

Solution for Secondary Transmission of Discarded Masks and Vaccination in Schools

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ABSTRACT

To defend our health, government dispenses the vaccine and claims strict COVID-19 rule. However, as students going back to school, it is necessary for us to consider the possibility of second virus transmission among teenagers. Thus, we surveyed high schools in the Boston area and studied eight different schools' participation. According to the results, we find out that there are hidden dangers in the percentage of wearing masks, the types of covers used, and how they are treated after it, but the vaccination awareness is excellent. For the target of different economic conditions in eight separate areas, there may be some differences in the purchase and use of protective equipment, but the feedback from teenagers willing to be vaccinated was higher than that of adults. For helping everyone's health and in-person lessons, we provide reasonable solutions to help better prevent the virus. First, we strongly recommend that schools should set up particular medical waste recycling bins. Then we suggest that by following CDC suggestion, you must remember to wear a mask, especially when you are on airplanes, buses, trains, or any other public transport, and when you are indoors in US transportation hubs such as airports and stations, you need to wear a mask on your nose and mouth. Try to avoid crowds and poorly ventilated spaces, wash hands frequently, and clean high contact surfaces daily. Also, we want to mention it to everyone. It is essential to change the mask often and try to keep it at least once a day. According to our research, we recommend changing masks immediately after work or school.

Ignore the risks of masks and the importance of vaccines

- **Virus survival rate and survival time**

The COVID-19 virus can survive on the mask surface for more than seven days and remain active. According to the relevant data in the research report and through strict experimental data statistics, it is found that the survival rate and survival time of the virus under daily room temperature conditions have been further improved. Statistics show that test masks and ordinary masks as well as plastic, stainless steel, glass, and ceramics are inevitable in daily life. For a long period, it was found that the COVID-19 virus can exist on the surface of these objects for more than seven days. Another report, the experimental results of the COVID-19 virus, showed that the COVID-19 virus could still survive on the mask surface and maintain its infectivity and activity after the seventh day of the experiment. In this situation and background, not taking discarded masks seriously will significantly increase the risk of infection caused by hand contact.^{1,13} The wrong disposal method may induce more serious consequences due to the sticky property of COVID-19 virus. The aerosol and surface pollution of sars-cov-2 observed in quarantine showed that it existed in the room of patients infected with sars-cov-2 regardless of the severity or acuity of the symptoms, and caused serious environmental pollution. Contamination exists in all types of samples: high-volume and low-volume air samples and surface samples, including personal belongings, room surfaces, and toilets. After testing, it was found that toilet samples of patients who were positive for viral RNA were consistent with other viral shedding reports in feces. At the same time, contamination was found on personal items, especially items that are usually handled by individuals alone, such as mobile phones and remote controls, as well as medical equipment that maintains constant contact with patients. The observation of virus replication in individual samples in cell culture confirmed the recovered virus's potential infectivity. Although the test carried out in this document is located in the room of a confirmed COVID-19 patient, it can still prove that the COVID-19 virus can attach to almost all articles in daily contact and it still potentially infectious.⁷

Until June 8, WHO has already listed the Pfizer/BioNTech, Astrazeneca-SK Bio, Serum Institute of India, Astra Zeneca EU, Janssen, Moderna, Sinopharm and Sinovac vaccines for emergency use.¹¹ Among them, the vaccines that can be vaccinated for 12-16 years old are Pfizer-BioNTech COVID-19 Vaccine.²

- **Summary of vaccine research conclusions.**

In the relevant research reports on vaccine safety that we searched and learned to read, there are two test ranges: 18 years of age and older, a small number of experimental reports on the age of adolescents.

We found that in children and adolescents aged 3-17 years, the two doses of Corona Vaccination are safe and well-tolerated, the doses being 1.5 μ g and 3 μ g, respectively. The incidence of adverse reactions in the different dose groups was similar, indicating no aggravating concern about dose-related safety. Most reactions are mild to moderate in severity and are short-lived. Pain at the injection site is the most reported symptom. The results are like our studies of adults and the elderly^{13,14}. In addition, compared with other age groups, the higher grade 1 injection site pain reported by adolescents aged 12-17 is the main reason for the slightly higher incidence of adverse reactions in this population, and the risk of vaccination has not increased. None of the serious adverse events reported during the trial was related to vaccination. Research evidence shows that although the degree of adverse reactions changes due to individual differences, it does not change the risk of vaccination, so there is no need to worry about this. In addition, the feedback of the vaccine experiment data of adolescents has caused an excellent serum response, which means that the vaccine has a good effect.¹

For 18-59-year-old adults, we learned from the study and summary of multiple research reports. First, it was reflected in a research report. The research and learning conducted ten experiments, and the ten experimental vaccines were successful. We found that among healthy adults 18-59 years old, Corona Vaccine at two different concentrations and using different dosing regimens is well tolerated and moderately immunogenic. The incidence of adverse reactions was similar in the 3 µg and 6 µg groups, indicating no dose-related safety issues, but longer-term follow-up is required. Finally, most adverse reactions are mild, and the most common symptom is pain at the injection site. ^{12,10,6}

- **Hospitalization of Adolescents Aged 12–17 Years increased during March and April⁴**

A recent CDC study found COVID-19-associated hospitalization rates among adolescents ages 12-17 years increased during March and April, following declines in January and February 2021. This trend differed from hospitalization rates among people ages 65 years and older—the age group with the highest COVID-19 vaccination coverage—who saw hospitalization rates stabilize during the same timeframe. This phenomenon shows that before there is an effective treatment for COVID-19, vaccination is the best way to prevent the spread of the epidemic and the best way to protect young people from returning to school safely.

Report data feedback

- **Ethical considerations**

Based on the consideration of privacy requirements, this questionnaire is only investigated by age group. Gender, ethnicity, and other natural attributes are not classified.

- **Overall situation by age group**

- **Adult (>18)**

Among the 373 valid questionnaires, there are 60 adult questionnaires. The survey results of the adult group show that most people have a good awareness of the use of masks and the continued use of masks after vaccination. And generally recognized and supported vaccination. This is not only manifested in their willingness to vaccinate but also their willingness to vaccinate their children. The details are as follows: 1). The proportion of surgical masks and masks of other materials is similar. 2). 55% of adults use masks for more than one day. On this issue, half of the adults in the adult group did not follow the CDC's time requirements for mask replacement. 3). Only half of the people handle or clean masks correctly after getting off work. 4). 43% of people believe that there is a possibility of spreading the virus after vaccination, and another 35% believe that the virus will be transmitted after vaccination. 5). 61% of people will choose to use it in the trash can where there is a remarkable collection of discarded masks. This shows that providing a convenient and correct trash can is very beneficial to prevent the spread of the virus. 6). According to CDC's guidance, discarded masks should be put in plastic bags, but surveys show that only 7% of people have done so. 7). Regarding whether to continue to wear a mask after vaccination, 78% of people will continue to wear a mask. The performance is excellent. 8). 89% of parents will let their children be vaccinated when vaccines for teenagers can be provided. This shows that most adults agree that vaccination is an effective way to control the epidemic. Of course, this may also be related to the high education level of the interviewee.

- **Adolescent (12-18)**

The content of the questionnaire feedback from the youth group: 1). 57% of the youth will choose to use surgical masks, which is higher than the proportion in the adult group. 2). 58% of teenagers will use masks for more than one day, which is slightly higher than the adult group, indicating that students will be lazier to change masks. Failure to comply with CDC's time requirements for mask replacement. 3). 71% of

people will discard or clean masks after school, much higher than the adult group. Adolescents' awareness of using masks is slightly higher than that of their parents. 4). 59% believe that the virus may continue to spread after vaccination, and 23% believe that the virus will still be transmitted after vaccination. 5). 61% of people will choose to use it in the trash can where there is a remarkable collection of discarded masks. This shows that providing a convenient and correct trash can is very beneficial to prevent the spread of the virus. 6). According to CDC's guidance, discarded masks should be placed in plastic bags. A survey by the youth group showed that 12% of people would choose to do so. Slightly higher than the adult group. 7). Whether to continue to wear a mask after vaccination, 71% of people will continue to wear a mask, which is slightly lower than the adult group. 8). 92% of students who can provide vaccines for teenagers will be vaccinated. This shows that most students agree that vaccination is an effective way to control the epidemic.

● **Single campus situation**

➤ Newton South High School (Newton Public School)

Newton South High School students: 1911⁸

Expenses Per Student in Newton \$23,499 / year⁸

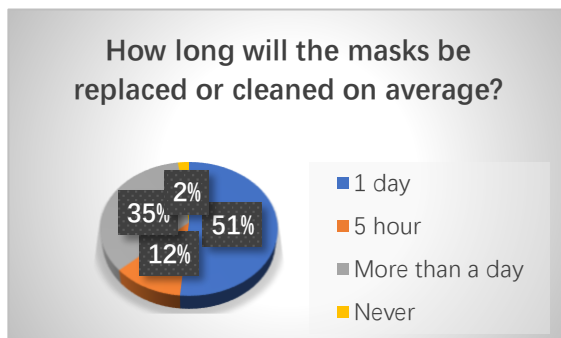
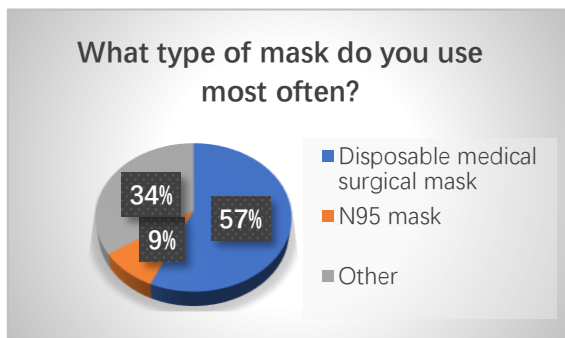
For population 25 years and over in Newton: Bachelor's degree or higher: 81.1%⁵

Graduate or professional degree: 51.2%⁵

Median Household Income in Newton in 2019: \$150,106⁵

Median Home Value in Newton in 2019: \$944,200⁵

Percentage of residents living in poverty in Newton in 2019: 5.6%⁵

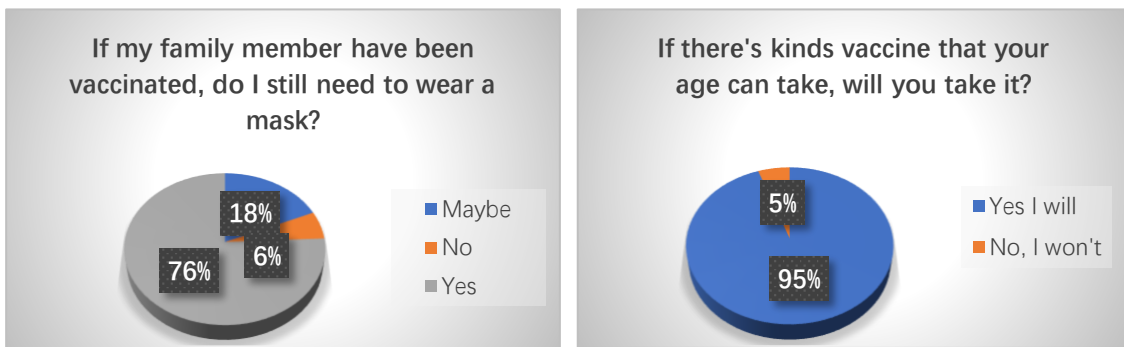


NSHS students have implemented the preventive measures against the epidemic virus well. 57% of the students choose to wear surgical masks with real preventive effects, and more than half of the students will change the masks within a day.



Less than one-third of the students will put their masks casually. According to the data, more than two-thirds of the students can put the masks in their bags or bags after use to avoid the possibility of secondary

infection. The feedback of these data can see that the NSHS students are doing well in implementing the epidemic prevention measures.

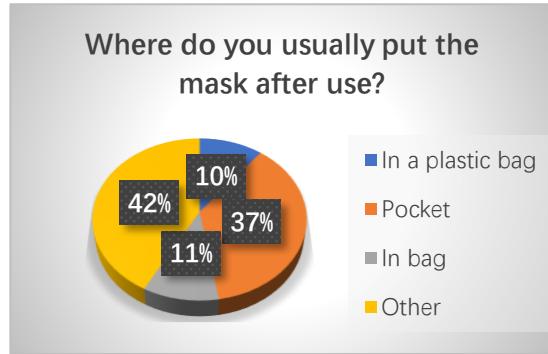


Similarly, it can be seen from the data feedback that NSHS students generally have a high awareness of vaccines. More than two-thirds of the students answered correctly about the wearing of masks after vaccination and whether they should be vaccinated. This reflects the students have a good understanding of the role of vaccines and preventive measures.

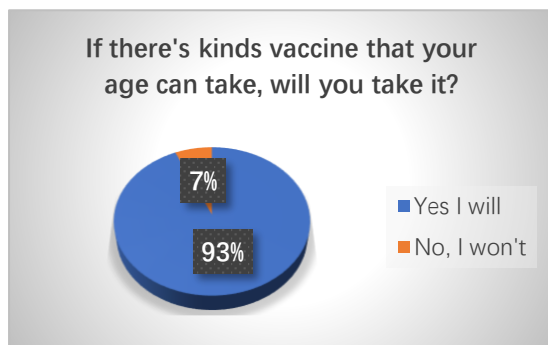
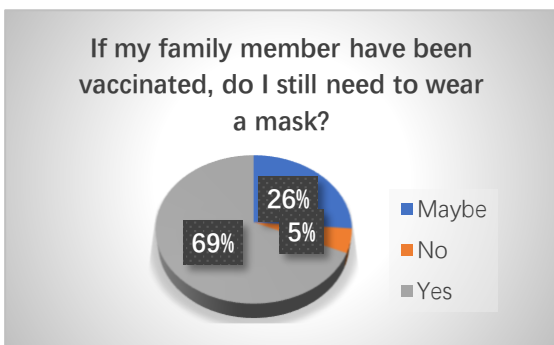
- Mount Alvernia High School (Private School)
 Mount Alvernia High School students: 204⁸
 Yearly Tuition: \$16,300⁸



Data feedback from Mount Alvernia School also revealed some hidden dangers. Among them, nearly 50% of the students did not use masks with real protective effects, giving feedback to a certain degree of potential risks. And there are also almost 50% of the data feedback that they will not clean or replace the masks after school. The combined comparison of these two data is not difficult to see that there is already a big deal in the most basic "mask" of preventive measures. Hidden dangers. After the masks with preventive effects are not used, the shows are not cleaned or replaced. This will significantly increase the probability of being infected and the possibility of spreading to others.



And in terms of the disposal of masks after the incident, 42% of the students said they would place them in other places, which would also lead to a substantial increase in the possibility of secondary infections.



However, it can be seen from the data feedback that Mount Alvernia students have excellent knowledge and awareness of vaccines. More than 90% of the students answered correctly about wearing masks after vaccination and whether they should be vaccinated. This reflects those students have a good understanding of the role of vaccines and preventive measures.

➤ Oak Hill Middle School (Newton Public School)

Oak Hill Middle School students: 630⁸

Expenses Per Student in Newton \$23,499 / year⁸

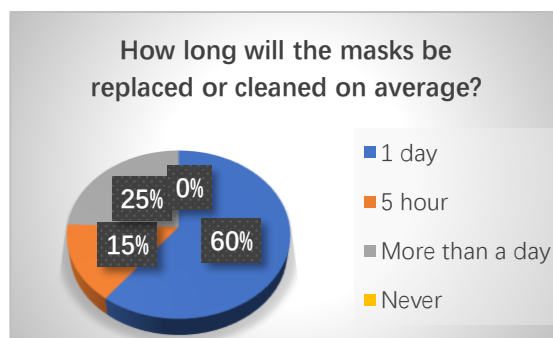
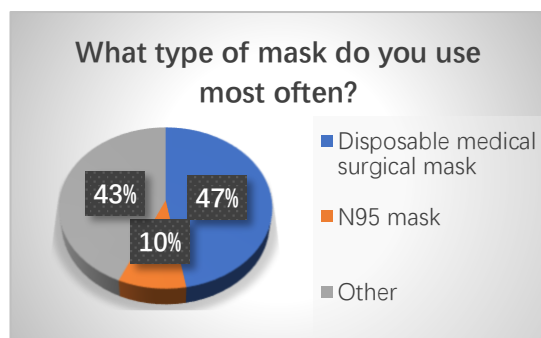
For population 25 years and over in Newton: Bachelor's degree or higher: 81.1%⁵

Graduate or professional degree: 51.2%⁵

Median Household Income in Newton in 2019: \$150,106⁵

Median Home Value in Newton in 2019: \$944,200⁵

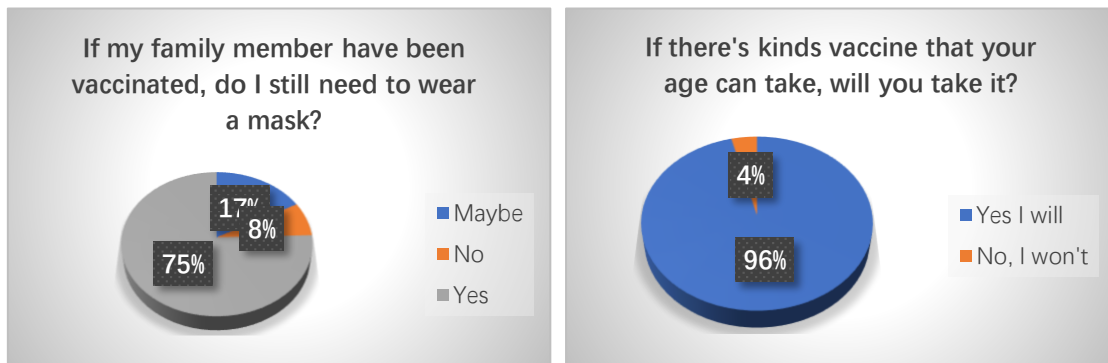
Percentage of residents living in poverty in Newton in 2019: 5.6%⁵



According to Oak Hill's data feedback, Oak Hill's students have a good understanding and implementation of epidemic prevention measures. Half of the students used surgical masks with adequate protection in shows, and the other half of the students answered. It reflects that in the case of their non-surgical covers if they are not replaced or cleaned and disinfected in time, there is a hidden risk of infection if they are not vaccinated.

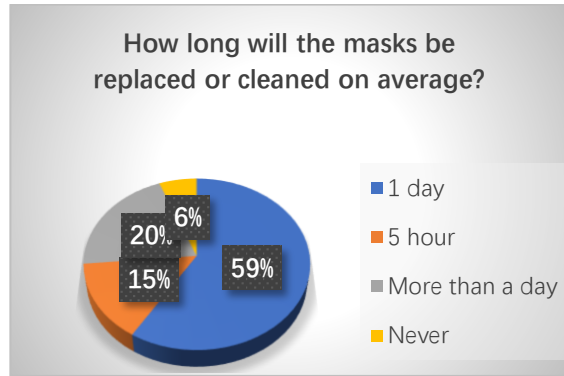
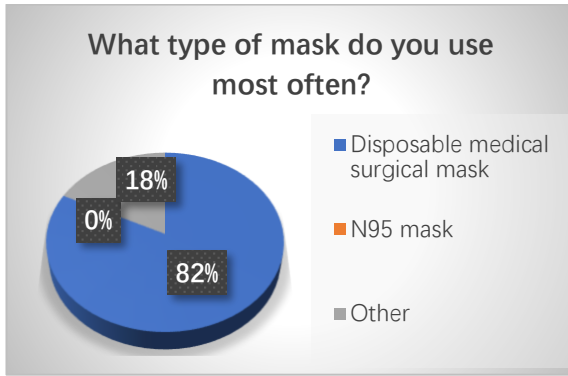


However, from the feedback after using the mask, it can be concluded that although the awareness of the mask is very good, less than half of the people who only questioned that the mask will be placed in a relatively sealed place after use, to prevent the possibility of secondary spread at that time, more than 60% of people will choose to put it in other places, which increases the risk of infection.

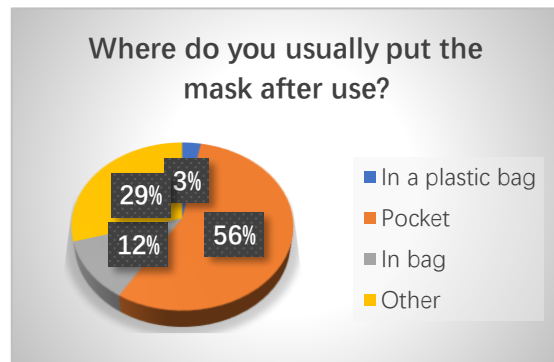


However, it can be seen from the data feedback that Oak hill students have a piece of excellent knowledge and awareness of vaccines. More than 95% of students have a positive attitude towards wearing masks after vaccination and whether they should be vaccinated. This reflects those students have a good understanding of the role of vaccines and preventive measures.

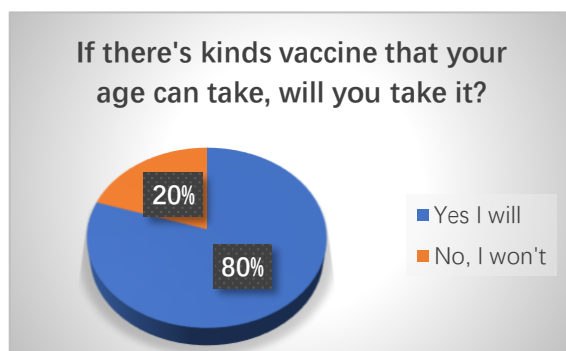
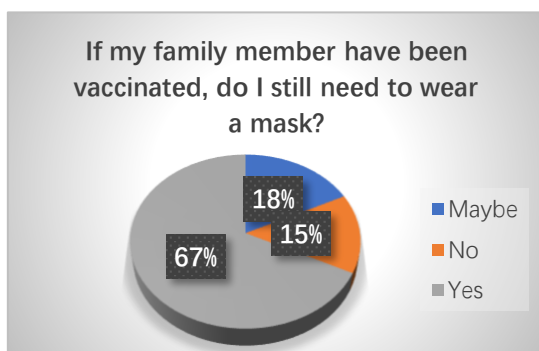
- Dover Sherborn High School (Dover Public School)
 - Dover Sherborn high school students: 674⁸
 - Expenses Per Student in Dover \$21,682 / year⁸
 - For population 25 years and over in Dover: Bachelor's degree or higher: 80.8%⁵
 - Graduate or professional degree: 54.1%⁵
 - Median Household Income in Dover in 2019: \$200,000⁵
 - Median Home Value in Dover in 2019: \$1,000,000⁵
 - Percentage of residents living in poverty in Dover in 2019: 0.5%⁵



According to data from Dover high school, up to 82% of students will use surgical masks, and 60% of students will change their masks within one day. This may be related to residents' financial income ability and education level. The data also reported that 6% of students never cleaned or replaced the masks after using them. This means that masks not only cannot be used as a protective measure to prevent the epidemic, but they may also become a carrier of transmission. They have increased the possibility of infection.



Similarly, in the data on the disposal of masks after use, 29% of Dover students choose to place them in bare spaces at will. This will increase the possibility of the second transmission of covers after use to others and significantly increase the potential safety hazards.



However, it can be seen from the data feedback that Dover's students have a piece of excellent knowledge and awareness of vaccines. More than 2/3 of the students' responses to the mask-wearing condition after vaccination and whether they should be vaccinated are correct. This reflects those students have a good understanding of the role of vaccines and preventive measures.

- Beebe School (Malden Public School)
Beebe School students: 903⁸

Expenses Per Student in Malden \$17,253/ year⁸

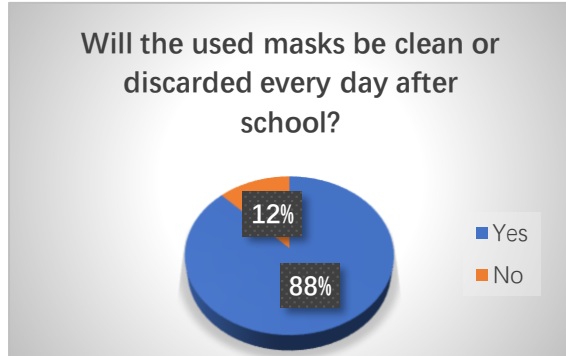
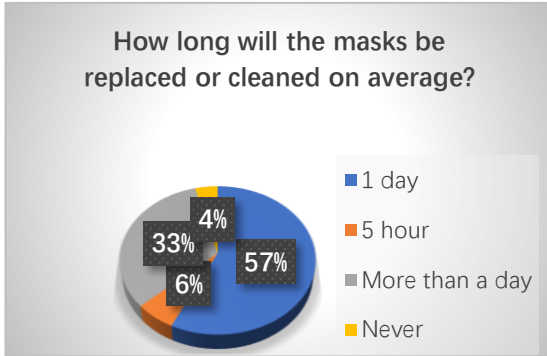
For population 25 years and over in Malden: Bachelor's degree or higher: 39.0%⁵

Graduate or professional degree: 15.9%⁵

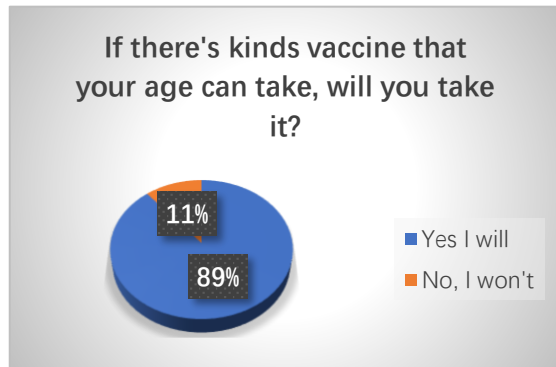
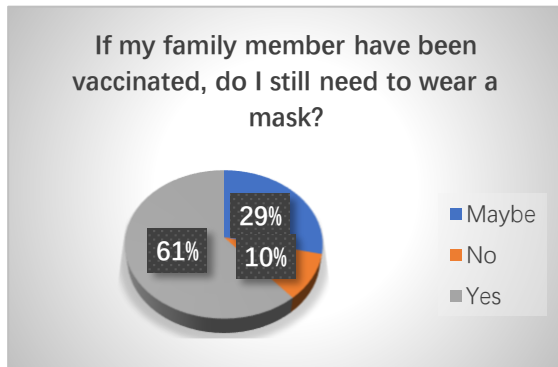
Median Household Income in Malden in 2019: \$68,838⁵

Median Home Value in Malden in 2019: \$457,365⁵

Percentage of residents living in poverty in 2019: 15.5%⁵



Judging from the data feedback, Beebe students' responses regarding the awareness and implementation of the epidemic prevention measures are excellent. Still, the unique feature is that Beebe's statistics show that masks are not replaced or cleaned. In the statistics, nearly 4% of the data responded that they never change or plot masks, which presents a huge hidden danger. This means that masks not only cannot be used as a protective measure to prevent the epidemic but become a carrier of transmission, which dramatically increases the possibility of infection.



However, it can be seen from the data feedback that Beebe students have excellent knowledge and awareness of vaccines. More than 2/3 of the students' responses to the mask-wearing condition after vaccination and whether they should be vaccinated are correct. This reflects those students have a good understanding of the role of vaccines and preventive measures.

- Mystic Valley Regional Charter School- High School (Public School) Draw lots from students registered in Everett, Malden, Medford, Melrose, Stoneham, and Wakefield to determine which child will go to school.

Mystic Valley Regional Charter School K-12: 1575⁸

Down here is some information about each town:

Everett:

Expenses Per Student in Everett \$17,578/ year⁸
Population 25 years and over in Everett: Bachelor's degree or higher: 20.0%⁵
Graduate or professional degree: 7.1%⁵
Median Household Income in Everett in 2019: \$68372⁵
Median Home Value in Everett in 2019: \$461,803⁵
Percentage of residents living in poverty in Everett in 2019: 12.6%⁵

Malden:

Expenses Per Student in Malden \$17,253/ year⁸
Population 25 years and over in Malden: Bachelor's degree or higher: 39.0%⁵
Graduate or professional degree: 15.9%⁵
Median Household Income in Malden in 2019: \$68,838⁵
Median Home Value in Malden in 2019: \$457,365⁵
Percentage of residents living in poverty in 2019: 15.5%⁵

Medford:

Expenses Per Student in Medford \$20,144/ year⁸
Population 25 years and over in Medford: Bachelor's degree or higher: 53.8%⁵
Graduate or professional degree: 27.2%⁵
Median Household Income in Medford in 2019: \$100,641⁵
Median Home Value in Medford in 2019: \$569,914⁵
Percentage of residents living in poverty in Medford in 2019: 8.8%⁵

Melrose:

Expenses Per Student in Melrose \$14,376/ year⁸
Population 25 years and over in Melrose: Bachelor's degree or higher: 61.6%⁵
Graduate or professional degree: 31.4%⁵
Median Household Income in Melrose in 2019: \$111,597⁵
Median Home Value in Melrose in 2019: \$649,005⁵
Percentage of residents living in poverty in Melrose in 2019: 4.1%⁵

Stoneham:

Expenses Per Student in Stoneham \$17,514/ year⁸
Population 25 years and over in Stoneham: Bachelor's degree or higher: 46.3%⁵
Graduate or professional degree: 18.2%⁵
Median Household Income in Stoneham in 2019: \$105,956⁵
Median Home Value in Stoneham in 2019: \$562,858⁵
Percentage of residents living in poverty in Stoneham in 2019: 5.0%⁵

Wakefield:

Expenses Per Student in Wakefield \$16,583/ year⁸
Population 25 years and over in Wakefield: Bachelor's degree or higher: 51.2%⁵
Graduate or professional degree: 21.5%⁵
Median Household Income in Wakefield in 2019: \$104,630⁵
Median Home Value in Wakefield in 2019: \$575,604⁵
Percentage of residents living in poverty in Wakefield in 2019: 4.2%⁵

Because the sample size of the school questionnaire is too small, no specific analysis is made, only the data is provided as a reference.

Solution for Secondary Transmission of Discarded Masks and Vaccination in Schools

What type of mask do you use most often?		How long will the masks be replaced or cleaned on average?		Will the used masks be clean or discarded every day after school?		Do you think the virus will be transmitted after vaccination?	
Disposable medical surgical mask	9	1 day	10	Yes	10	Yes	1
N95 mask	1	5 hours	0			No	1
Other	1	More than a day	1	No	1	Maybe	9
		Never	0				

Will discarded masks be thrown in a special medical waste trash can?		Where do you usually put the mask after use?		If my family member has been vaccinated, do I still need to wear a mask?		If there's kinds of vaccine that your age can take, will you take it?	
Maybe if there is special medical waste trash can	9	In a plastic bag	2	Maybe	6	Yes, I will	9
		Pocket	0				
Yes	1	In bag	0	Yes	5	No, I won't	0
No	1	Other	9	No	0		

➤ Charles E. Brown Middle School (Newton Public School)

Charles E. Brown Middle School students: 744⁸

Expenses Per Student in Newton \$23,499 / year⁸

For population 25 years and over in Newton: Bachelor's degree or higher: 81.1%⁵

Graduate or professional degree: 51.2%⁵

Median Household Income in Newton in 2019: \$150,106⁵

Median Home Value in Newton in 2019: \$944,200⁵

Percentage of residents living in poverty in Newton in 2019: 5.6%⁵

Because the sample size of the school questionnaire is too small, no specific analysis is made, only the data is provided as a reference.

What type of mask do you use most often?		How long will the masks be replaced or cleaned on average?		Will the used masks be clean or discarded every day after school?		Do you think the virus will be transmitted after vaccination?	
Disposable medical surgical mask	1	1 day	1	Yes	2	Yes	1
N95 mask	0	5 hours	0			No	0
Other	2	More than a day	1	No	1	Maybe	2
		Never	1				

Will discarded masks be thrown in a special medical waste trash can?		Where do you usually put the mask after use?		If my family member has been vaccinated, do I still need to wear a mask?		If there's kinds of vaccine that your age can take, will you take it?	
Maybe if there is special medical waste trash can	2	In a plastic bag	0	Maybe	1	Yes, I will	2
		Pocket	0				
Yes	1	In bag	2	Yes	0	No, I won't	0
No	0	Other	1	No	2		

➤ Malden High school (Malden Public School)

Malden High school students: 1845⁸

Expenses Per Student in Malden \$17,253/ year⁸

For population 25 years and over in Malden: Bachelor's degree or higher: 39.0%⁵

Graduate or professional degree: 15.9%⁵

Median Household Income in Malden in 2019: \$68,838⁵

Median Home Value in Malden in 2019: \$457,365⁵

Percentage of residents living in poverty in 2019: 15.5%⁵

Because the sample size of the school questionnaire is too small, no specific analysis is made, only the data is provided as a reference.

What type of mask do you use most often?		How long will the masks be replaced or cleaned on average?		Will the used masks be clean or discarded every day after school?		Do you think the virus will be transmitted after vaccination?	
Disposable medical surgical mask	5	1 day	4	Yes	5	Yes	0
N95 mask	0	5 hours	1			No	1
Other	0	More than a day	0	No	0	Maybe	4
		Never	0				

Will discarded masks be thrown in a special medical waste trash can?		Where do you usually put the mask after use?		If my family member has been vaccinated, do I still need to wear a mask?		If there's kinds of vaccine that your age can take, will you take it?	
Maybe if there is special medical waste trash can	5	In a plastic bag	3	Maybe	1	Yes, I will	2
		Pocket	2				
Yes	0	In bag	0	Yes	1	No, I won't	0
No	0	Other	0	No	3		

RESULTS

- Mask effective solving solution**

According to the feedback data collected, we found that the reasons for the differences in the results of questionnaires among different schools are as follows. During the investigation process, we searched the income obtained in the school location. We found that the higher the median household income, the more significant the proportion of students using N95 or medical surgical masks. The lower the payment, the higher the balance of using ordinary. Most medical surgical masks are disposable. N95 veneers can only be used a few times, and the use cost is relatively high. The standard cover can be used after repeated washing, and the cost of use is low. Although medical surgical masks and N95 masks have the best protective effects, the lack of PPE during the epidemic caused prices to soar. This may be one of the reasons for the relatively low proportion of surgical masks and N95 masks used in areas with lower economic income. There is no significant difference in the proportion of residents' education level to the use of shows. Regarding the disposal of masks, the feedback results of each school reflect different advantages and disadvantages, but overall, the implementation of epidemic prevention is excellent. For example, according to data feedback from NSHS, most students can put the used masks in a sealed environment to reduce secondary infection. However, the results of data feedback from some schools are not very optimistic, and it is still necessary to continue to improve the awareness and implementation of preventive measures.

Judging from the data collected, adults and adolescents have excellent understanding and initiative for vaccination. Based on the analysis of the differences in education and income of residents in different regions and the proportion of poor people, these factors did not affect students' understanding of vaccination. All students interviewed showed a high willingness to vaccinate, and there was no regional difference. This indicates that under the vigorous publicity of the media and schools, residents in all interviewed areas have gained a complete understanding of whether the vaccine can protect against COVID-19. But here we need to remind you that whether you are an adult or a teenager, each body has a different constitution, and you must decide whether it is suitable for vaccination according to your physical condition.

SOLUTION

- **Suggestions about virous prevention:**

Although most people's measures to prevent the epidemic are now well implemented, as the saying goes, details determine success or failure. There are still some hidden dangers regarding the disposal of masks after use. Based on the phenomenon reflected in the data feedback, we suggest: Please remember to place the front in a relatively sealed environment after use and replace or clean it as soon as possible to reduce the possibility of infection caused by the mask after use.¹

- **Suggestions about Vaccine:**

Although each body's constitution is different, and the short-term effects of side effects after vaccination may be other, experiments can prove that the current vaccine can play an apparent preventive impact. Although the data collected reflects that most of the students and parents are willing to take the initiative to vaccinate, but a small number of people still hold a wait-and-see attitude or refuse. Based on the good results reflected in the vaccine experiment, we give another suggestion: For your safety, please get the vaccine as soon as possible.

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