Face Coverings in Post-COVID Society to Help Prevent the Transmission of Respiratory Illnesses on Public Transit

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Abstract

Background:
During the COVID-19 pandemic, cases of influenza drastically decreased in numerous countries around the world. Several non-pharmaceutical health measures were put in place to help mitigate the spread of the virus, including a mask mandate for public spaces. On public transit, there is potential for respiratory virus spread through droplet transmission and common contact fomites between riders. This study investigated how current residents of Metro Vancouver who use transit at least once per week would support optional guidelines for mask-use during annual flu seasons to help continue to mitigate the transmission of respiratory illnesses after COVID-19 mandates have ended.

Methods:
A self-administered electronic survey was designed using SurveyMonkey and posted on Facebook and Reddit to collect nominal and ordinal data regarding how different variables can affect riders' likelihood of continued mask use and support for optional mask guidelines on transit during annual flu seasons. These variables included age, level of education, gender identity, mask comfort level, and transit use frequency. Inferential and descriptive data analyses were performed by using Real Statistics in Microsoft Excel.

Results:
There were 299 eligible respondents, 79% of which had plans to voluntarily continue wearing masks, with 89% in support of optional mask guidelines on transit during flu seasons. The findings of this study determined that several statistically significant associations existed between education level, mask comfort level and transit use frequency, and support for mask promotion on transit and plans to continue wearing a mask after the mandate ended.

Conclusions:
The findings of this study suggest that adults under the age of 45 in Metro Vancouver who possess a post-secondary education are more likely to be in favour of adopting the use of face coverings into their daily lives. This research can be used to design public health campaigns which encourage mask use on transit through targeted education and media such as posters, signage, and social platforms to help reduce health care costs associated with influenza.

Keywords: *public transit, face mask, face covering, respiratory illness, influenza, post-COVID, Metro Vancouver, bus, sky train, British Columbia*

Introduction

The use of face coverings has been implemented as one of several non-pharmaceutical public health measures during the COVID-19 pandemic to help prevent transmission of the SARS-CoV-2 virus in indoor public settings. It has been observed during the pandemic that the use of these health measures has correlated with a global decrease in the number of confirmed cases of influenza during the 2020-2021 flu season, with no reports of laboratory confirmed

flu outbreaks or severe flu outcomes in any Canadian provinces or territories (PHAC, 2021). By continuing to implement some of the same non-pharmaceutical health measures used during the pandemic, such as mask wearing during annual flu seasons, it may be possible to continue to reduce annual cases of influenza after COVID-19 mandates have ended.

Face masks can be "equated to wearing a seatbelt or stopping smoking" in regard to how they can save lives, so it seems entirely likely that "many people will continue to wear masks after the immediate threat of COVID-19 has subsided" (Ries & Cassell, 2021). One of the leading causes of mortality in older populations during winter flu seasons worldwide is influenza (Kobayashi & Noguchi, 2021). By adopting guidelines for optional mask use during annual flu seasons on public transit systems, seasonal health care burdens may be alleviated or lessened which can in turn help to protect vulnerable populations such as the elderly and individuals with health conditions.

Literature Review

The transmission of acute respiratory infections (ARIs) such as COVID-19, SARS, MERS and H1N1 poses a global health hazard (Jefferson et al., 2020). A study from the Journal of Travel Medicine and Infectious Disease compared incidence rates of COVID-19 in countries such as China, South Korea, Singapore Spain, Italy, France, Germany, and the U.S. and found that "community-wide mask wearing may assist in controlling COVID-19 with reduced emission of infected saliva and respiratory droplets from mildly symptomatic patients". Respiratory virus infections such as COVID-19 and influenza are spread by the communication of aerosolized droplets, this includes the potential for transmission when in closed environments such as crowded transportation vehicles. Individuals who depend on transit systems for work, school or their day to day lives may not have the luxury of avoiding use of these systems during annual flu seasons or outbreaks. "The physical barrier provided by a mask can effectively prevent the respiratory tract from contacting the outside virus, thereby reducing the risk of respiratory virus infections" (Liang et al., 2020).

A study by the European Centre for Disease Control found that face mask use has been shown to reduce disease transmission by about 6% to 15% (Brainard et al., 2020). A separate review found that masks can reduce the risk of viral infection by 56% and states that even relatively ineffective non-medical grade "social" masks can produce meaningful reductions in community transmission (Liang et al., 2020). Wearing a face covering is a reasonable and implementable control measure to help reduce respiratory virus transmission however, according to a Danish study regarding the effectiveness of mask recommendations as public health guidelines, more studies are needed to determine whether face masks prevent transmission through source control of infected mask wearers or by having a protective effect on uninfected wearers (Bundgaard et al., 2021).

The implementation of face coverings has been widely accepted in many Asian countries including Japan, Taiwan, Korea, and China as a part of positive hygiene practices. A survey study from Japan of 3,129 individuals aged 20 to 69 years found that 38.4% of participants (n=1,203) said that they frequently or occasionally wore a face mask in public, with the highest proportion of wearers among the oldest age group (60-69) and the lowest

proportion of wearers in the youngest age group (20-29) (Wada et al., 2012). These results indicate that there is likely a high level of social and cultural acceptance for such health behaviours in the country, especially among older demographics. It also suggests that a relationship may exist between age and willingness to wear face masks. Another study from Japan shows that there was a correlation between the COVID-19 pandemic and a decrease in the numbers of annual influenza cases in Japan in 2020 compared to expected rates dating back to 2012, and the same decrease is projected to continue for 2021 (Brainard et al., 2020). It is also shown that cases of the flu spiked in 2017 when vaccination rates were low in the population, which suggests that vaccination plays an important role in conjunction with mask wearing for the suppression of influenza cases in a population (Kobayashi & Noguchi, 2021). There appears to be a correlation among this population between following COVID-19 transmission mitigation strategies including social distancing and mask wearing, and a decrease in the number of influenza cases in Japan.

A similar study from Taiwan compared influenza rates, from October to Mid-April between 2018-2019 and 2019-2020 and found that the number of people with influenza per week significantly decreased after public health measures were enacted, with the number of patients experiencing severe complications from influenza infections also significantly decreasing (Hsu et al., 2020). This Taiwanese study echoes the findings of the study from Japan, suggesting that there may be a correlation between COVID-19 health measures such as mask wearing in public settings and a significant decrease in the number of reported influenza cases during flu seasons. China's *Patriotic Public Health Campaign* has also led to a decrease in respiratory illnesses such as seasonal influenza activity with physical containment strategies including mask wearing, contact tracing, environmental disinfection, and lockdown measures (Luo et al., 2021).

People depend on transit systems for transportation to employment and social outings. These systems are an integral part of urban societal networks but can also act as environments for disease transmission because "droplet-borne and airborne viruses are likely to cause large- scale transmissions among the passengers within closed transportation vehicles" (Liang et al., 2020). According to a study from the Eurasian Journal of Medicine, "large [respiratory] droplets and airborne routes are credited to person-to-person transmission, which could be the cause of a large number of influenza infections" (Vo et al., 2020). During the fall and winter seasons more people tend to use public transit, and as a result the vehicles become more crowded. When in close proximity to one another, it is possible for respiratory droplets from infected individuals to be communicated to other passengers. By implementing a physical barrier such as a face covering, passengers can "effectively prevent the respiratory tract from contacting the outside virus, thereby reducing the risk of respiratory virus infections" (Liang et al., 2020).

In South Korea, a study was conducted that analyzed subway use density for temporal associations with cases of influenza-like illnesses and found a "probable link between public transportation and ILI rate" (Seong et al., 2021). The same South Korean study also states that "the presence of a high-speed railway station was associated with the pandemic spread of COVID-19 according to the early studies conducted in China". Due to the nature of

transit systems, studies suggest that there is an elevated risk of disease transmission among riders due to respiratory droplet spread and the contamination of common contact surfaces. For this reason, "respiratory protection by wearing masks is one of the methods to prevent infection of the influenza virus" (Vo et al., 2020).

Due to conflicting research regarding the efficacy of face masks in preventing the spread of respiratory illnesses such as COVID-19, there is still a "small but vocal group of individuals who refuse to wear masks" (Taylor & Asmundson, 2021). A Canadian study of 2,078 American and Canadian adults found that factors which affect how a person accepts mask use include levels of physical discomfort, inconvenience, disbelief in how effective mask use is, beliefs that masks have adverse interpersonal effects, and psychological reactance (Taylor & Asmundson, 2021). The same study discusses how anti-mask sentiments have stayed relatively consistent since 1919 when the *Anti-Mask League* was established in the United States. In 1919, members of this group argued that masks were not effective against the Spanish flu and that a mask mandate issued by the government violated their civil liberties (Taylor & Asmundson, 2021).

According to a Pakistani survey study of 738 residents from provincial capitals, willingness to wear face masks can be most influenced by focusing on the perceived benefits of using face coverings and by the risk perceptions of respiratory illnesses through public health campaigns (Irfan et al., 2021). This idea of focusing on the perceived benefits of mask use to help increase public willingness to wear face coverings echoes the findings of the Canadian study regarding psychological reactance, which states "if a person refuses to wear a mask simply because he or she believes them to be ineffective, then it might be that targeted education may be sufficient" (Taylor & Asmundson, 2021). These studies suggest that an effective way to encourage hesitant members of the public to continue wearing face masks is to communicate the benefits of mask use and risks associated with ILIs through educational material such as public health guidelines based on logical, relevant research findings.

Public health guidelines that focus on enhancing public perceptions of ILI risks and the benefits of face masks could help to promote the continued use of face coverings in British Columbia and the rest of Canada after COVID-19 mandates have ceased and would in turn generate future research data about mask use as an ILI mitigation strategy. By conducting a survey of residents of British Columbia who use public transit systems, willingness to wear face masks during annual flu seasons can be evaluated and this knowledge can then be translated into effective public health guideline campaigns for the future, potentially decreasing associated health care system burdens.

Research Question / Purpose of this Study

Do residents of Metro Vancouver support wearing face coverings when using public transit after pandemic orders have ceased to help prevent the spread of respiratory illnesses? The purpose of this research project is to identify which demographics of BC's population would be in favor of accepting continued mask use on transit and determining any barriers to compliance.

Materials and Methods

For this study, an electronic self-administered survey using the website SurveyMonkey was chosen as the standard method. A link to the survey was posted on Reddit and Facebook groups on January 13, 2022 and left active for one week. The subreddits used were r/Vancouver, r/BritishColumbia, r/SurreyBC, r/Burnaby, r/Richmondbc, r/Portmoody and r/NewWestminster. Facebook groups included "Jobs Vancouver BC", "Vancouver Jobs, Careers & Business Opportunities", "Vancouver Jobs" and "Expo Line Memes for TransLink Oriented Teens". These groups and subreddits were chosen based on their community sizes, interest in a prize incentive, study relevance, and geographic location. A Canadian licence was obtained for SurveyMonkey so that study data will remain stored on Canadian servers. Survey analysis was performed using a Chi-Square Test of associations on Real Statistics in the Windows365 Excel program using a personal laptop computer.

Through descriptive and inferential statistical analyses of survey responses, the strength of association can be determined between variables including age, gender, transit use frequency, dependence on transit systems, and respondents' willingness to continue to wear face masks after COVID-19 measures have ceased, or support for mask guidelines on public transit during flu seasons, which may suggest statistically significant relationships. These relationships can in turn be used to guide future public health policies regarding the continued use of face masks in public settings such as on transit systems.

Statistical Analysis

As previously discussed, certain question categories were collapsed or combined to improve survey analysis, these included age and level of education. About half of survey respondents were under 30 years old and another half were 30 to 45, with 4% being over 45 years old. For recent level of education, twice as many respondents had attended college or university compared to respondents with high school or less.

Transit use frequency was evenly distributed with 33% taking less than 5 trips per week, 46% taking 5-10 trips per week, and 21% taking more than 10 trips per week. Gender identity was also evenly sampled, with 57% of respondents identifying as male, 42% as female, and 1% as non-binary. The most frequent response for level of mask comfort was "Very Comfortable" with a total of 120 responses, and the least frequent response chosen was "Very Uncomfortable" with a total of 22. A high number of respondents said they would continue wearing face masks after COVID-19 measures have ceased, with 79% saying they will continue mask use and only 21% opting to not wear masks moving forward (Figure 2.). Lastly, there was a great deal of support for optional guidelines of wearing face coverings on transit post-COVID during annual flu seasons with 89% in favour and 11% opposed (Figure 1.)

Figure 1.

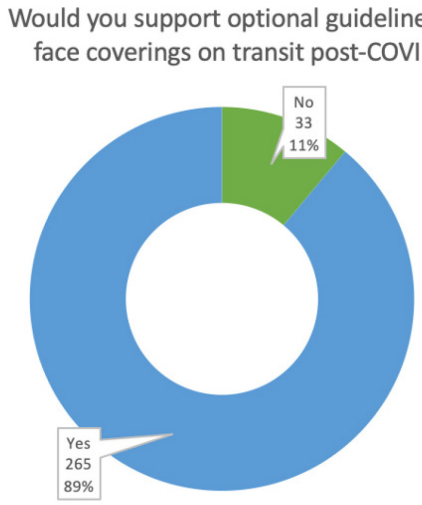
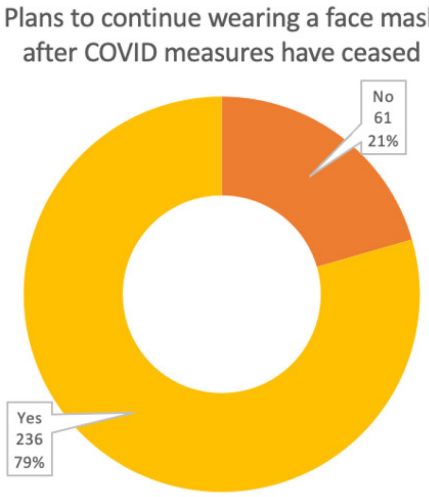


Figure 2.



Excel's Real Statistics was the statistical package used (Zaiontz, 2020). Before Chi-square tests were performed for statistical analyses of survey data, ineligible and excluded responses were removed. Submissions with an omission of one of the two eligibility questions and a "Yes" for the other were not removed because they may be eligible but chose not to answer. From 347 initial respondents, the sample size was reduced to 299. Interpretation of inferential statistics results has been condensed in Table 1. The table includes p-values for 5 null and alternative hypotheses, with interpretations of p-values, conclusions about statistical significance and some discussion regarding corrections of potential Type I and Type II errors.

Results

Table 1. Results of Inferential Statistics

H_o and H_a	Test used	Result	Conclusion
H_{01} There is no association between level of education and plans to continue wearing face coverings after COVID orders have ceased. **H_{a1}** There is an association between level of education and plans to continue wearing face coverings after COVID orders have ceased.	Chi-square test	p-value = 0.00182	Reject null hypothesis, conclude that a statistically significant association exists between level of education and plans to continue wearing face coverings after COVID.

H_{02} There is no association between level of mask comfort and plans to continue wearing face coverings after COVID orders have ceased. **H_{a2}** There is an association between the level of mask comfort and plans to continue wearing face coverings after COVID orders have ceased.	Chi-square test	p-value = 0.04808	Reject null hypothesis, conclude that a statistically significant association exists between mask comfort and plans to continue wearing face coverings after COVID.
H_{03} There is no association between level of mask comfort and support of mask-wearing as an optional public health guideline on transit during annual flu seasons. **H_{a3}** There is an association between level of mask comfort and support of mask-wearing as an optional public health guideline on transit during annual flu seasons.	Chi-square test	p-value = 0.002176135	Reject null hypothesis, conclude that a statistically significant association exists between mask comfort and support for optional public health guidelines on transit during flu seasons.
H_{04} There is no association between transit use frequency and plans to continue wearing face coverings after COVID orders have ceased. **H_{a4}** There is an association between transit use frequency and plans to continue wearing face coverings after COVID orders have ceased.	Chi-square test	p-value = 0.006204831	Reject null hypothesis, conclude that a statistically significant association exists between transit use frequency and plans to continue wearing face coverings after COVID.
H_{05} There is no association between transit use frequency and support of mask-wearing as an optional public health guideline on transit during annual flu seasons. **H_{a5}** There is an association between transit use frequency and support of mask-wearing as an optional public health guideline on transit during annual flu seasons.	Chi-square test	p-value = 0.035913763	Reject null hypothesis, conclude that a statistically significant association exists between transit use frequency and support of optional mask guidelines on transit during flu seasons.

Discussion

The purpose of this study was to determine if residents in Metro Vancouver would be in favour of optional public health guidelines for face coverings on public transit systems during annual flu seasons. It was determined that 89% of respondents were in support of the guidelines. The statistical significance of associations between age, gender identity, level of education, transit use frequency, mask comfort, and access to alternate travel, and their influences on guideline support was analyzed. These factors were also compared with respondents' plans to continue wearing masks after COVID measures cease. Age, gender identity, level of education, and access to alternate travel did not have statistically significant associations with support for optional mask guidelines on transit and all had p-values that exceeded 0.05. The same was true for determining associations with future mask use post-COVID for age, gender identity and access to alternative travel, but in contrast, recent level of education did have a significant association with a p-value of 0.001.

These results contrast the findings of a Japanese mask study which found that mask use was most common among adults over 60 and was least common among adults aged 20-29 (Wada et al., 2012). We would expect to see an association between age and continued mask use among older adults, however in the current study it was found that 78% of respondents under 30 planned to continue wearing masks compared to 82% of respondents 30-45 years of age and 62% of adults over the age of 45. This suggests that mask acceptance and plans for continued mask use are more common among adults under the age of 45. Since recent level of education was found to have a statistically significant association with plans to continue mask use post-COVID, it may indicate that adults under 45 with a post-secondary education are more willing to accept long-term cultural changes such as integrating mask use into their daily lives. Level of education may also have a significant association with support for mask guidelines on transit since its p-value was 0.08, which is potentially a Type II (beta) error. By now, people of varying education levels may be aware of existing research about the efficacy of physical barriers in public settings such as wearing masks to help prevent pathogens such as influenza and COVID-19 from contacting the respiratory tract (Liang et al., 2020).

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Mask comfort level was found to have a statistically significant association with both plans to continue mask use post-COVID and support for optional mask guidelines on transit with p-values of 0.048 for plans to continue mask use and 0.002 for

transit guideline support. The survey data suggests that respondents who have higher levels of comfort with wearing masks are more likely to continue wearing face coverings after COVID-19 measures have ceased and are in support of optional guidelines for mask use on transit during flu seasons. These study results are intuitive, as we would expect to see individuals who are more comfortable wearing masks to continue using them in the future. This is consistent with the findings of a Canadian survey study which discusses level of physical discomfort as a factor in determining mask use acceptance (Taylor & Asmundson, 2021). The p-value for mask comfort level and plans for continued mask use is 0.048 which is close to the cut-off of 0.05 indicating that this an alpha error. If we decrease the p-value to 0.01 there is no longer a statically significant association.

Level of mask comfort is also associated with transit use frequency and has a p-value of 0.038 which suggests another potential alpha error. It indicates that transit riders who take transit 5-10 times per week tend to be more comfortable with mask use compared those who take transit less than 5 times or more than 10 times per week. This can be interpreted as wearing a mask once or twice a day on transit during a regular 5-day work week is more comfortable compared to wearing a mask less often or on a more frequent basis. Transit use frequency had statistically significant associations with both plans to continue mask use after COVID-19 and support for optional mask guidelines on transit during flu seasons with p-values of 0.006 and 0.0359 respectively. Again, the data suggests that individuals who ride transit 5-10 times per week are more likely to support mask guidelines and continue mask use compared to those who ride transit less than 5 times per week or more than 10 times per week. The association between transit frequency and plans to continue wearing masks is below the adjusted p-value of 0.01 and does not constitute an alpha error. This means that the association likely exists in the greater population. The association between transit frequency and support for mask guidelines on transit is very close to the cut-off of 0.05 and is likely an alpha error, meaning that the association may not exist in the greater population. If we change the cut-off to 0.01, then the association is no longer statistically significant.

According to the Public Health Agency's FluWatch, as of March 12th, 2022, there had been "no evidence of community circulation of influenza in the 2021-2022 season to date" (PHAC, 2022). This is consistent with FluWatch data from the 2020-2021 season which also found no reports of laboratory confirmed flu outbreaks or severe flu outcomes (PHAC, 2021). During the COVID-19 pandemic influenza cases have decreased drastically and it may be possible to maintain these health outcomes into the future. A 2020 study from Taiwan found that during the 2019-2020 season the number of patients with severe complications from influenza significantly decreased (Hsu et al., 2020). From August 29, 2021, to February 19, 2022, there had been less than 5 influenza-associated hospitalizations (PHAC, 2022). We need to consider what aspects of the controls put into place during the COVID-19 pandemic can be promoted as part of a long-term cultural shift to help prevent respiratory illness spread on public transit.

Knowledge Translation

The information collected in this study may prove very useful in the future to gather support for funding public health campaigns in Metro Vancouver to promote optional mask use guidelines on public transit systems during annual flu seasons. There is overwhelming support for such guidelines with 89% of respondents in favour. For those who are opposed to wearing masks on transit to help prevent the transmission of respiratory infections, if their opposition is based on a disbelief in mask efficacy, targeted education has been found to be one of the most effective methods to foster mask acceptance (Taylor & Asmundson, 2021). By creating several temporary poster or signage designs to promote mask use featuring key evidence-based research findings that suggest mask use can help prevent respiratory illness spread and protect vulnerable populations, long-term public support for mask use during flu seasons can be fostered.

Promotional campaigns at Skytrain and bus stops, or on trains and buses themselves can serve to gently remind members of the public to wear a face mask during flu seasons to help keep influenza numbers low. The cost of this program could be offset by reductions in health costs.

Limitations

The most impactful limitation of this study was not being able to conduct an in-person survey. By relying solely on an electronic self-administered study, it was difficult to gather data from certain demographics such as adults over the age of 45, individuals under 18, and those with a high school education or less. The survey was posted on Reddit and Facebook groups, some of which required permission from group administrators or did not allow surveys to be posted on their discussion boards. The demographics of both Reddit and Facebook users tend to be adults between 20 and 40 years of age. Had the survey also been performed in person, then responses could have been gathered from a wider range of respondents to better represent transit riders in Metro Vancouver as a target population.

For statistical significance, a sample size of 30 respondents per question category was required. This was not achieved for several of the questions in this survey. For example, before survey data was collapsed there were only 5 eligible respondents under 18, 12 respondents from 46-60 and 1 respondent over 60. For education, there were only 26 eligible respondents who hadn't completed high school. Gathering a large enough sample size for this study was a limiting factor in establishing statistically significant results. The data is most likely skewed, because twice as many respondents had a college or university education compared to those with a high school level education or less. The respondents in this study were predominantly under 45 with a post-secondary education, which may not be reflective of the greater population.

Another factor that limited the scope of this study was not being able to conduct in-person surveys at TransLink terminals in Metro Vancouver. An email application was sent to TransLink's head office to request permission to conduct an in-person survey at transit stations for the purpose of this study. Although communication was established, the proposed study required a lengthy approval process

and could not be completed due to time restraints. It was also not considered acceptable to conduct in-person surveys during the COVID-19 pandemic.

Future Research

Here are some suggestions for future student projects based on this research:

- Cultural analysis of mask acceptance in a post-COVID society
- Efficacy of public health campaigns regarding mask use in a post-COVID society
- Comparison of pre-COVID and post-COVID respiratory illness rates
- Analysis of non-pharmaceutical health measure efficacy in urban societies

Conclusion

After two years of mask mandates, it appears that members of the public are willing to accept regular mask use to help protect vulnerable members of their communities and would support health promotion campaigns for face coverings on public transit systems during annual flu seasons. Factors that influence mask acceptance include mask comfort, education, and transit use frequency. This information can be used to design effective, targeted public health promotions for mask use on transit. By creating an awareness campaign to encourage transit riders to wear face coverings during annual flu seasons, the safety of public settings such as transit vehicles can be enhanced using targeted signage, social media, and other platforms.

Due to the number of public control measures that were introduced to help mitigate the spread of SARS-COV-2, ongoing research is still needed to determine mask efficacy in preventing the transmission of respiratory illnesses such as COVID-19 and influenza on transit systems. Mask wearing is likely just one piece of a larger picture, one of several contributing factors that helped to prevent flu transmission. During the COVID-19 pandemic flu rates have drastically decreased in many countries around the world, now we must determine how to continue these trends into the future to reduce health care costs and prevent undue adverse health effects.

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Competing Interests

The authors declare that they have no competing interests regarding this study.

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