medical-related public, in the future.



**Figure 2** Association between the public demographic characteristics and willingness to perform chest compression-only cardiopulmonary resuscitation (CO-CPR) and standard CPR (S-CPR). OR and 95% CIs were estimated by ordinal regression.

**Table 3** The major reasons for not performing CO-CPR or S-CPR

Reasons	CO-CPR (%)			S-CPR (%)		
	All	Male	Female	All	Male	Female
Lack of confidence	26.6	23.3	29.0†	28.7	24.8	31.5†
Fear of harming the victim	23.4	20.9	25.3†	21.5	17.6	24.4†
Fear of causing trouble (legal trouble)	20.7	23.8	18.4†	20.6	23.9	18.2†
Fear of disease transmission	7.7	9.0	6.8†	22.9	22.9	22.9

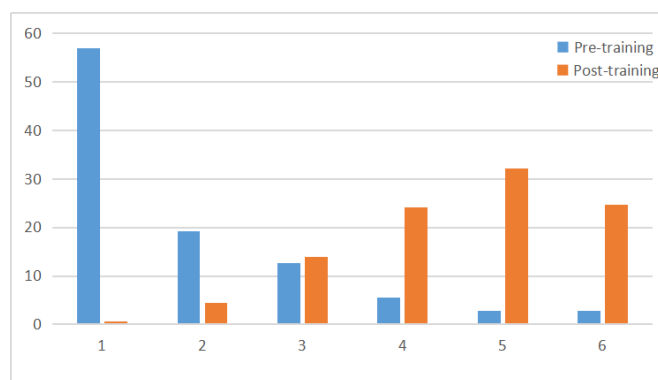
\* $p < 0.05$ .

†\*\* $p < 0.01$ , the  $\chi^2$  test were between the gender groups.

CO-CPR, chest compression-only CPR; CPR, cardiopulmonary resuscitation; S-CPR, standard CPR.

### Willingness and factors influencing in performing CO-CPR and S-CPR

In all eight hypothetical scenarios, people were reluctant to perform S-CPR compared with CO-CPR, which was in accordance with previous studies.<sup>13 19</sup> MMV was more intimate so the reluctance is stronger, and the relationship with the victim influences their willingness.<sup>16 20 21</sup> In contrast with the past, the public’s overall willingness has increased, with the updating guidelines and evolving society.<sup>22 23</sup> Our results suggest that the public in poor health or with sick family members present more positive attitudes and willingness towards CPR. We believe that this may be due to compassion and empathy, though there were some differences in previous studies.<sup>15 16 21</sup> Given that first-aid courses are not compulsory except in medical schools in China, those in medical-related occupations view CPR more positively. Overall, the positive attitudes shown in this study should encourage us to disseminate CPR knowledge to a larger population, and CPR training can be enhanced and directed towards specific groups.



**Figure 3** Proportions (%) of scored confidence to perform cardiopulmonary resuscitation (CPR) on emergency pre-CPR and post-CPR online training. Scores from ‘1’ (completely not confident) to ‘10’ (very confident) quantified the confidence level. The confidence change was statistically significant ( $p < 0.05$ ).



## Reluctance to perform CO-CPR and S-CPR

Our survey indicated that the top three reasons for being unwilling to perform CO-CPR were lack of confidence, fear of harming the victim and causing legal trouble. Men mostly chose 'fear of causing trouble (legal trouble)' as their major obstacle, whereas women mainly had a lack of confidence. Maybe men are more concerned with self-protection, while women exhibit more sympathy in emergencies.<sup>22</sup> Solid confidence builds on adequate theoretical knowledge and skills, otherwise CPR will carry more risk.<sup>21 24</sup> In addition, fear of causing legal trouble, which refers to the absence or imperfection of relevant legislation, also contributes to the performing reluctance.<sup>15</sup> This suggests that the government implements legislation to protect performers and provides training to build confidence towards bystander CPR. As for S-CPR, the main obstacle was lack of confidence (28.7%) as well, especially among women (31.5%). The second difficulty, fear of disease transmission (22.9%), covered a large percentage (94%) in Sweden<sup>25</sup> and 58.9% in South Africa,<sup>26</sup> but in Crimea only about 2.1%–9.7% of people worried about disease transmission.<sup>21</sup> These differences may stem from cultural and regional epidemiological differences such as the high HIV prevalence in South Africa.<sup>27</sup> However, the '2010 Cardiopulmonary Resuscitation (CPR) and the American Heart Association Cardiovascular Emergency Guidelines' allows non-medical professionals to perform CO-CPR, to encourage a wider public to participate in first aid.<sup>28</sup> Some studies have indicated that performing CO-CPR can still improve the patients with cardiac arrest survival.<sup>29–31</sup> We encourage the public to actively engage in CO-CPR first when confronting OHCA, to improve the rate of survival. It is reported that specially modified curriculum, targeting preidentified obstacles to providing CPR, can increase public willingness to attempt it.<sup>32</sup> In light of these barriers towards performing CPR, our training will emphasise the importance of CPR, and will target the different genders, in order to achieve a greater overcoming of the obstacles.

## The necessity of online CPR training promotion in China

CPR training has a positive impact on the attitudes towards performing CPR, which improves the survival rate of OHCA.<sup>33 34</sup> In our study, 34.8% respondents had previous CPR training, which was much more than the study of Chen *et al* in 2015 (8%).<sup>14</sup> Although the average rate of CPR training (26%) in China has improved during these years,<sup>35</sup> it is still lower in contrast with 53% in Crimea,<sup>21</sup> 54.7% in the USA<sup>36</sup> and 55.7% in Australia.<sup>37</sup> The primary reasons for not receiving CPR training were not knowing where to study and no free training locations, which were similar to those noted in a previous investigation.<sup>26</sup> Since 2015, AHA has recommended online training as resources for teaching and learning. Students take video-based courses before simulation training, with instructors providing feedback to standardise their performing.<sup>38</sup> It is noteworthy that public confidence in performing CPR improved 2.4-fold after our online training, which is consistent with the study of Cason and Stiller.<sup>10</sup> In recent years, online training is an a feasible way for the public to gain first-aid knowledge, and according

to several studies has brought a similar quality to the learning of CPR techniques.<sup>39–41</sup> Therefore, as a nation, we should call for full use of online platforms, to provide quality and free CPR training for the wider public.

## Limitations

Our study has several limitations. First, this survey was released through the internet to the public who had attended our online CPR training. These respondents usually paid more attention to CPR, thus leading to more optimistic results. Still, it does show the overall benefit of CPR online training. Second, our online training and questionnaire focused on theoretical knowledge, rather than on the practical skills of CPR. Future investigations should explore the practical skills more and then fully evaluate the effects of online CPR training. Finally yet importantly, the majority of respondents who were motivated to learn CPR were 18–25 years old. The results of our study might therefore be more positive than in reality, and each limitation warrants further research.

## CONCLUSIONS

The public has overwhelmingly positive attitudes and willingness to attempt CPR after online training. There are many factors influencing their attitudes and willingness, including gender, age and occupation. Nevertheless, the public still show a reluctance to some extent to perform CO-CPR or S-CPR, especially the latter. Obstacles to CPR include lack of confidence, fear of harming victim, fear of causing legal trouble or fear of disease transmission. Notably, online CPR training leads to a remarkable improvement in the public's confidence, confirming its beneficial effects and advantages when compared with the effects thus far of offline training. By taking advantage of online CPR training, it can be more convenient for the public to get free and flexible training. Considering the low bystander CPR rate in China and our study results, we should emphasise the importance of CPR and focus on overcoming the psychological and operational obstacles in performing CPR.

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**Contributors** YJ was the first author. She analysed the data, interpreted the data and was a major contributor in writing the manuscript. BW participated in formulation of the figure, in data processing and in revising the manuscript. LL took part in the questionnaire design and modified the manuscript. JL interpreted the data and modified the manuscript. XJ designed the study, collected data and gave critical appraisal of the manuscript. All authors read and approved the final manuscript.

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**Competing interests** None declared.

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**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** All data relevant to the study are included in the article or uploaded as supplementary information. No additional data are available

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