
COVID-19 Vaccine Hesitancy Assessment

October 2021

Tori Doll, AmeriCorps VISTA Member



Executive Summary:

As the COVID-19 pandemic and the use of the COVID-19 vaccine enter into their second year, COVID-19 vaccination rates remain relatively low worldwide. Low vaccination rates can be largely attributed to vaccine hesitations and misinformation rather than availability of the vaccine at this point in time within the United States. The *COVID-19 Vaccine Hesitancy Survey* was created to gather information about individuals' hesitations or beliefs towards the vaccine within the Billings community to help address the low vaccination rate. Survey data from 76 respondents are summarized and displayed throughout this report. Given the feedback provided by community members, the following hesitations/beliefs are the most important to be addressed:

- Vaccine Development and Approval
- Vaccine Safety and Side Effects
- Vaccine Information
- Vaccine Efficacy and Effectiveness

Introduction:

COVID-19 is a zoonotic disease (a disease which can be transferred between animals and humans) that most often causes respiratory system symptoms and can result in fatality.¹ COVID-19, and more specifically the virus that causes COVID-19, SARS-CoV-2, was first discovered in Wuhan, China in December 2019 and has since led to a global health crisis that continues today. In an effort to end the COVID-19 pandemic, several pharmaceutical companies, including Pfizer/BioNTech, Moderna, Johnson & Johnson, AstraZeneca, and Sinovac, launched efforts to create a COVID-19 vaccine.² Currently, there are 123 different COVID-19 vaccines in development worldwide. The COVID-19 vaccine developed by Pfizer/BioNTech was the first vaccine to be approved via emergency use authorization (EUA) by the U.S. Food and Drug Administration (FDA) on December 11, 2019.³ The FDA currently has authorized three vaccines for use in the United States including Moderna and Johnson & Johnson under EUA and Pfizer/BioNTech under full authorization of use. Although the COVID-19 vaccine has been available for almost two years, COVID-19 vaccination rates remain relatively low worldwide and only 55.6% of those eligible for the vaccine within the United States have been fully vaccinated.⁴

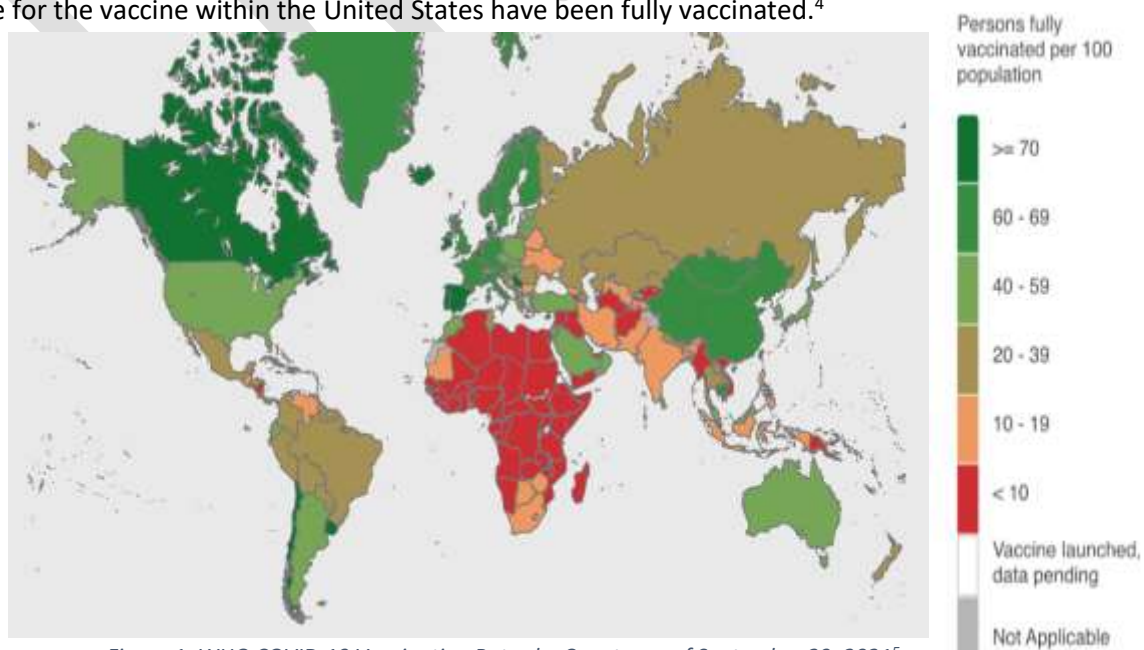


Figure 1: WHO COVID-19 Vaccination Rates by Country as of September 29, 2021⁵

Within the United States, there are some states and territories with COVID-19 vaccination rates as low as 34%.⁴ Low vaccination rates can be largely attributed to vaccine hesitancies and misinformation rather than availability of the vaccine at this point in time. According to the World Health Organization, vaccine hesitancy is among the top ten threats to global health and is defined as “the reluctance or refusal to vaccinate despite the availability of vaccines.”⁶ Vaccine hesitancy is not a static measure, but can wax and wane depending on several factors including, but not limited to, factors like the political climate and emerging variants.⁷ The last Yellowstone County vaccine hesitancy survey was conducted by RiverStone Health in January 2021. Since that date, there have been several new variants emerging such as the proliferate Delta variant, and many political climate changes, which could potentially have impacted vaccine hesitancy.

Based on their research into COVID-19 vaccine hesitancy, Kaiser-Permanente has determined there are seven different types of individuals when it comes to vaccination.⁸



Figure 2: The Individual Types and How to Address Their Concerns⁸

The *Steadfast Opponent* refers to individuals who do not see themselves getting the vaccine because it does not align with their beliefs. *Healthy Independents* believe the vaccine is fine for others and trust in their good health and immune systems above the vaccine. *Concerned Skeptics* are fearful of side effects and what short and/or long-term health implications may look like for their unique health conditions. For the *Indifferent Individuals*, getting the vaccine is not foremost in their thoughts. *Cautious Supporters* believe that the vaccine is helpful, but they have a few reservations. *Reluctant Vaxxers* have reservations about the vaccine relative to the rushed development and potential side effects. Finally, the *Vaccine Advocate*, refers to individuals who are fully supportive of getting the vaccine or have already been vaccinated.

The *COVID-19 Vaccine Hesitancy Survey* was designed to reflect the individual types described by Kaiser-Permanente and a few other common hesitancies or beliefs. The purpose of this survey was to determine what the vaccine hesitations are, within the current climate, to best direct vaccine efforts within the City of Billings.

Methods:

While the COVID-19 vaccine is readily available to everyone age 12 and older, many people are hesitant about receiving the vaccine. According to the Centers for Disease Control and Prevention (CDC), as of September 26, 2021, Montana currently ranks 46th out of 63 United States Territories and States for the percentage of eligible residents with at least one dose (55%) and 43rd for the percentage of eligible residents who are fully vaccinated (48%).⁴ Yellowstone County currently ranks below the Montana state average for individuals 12 and older who are fully vaccinated.⁹ In response to the low COVID-19 vaccination rates, the *COVID-19 Vaccine Hesitancy Survey* was created to gather local information about hesitancies or beliefs relative to the vaccine. Survey questions were developed to assess the most common hesitancies or beliefs attributed to the vaccine, while collecting enough demographic information to assess any differences within these demographic groups. The survey was reviewed by City staff, RiverStone Health, and St. Vincent de Paul who offered edits and revisions. The finalized *COVID-19 Vaccine Hesitancy Survey* consisted of 13 questions including two open-ended questions. The survey can be found in **Appendix A**.

The *COVID-19 Vaccine Hesitancy Survey* was intended to be a fully virtual survey and was publicized via flyers and social media to raise community awareness. Over 550 flyers were distributed to a wide array of community and local businesses and partners including: the Billings Metro VISTA Project Facebook page, the Billings Public Library, the City of Billings official website and social media accounts, RiverStone Health's Facebook page, signage within Billings MET Transit buses and transit hubs, HomeFront properties, downtown community bulletin boards, community parks, coffee shops, laundromats, and restaurants. A complete list of the flyer and social media distribution, as well as flyer examples, can be found in **Appendix A**. Additionally, to reach the homeless or transient populations without access to the internet, hard copies of the *COVID-19 Vaccine Hesitancy Survey* were distributed to the Community Crisis Center and St. Vincent de Paul along with collection boxes. Both the online and physical surveys were collected from August 2 through September 20, 2021.

In total, 104 surveys were collected and completed. After removing surveys of those respondents that stated that they were already vaccinated, or those who did not complete past the demographic section within the survey, 76 surveys were analyzed using statistical software, R.¹⁰

Results:

Demographics

Respondents were asked to answer seven questions to obtain demographic information including Age, Ethnicity, Race, Size of Household, Household Income, Special Circumstances, and Location. Data for these questions are presented in **Appendix B**. Special consideration should be taken when interpreting the results for the demographic section due to the skewed nature of the data. To be sensitive to the homeless and transient populations, questions regarding the household (location, household vaccination status, and number of household members) were excluded from distributed hard copy

surveys and, subsequently, from the analysis for those questions. Below are some key figures from the demographic section:

- **Age:** The 50-59 year old age group was the highest reporting age group with 22 respondents (29%) followed by 40-49 year olds (20 respondents; 27%).
- **Ethnicity:** Sixty respondents identified as non-Hispanic or Latino (87%).
- **Race:** Fifty-six respondents identified as White or Caucasian (81%).
- **Size of Household:** The average household size was three individuals. Twenty-four respondents reported having a household size of two individuals (37%).
- **Household Income:** Thirty-four respondents reported having a household income of 100% of the Area Median Income (AMI)¹¹ or greater (49%).
- **Special Circumstances:** Ten respondents indicated that they were currently experiencing homelessness (13%).
- **Location:** Nineteen respondents reported they lived in the Billings Heights (31%).

COVID-19 Vaccination within Household:

Respondents were asked to select whether any other members of their households had been previously vaccinated for COVID-19. Special consideration should be taken when interpreting the results for this question due to the skewed nature of the data as explained above. Sixty-two of the 76 respondents answered this question and responses are shown below in Figure 3. Forty-nine respondents reported no other household members who had already received the COVID-19 vaccine (79%) while 11 reported that other household members had already been vaccinated (18%).

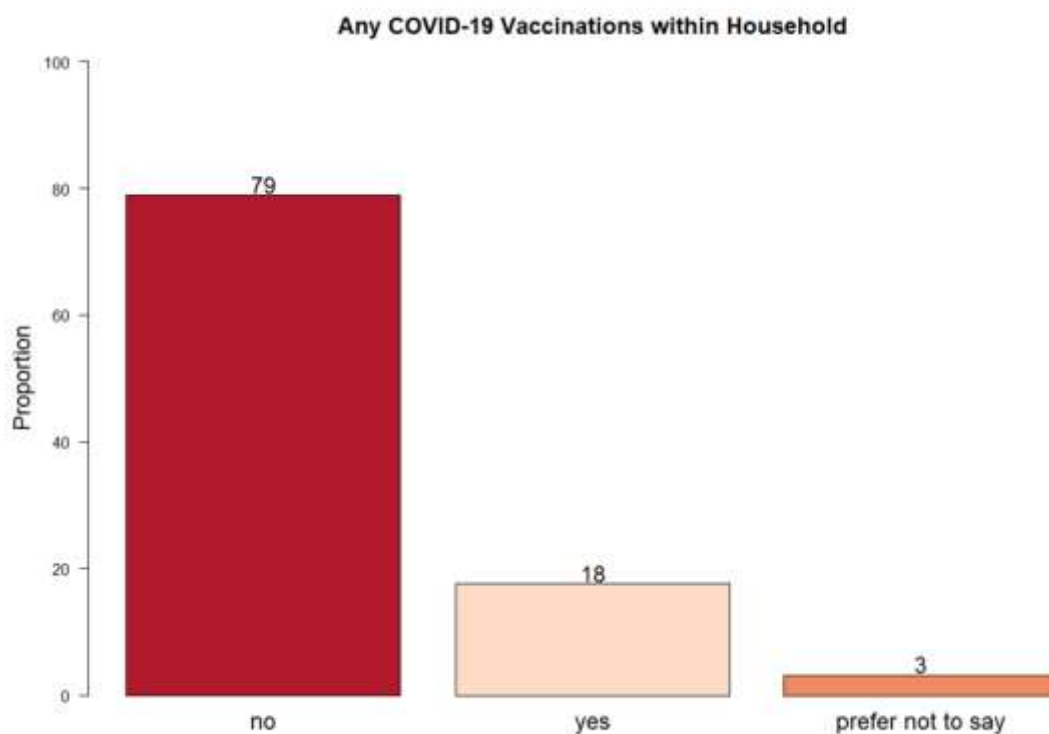


Figure 3: Household Vaccination Status

Overall Hesitancies and/or Beliefs:

Respondents were asked to select from a list of 19 hesitancy/belief options, with the ability to choose more than one answer, to best describe their hesitations. Each hesitancy/belief was assigned an abbreviation as well as a subsection grouping to which it will be referred to throughout this report as seen below in Table 1.

Table 1: Abbreviations, Groupings, and Full Descriptions of Hesitancies

	Abbreviation	Grouping	Full Hesitancy
1	Pandemic Over	Disbelief	I believe that the pandemic is almost over and the vaccine is unnecessary.
2	Side Effects	Vaccine Safety and Side Effects	I am concerned about possible side effects of the COVID-19 vaccine.
3	Safe	Vaccine Safety and Side Effects	I plan to wait and see if the vaccine is safe; if so I may get it later.
4	EUA	Vaccine Development and Approval	I plan to wait until the vaccine is fully approved by the FDA because I do not fully trust the emergency approval process.
5	Not Effective	Vaccine Efficacy and Effectiveness	I believe the vaccine is not effective.
6	Big Pharma	Trust	I do not trust "big pharma" and/or other vaccine profit motives.
7	Research	Vaccine Development and Approval	I believe the vaccine research and development were too rushed.
8	Conflicting Guidance	Vaccine Information	There is so much conflicting guidance; I do not know what is true about COVID-19 vaccines.
9	Healthcare Trust	Health System	I have trust issues with the healthcare system due to discrimination and inequality that I experienced in the past.
10	Vaccine Opposition	Disbelief	I do not believe I need a COVID-19 vaccine.
11	Already Had	Natural Remedies and Immunity	I already had COVID-19; the vaccine is unnecessary.
12	Breakthrough	Vaccine Efficacy and Effectiveness	I do not see the point in getting vaccinated if people are still catching COVID-19 after being fully vaccinated.
13	Allergies	Vaccine Safety and Side Effects	I am concerned about having an allergic reaction to the COVID-19 vaccine.
14	Vaccine Understanding	Trust	I do not trust COVID-19 vaccines or I do not want to put anything into my body that I do not fully understand.
15	Natural	Natural Remedies and Immunity	I already use other methods, such as natural remedies and activities, to combat the COVID-19 infection and they have worked so far.
16	Pre-Existing Condition	Vaccine Safety and Side Effects	I believe there is not enough information out about the effects on someone in my condition.
17	Insurance	Health System	I do not have health insurance and I do not believe I can afford the COVID-19 vaccine.
18	Long-term	Vaccine Efficacy and Effectiveness	I believe there has not been enough time to study the long-term effectiveness of the vaccine.
19	Sick leave	Vaccine Safety and Side Effects	I have no sick leave and am concerned the side effects of getting vaccinated may cause me to miss work.

The overall percentage of the hesitancies/beliefs selected by the 76 respondents are shown below in Figure 4. The top five selections were Side Effects (66%), Research (62%), Long-term (53%), Vaccine Understanding (49%) and Safe (45%).

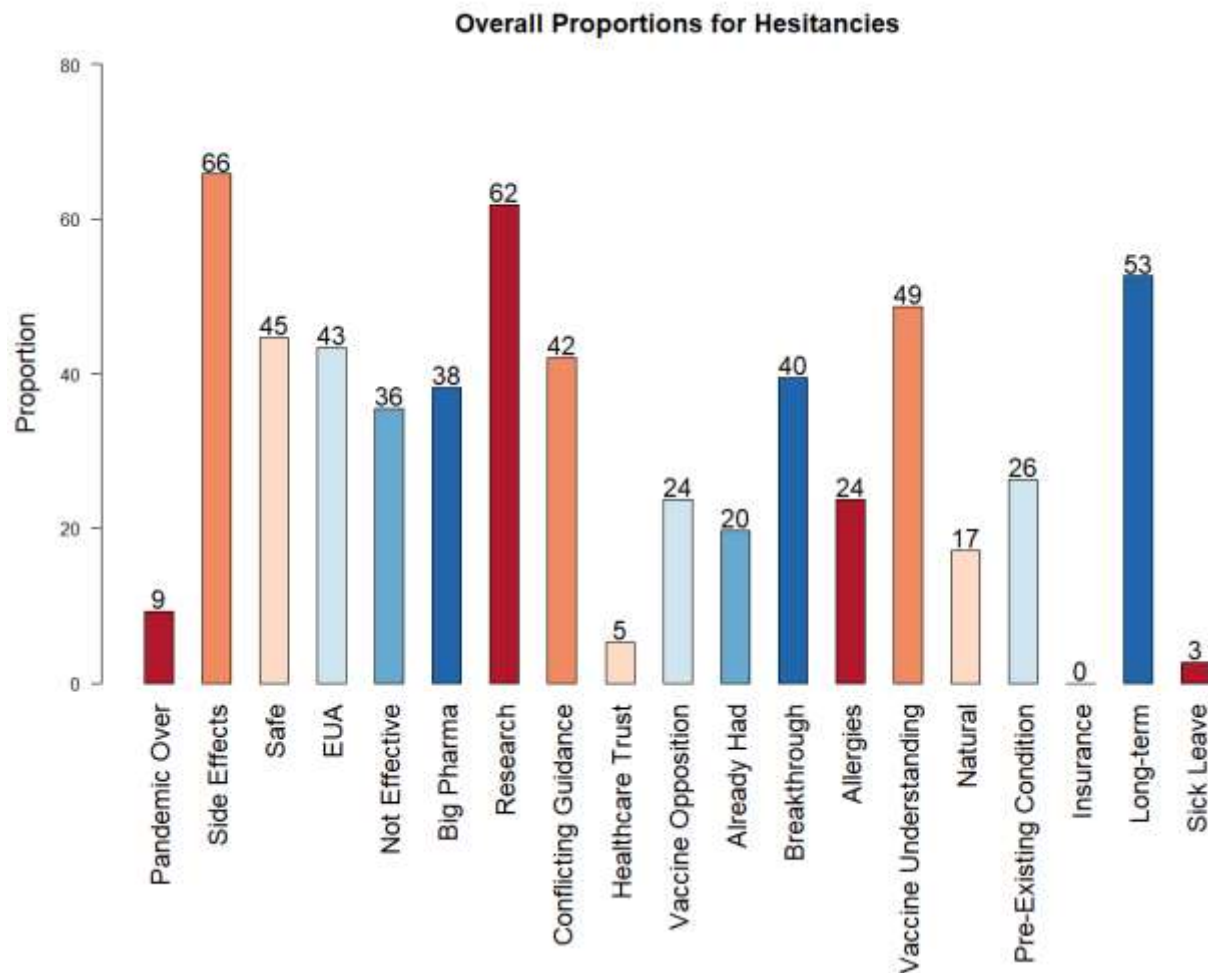


Figure 4: Overall Hesitancies

Likelihood of Vaccination and Best Times/Days for Vaccination Clinic to be held:

Respondents were asked to rank their likelihood of getting the COVID-19 vaccine in the future on a scale of one (considering it) to five (never getting it). Sixty-seven of the 69 respondents answered this question with an average ranking of approximately four. Thirty respondents answered with a ranking of five (40%).

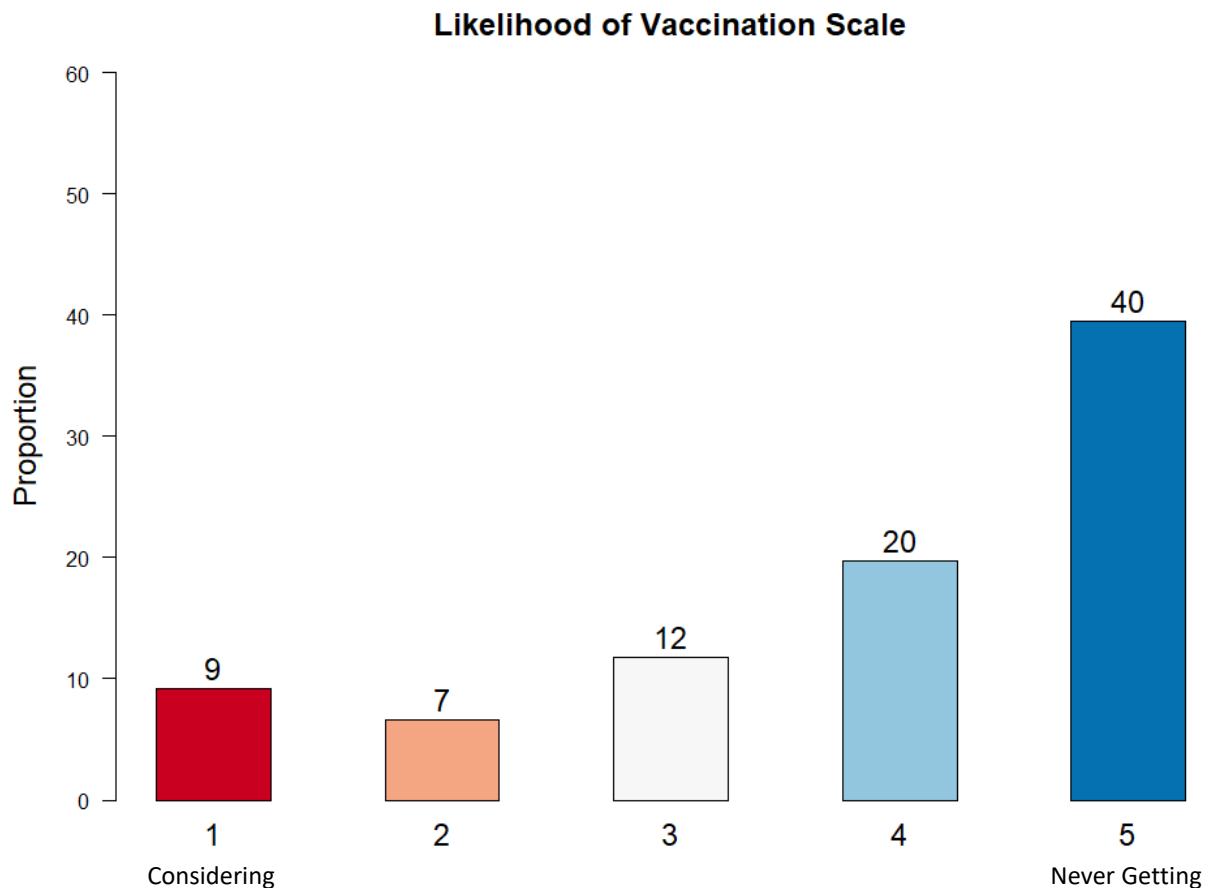


Figure 5: Likelihood of Vaccination based on 1 to 5 Scale

Respondents were asked to select from a list of seven days and six times, with the ability to choose more than one answer, to best describe when they would be available for a potential COVID-19 vaccination clinic in the future. The top three choices for days were Sunday (16 respondents; 21%), Friday (14 respondents; 18%) and Monday (14 respondents; 18%). Thirteen of the respondents chose the time of 12:00 p.m. – 2:00 p.m. as the best option for a clinic (17%).

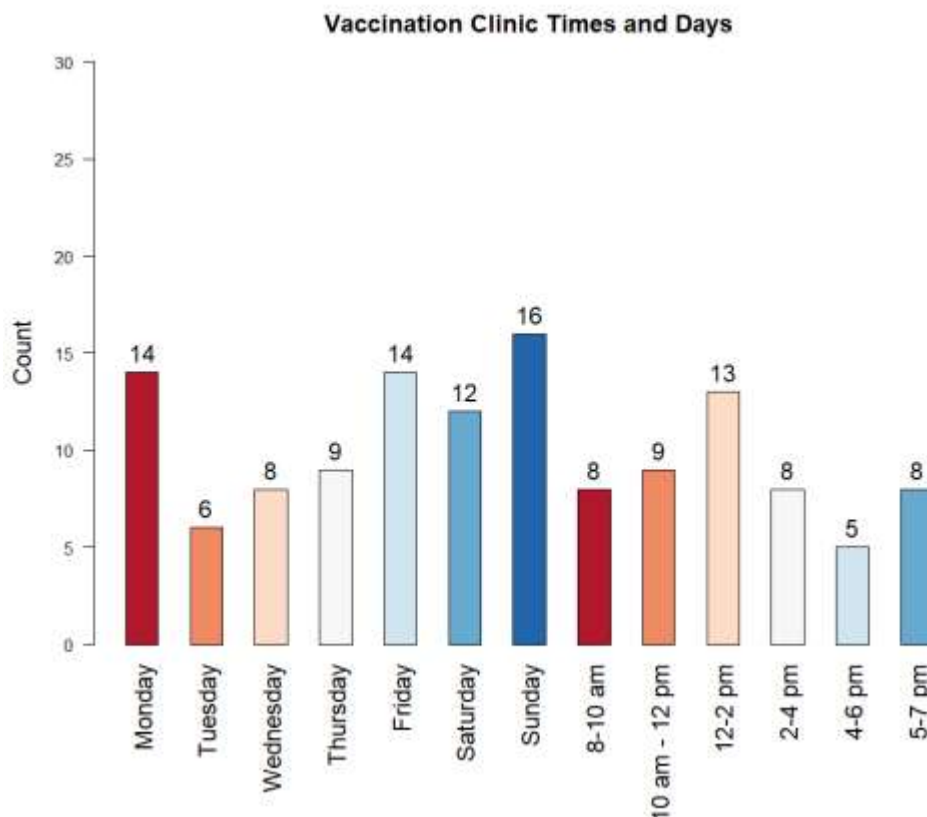


Figure 6: Vaccination Clinic Times and Days

Open-ended comment sections about COVID-19 vaccine and the general pandemic:

Respondents were given two open-ended comment sections to address any other hesitations or concerns they had about the COVID-19 vaccine as well as any thoughts or concerns they had about the Coronavirus pandemic or relief efforts. Twenty-nine of the 76 respondents completed at least one of these open-ended sections. The responses from the two questions were combined as all respondents talked about the COVID-19 vaccine in the open-ended section about the general pandemic. These responses were then categorized by key phrases or words and a word cloud was generated. The larger the phrase appears, the more times it was mentioned. The phrases of “too politicized” (10), “contradictory numbers/information” (7), “personal choice freedom” (5), “side effects” (4), “pointless” (4), “fertility” (2), and “already had COVID-19” (2) were the phrases with more than one response.

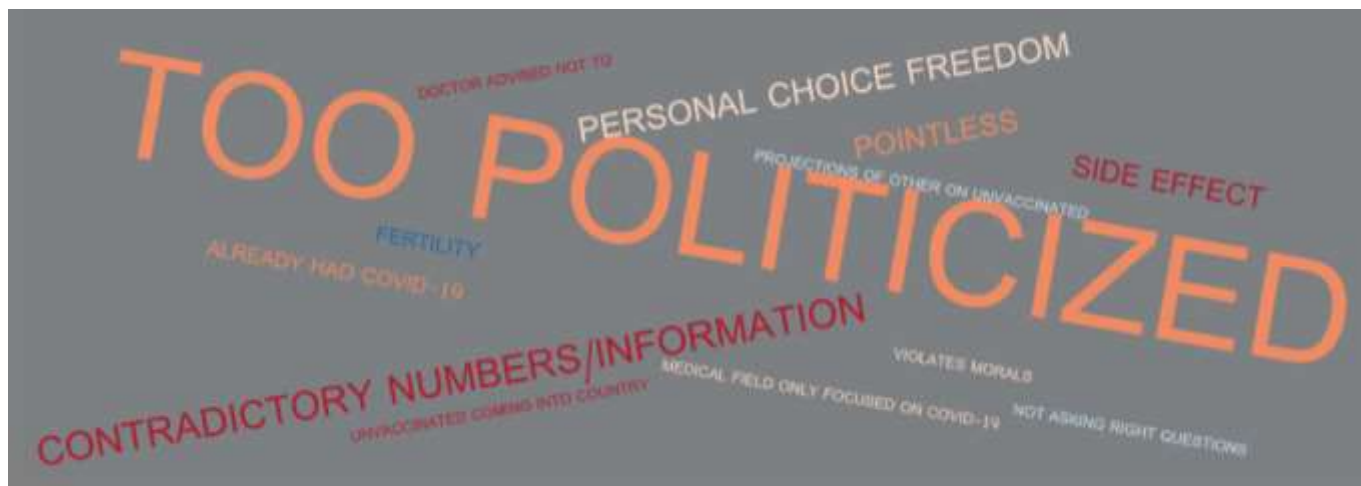


Figure 7: Word Cloud by Most Popular Categories for Open-ended Questions

Discussion:

Demographics:

In order to determine the comparability of the survey sample and the general population of Billings, several of the demographic results were compared to U.S. Census data for the City of Billings. The race and ethnicity data was comparable to that of the census with a much greater proportion of respondents identifying as American Indian or Alaska Native for race and a smaller proportion of respondents identifying as Hispanic or Latino for ethnicity. Complete data for race and ethnicity are shown below in Table 2.

Table 2: Race and Ethnicity for Survey and U.S. Census for the City of Billings

Race/Ethnicity	Survey	Billings Census ¹²
White	82%	89%
Black or African American	0%	1%
American Indian or Alaska Native	13%	5%
Asian	0%	1%
Native Hawaiian and Other Pacific Islander	0%	0%
Two or More Races	3%	4%
Hispanic or Latino	3%	6%
Not Hispanic or Latino	87%	85%

The average household size among survey respondents was determined to be 3.06, which is greater than the average household size for Billings (2.27) reported by U.S. Census data. In the U.S. Census data, only 10% of the City of Billings population was stated to be persons in poverty whereas a much higher proportion (42%) of the survey respondents stated that they were living at or below 80% AMI.¹¹ The differences in race and ethnicity and household income may be attributed to the method of distribution. Nineteen of the 76 respondents (25%) responded via paper surveys placed at St. Vincent de Paul and the Community Crisis Center. Each of these service providers serve the homeless or transient populations as well as those living in poverty. According to the United States Department of Housing and Urban

Development, although Native Americans make up a small portion of the total population in Montana, they make up nearly 19.9% of state's homeless population.¹³ This can potentially explain the difference between the survey population and the general population of Billings.

Comparison to National Surveys:

In order to determine how the *COVID-19 Vaccine Hesitancy Survey* results compared to those on a national level, the vaccination status of the household and overall hesitancies were compared between this survey, the Kaiser Family Foundation (KFF) National Survey, and the Household Pulse National Survey.^{14, 15} The KFF survey found that in those hesitant about the COVID-19 vaccine, 75% lived with all unvaccinated household members and only 22% lived in a mixed vaccinated and unvaccinated household. This closely matches what was found in the *COVID-19 Vaccine Hesitancy Survey*, shown below in Table 3, which may indicate that universally those that are unvaccinated are more likely to live in a household where every member is unvaccinated compared to a mixed household.

Table 3: Comparison of Vaccinated Status of Household from Survey and KFF National Survey

Other Household Members	Survey	Kaiser National Survey¹⁴
<i>Vaccinated</i>	18%	22%
<i>Unvaccinated</i>	79%	75%

The overall hesitancies and beliefs, which were mentioned in the three surveys, were compared and are shown below in Table 4. Overall, concerns about possible side effects was ranked first across all three surveys. The concern about breakthrough infection, which can be defined as the ability to still contract COVID-19 even though the individual is fully vaccinated, was much higher in the *COVID-19 Vaccine Hesitancy Survey* (49%) than the Household Pulse National Survey (20%). This difference could potentially be due to the timeframe of data collection. The Household Pulse National Survey was collected in March 2021 compared to August-September 2021 for the *COVID-19 Vaccine Hesitancy Survey*. During this time, the emergence of the Delta variant may have made breakthrough infections more prominent increasing concerns and hesitations. The other hesitancies or beliefs mentioned were relatively similar between the three surveys in ranking and selection percentage by respondent.

Table 4: Comparison of Hesitancies/Beliefs from Survey, KFF National Survey, and Household Pulse National Survey

Hesitancy or Belief	Survey	Kaiser National Survey¹⁴	Household Pulse National Survey¹⁵
<i>Side Effects</i>	66%	53%	48%
<i>Safe</i>	45%	37%	38%
<i>Vaccine Opposition</i>	24%	38%	27%
<i>Vaccine Understanding</i>	40%	26%	36%
<i>Breakthrough</i>	49%	-	20%
<i>Pre-Existing Condition</i>	27%	14%	6%
<i>Sick Leave</i>	3%	7%	-

Age Group and Overall Hesitancies/Beliefs:

Because vaccination rates are not equal between the age groups within Billings, the reported hesitancies/beliefs of the respondents were further broken down to examine them so that the results

can better address each group. The proportion of respondents within each age group were calculated for each hesitancy and concern and then ranked in order of highest proportion to lowest proportion. Those who stated “Prefer not to say” were excluded from this portion of the analysis as well as those who stated they were in the 60-69 year old age group due to low numbers of respondents. The final ranking of the hesitancies/beliefs by age group is shown below in Table 5. The hesitancies are colored from dark red (highest proportion) to dark blue (lowest proportion) based on the proportion of the age group that selected that specific hesitancy.

Table 5: Ranking of Hesitancies by Age Group

	18-29 Year Olds (n=13)	30-39 Year Olds (n=16)	40-49 Year Olds (n=20)	50-59 Year Olds (n=22)
1	Side Effects (77%)	Long-term (56%)	Side Effects (65%)	Side Effects (73%)
2	Safe (62%)	Research (50%)	Research (65%)	Vaccine Understanding (73%)
3	Research (62%)	Side Effects (44%)	Not Effective (50%)	Research (68%)
4	Conflicting Guidance (62%)	Safe (44%)	Breakthrough (40%)	EUA (55%)
5	Long-term (62%)	Big Pharma (44%)	Vaccine Understanding (40%)	Long-term (55%)
6	EUA (54%)	Conflicting Guidance (44%)	Long-term (40%)	Safe (50%)
7	Pre-existing Condition (54%)	EUA (38%)	Safe (35%)	Big Pharma (50%)
8	Breakthrough (46%)	Already Had (31%)	Big Pharma (35%)	Breakthrough (46%)
9	Vaccine Understanding (46%)	Vaccine Understanding (31%)	Vaccine Opposition (35%)	Conflicting Guidance (41%)
10	Vaccine Opposition (31%)	Not Effective (25%)	EUA (30%)	Not Effective (27%)
11	Already Had (31%)	Breakthrough (25%)	Conflicting Guidance (30%)	Allergies (23%)
12	Allergies (31%)	Allergies (25%)	Allergies (15%)	Pre-existing Condition (23%)
13	Natural (31%)	Pre-existing Condition (25%)	Pandemic Over (10%)	Pandemic Over (14%)
14	Not Effective (23%)	Vaccine Opposition (13%)	Already Had (10%)	Vaccine Opposition (14%)
15	Pandemic Over (8%)	Natural (6%)	Natural (10%)	Already Had (14%)
16	Big Pharma (8%)	Pandemic Over (0%)	Pre-existing Condition (10%)	Healthcare Trust (9%)
17	Sick Leave (8%)	Healthcare Trust (0%)	Healthcare Trust (5%)	Natural (5%)
18	Healthcare Trust (0%)	Insurance (0%)	Insurance (0%)	Insurance (0%)
19	Insurance (0%)	Sick Leave (0%)	Sick Leave (0%)	Sick Leave (0%)

Respondents within the 18-29 year old age group responded that within the top four hesitancies/beliefs, vaccine safety and side effects ranked first, followed by vaccine development and approval, vaccine information, vaccine efficacy and effectiveness, and trust, respectively. Respondents within the 30-39 year old age group responded that within the top four hesitancies/beliefs, vaccine efficacy and effectiveness ranked first followed by vaccine development and approval, vaccine safety and side effects, trust and vaccine information, respectively. Respondents within the 40-49 year old age group responded that within the top four hesitancies/beliefs, vaccine safety and side effects and vaccine development and approval ranked first, followed by vaccine efficacy and effectiveness, trust, and

disbelief, respectively. Respondents within the 50-59 year old age group responded that within the top four hesitancies/beliefs, vaccine safety and side effects and trust ranked first, followed by vaccine development and approval and vaccine efficacy and effectiveness, respectively. The differences between the hesitancy/belief rankings by age group could not be statistically assessed to determine significance as the group sizes and variances differed.

Income Level and Overall Hesitancies/Beliefs:

The reported hesitancies/beliefs of the respondents were also broken down by income level to examine the difference between low-income respondents and average to high income respondents so that the results can better address each group. The proportion of respondents within each income group were calculated for each hesitancy and concern. Those who stated “Prefer not to say” were excluded from this portion of the analysis. The final overall proportions of hesitancies/beliefs by income group are shown below in Figures 8 and 9.

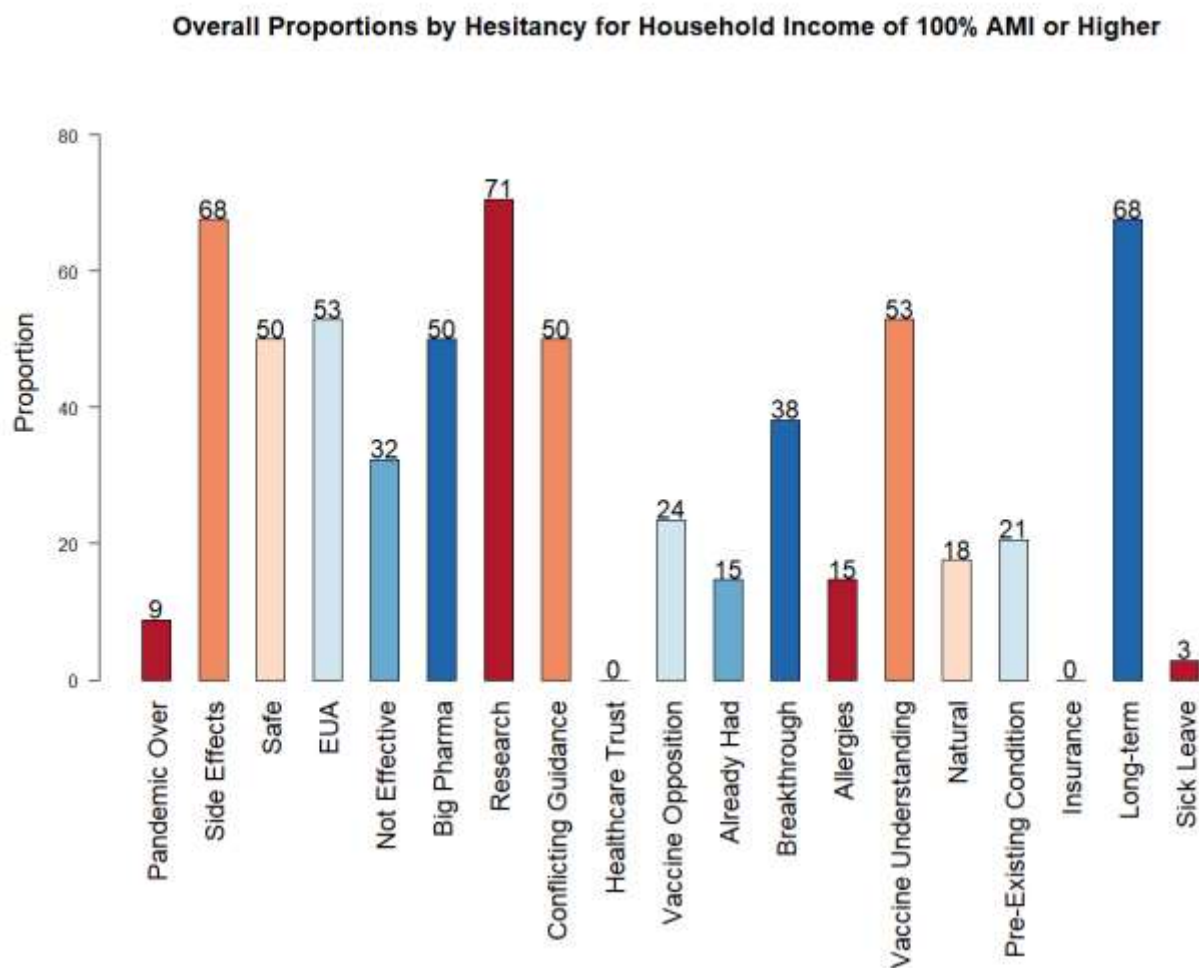


Figure 8: Overall Proportions of Respondents with Average or High Income by Hesitancy/Belief

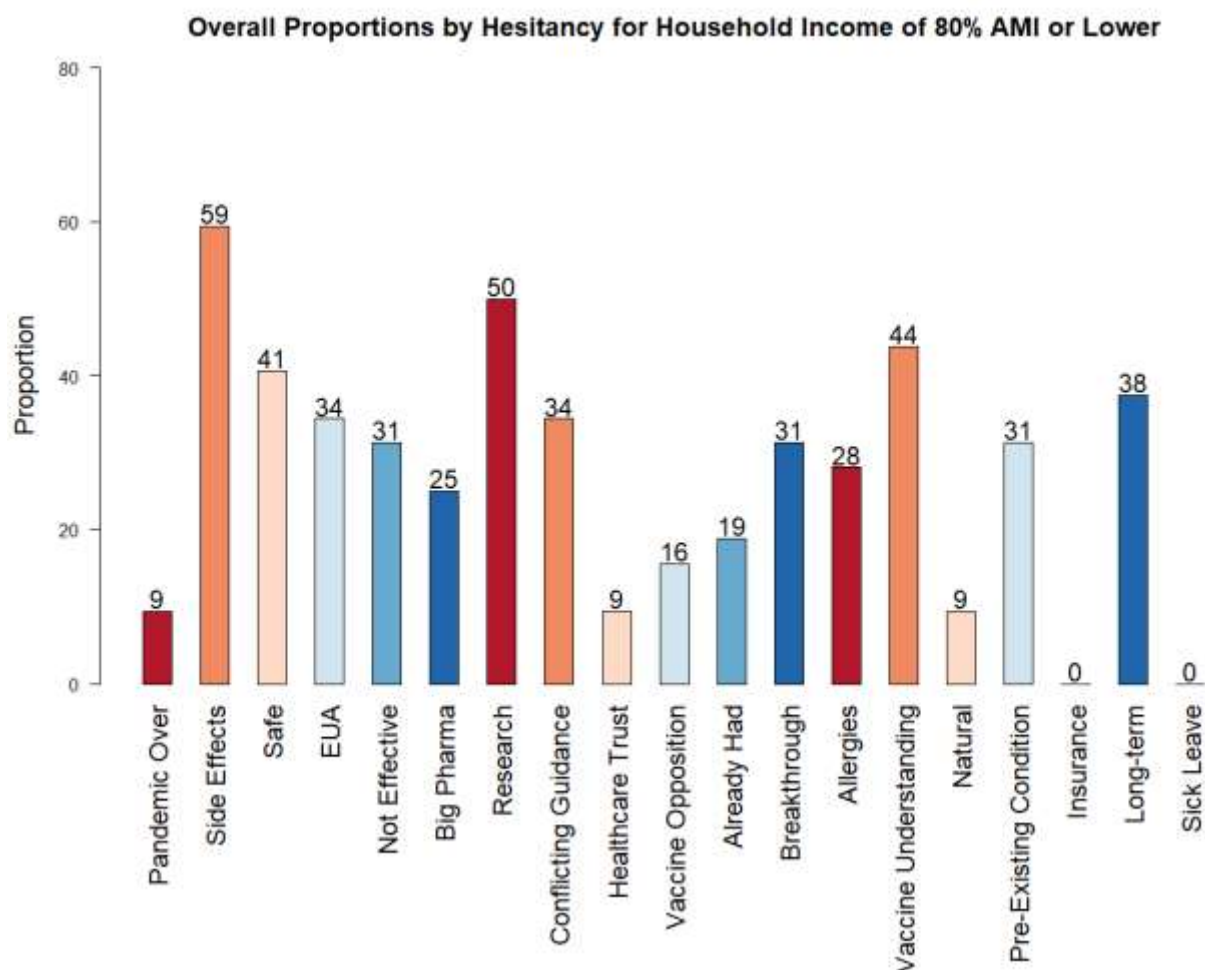


Figure 9: Overall Proportions of Respondents with Low Income by Hesitancy/Belief

Respondents who stated that their household income was 100% of the AMI or more (n=34) responded that in their top four hesitancies/beliefs, vaccine development and approval ranked first, followed by vaccine safety and side effects, vaccine efficacy and effectiveness, trust, and vaccine information, respectively. Respondents who stated their household income was 80% of the AMI or less (n=32) responded that in their top four hesitancies/beliefs, vaccine safety and side effects ranked first, followed by vaccine development and approval, and trust, respectively. Each hesitancy/belief was then tested to determine if there was any statistical significance to their differences between income groups. To observe this difference, a p-value and 95% confidence interval was calculated using a t-test. A p-value is a measure of the probability than an observed difference could have occurred just by random chance. If the p-value is less than 0.05, than the observed difference could not have just occurred by random chance. The significant results are shown below in Table 6.

Table 6: Statistically Significant Hesitancies/Beliefs between Income Levels

	p-value <0.05	95% Confidence Interval (CI)
Long-term	0.014	(0.064, 0.539)
Big Pharma	0.037	(0.016, 0.484)

The only two differences in hesitations/beliefs between the two income groups that were deemed significant by this test were Long-term, “I believe there has not been enough time to study the long-term effectiveness of the vaccine.”, and Big Pharma, “I do not trust “big pharma” and/or other vaccine profit motives.” Both of these hesitations/beliefs were significantly higher in the average to high income group at 68% and 50%, respectively, compared to the low-income group at 38% and 25%, respectively.

Limitations:

This study had several limitations. The first of which was the distribution method of the *COVID-19 Vaccine Hesitancy Survey*. Because this survey was intended to be completely virtual, those without access to the Internet, the ability to scan the QR code, or knowledge of how to use the Internet would not have been able to complete the survey. It is also possible some people may not have completed the survey due to the sensitive subject, especially in the current sociopolitical climate. Therefore, this survey relied heavily on the direct cooperation of the community. A response rate could also not be calculated, due to the fact that this survey was not delivered to a finite list of individuals. The survey was not fully representative of the general population of the Billings Community based on the demographic data collected. This indicates the potential of non-response bias, which may have skewed the results especially when looking at the relationship between Age Group and Income Level versus Hesitancy/Belief.

Conclusion and Further Direction:

As the COVID-19 cases continue to rise with the emergence of new variants, and vaccination rates slow, the results of this survey can be used to help identify ways to address public vaccine concerns in Billings. Survey data from 76 respondents are summarized and displayed throughout this report.

Community members’ feedback received through this survey indicates the following hesitations/beliefs are the most important to be addressed:

- **Vaccine Development and Approval**
- **Vaccine Safety and Side Effects**
- **Vaccine Information**
- **Vaccine Efficacy and Effectiveness**

Although vaccine hesitancy is best handled on an individual basis, there are several potential ways to generally address some of these concerns. These may include:

- **Developing a COVID-19 community corps**
A COVID-19 community corps consists of establishing trusted messengers within the community, such as doctors, well-known leaders within the community, religious leaders, etc., and enables those with concerns to access creditable information on a more personal level.
- **Educational videos**
Educational videos on how the vaccine was developed and the approval process may be useful in providing another method of information delivery for visual and auditory learners.

- **Monthly question and answer (Q&A) sessions**

Monthly Q&A sessions with a panel of local doctors and public health professionals would enable another platform for individuals to seek answers to their questions, opinions, and concerns.

- **Social proof**

Social proof is a socio-psychological experience which occurs when an individual is unsure and looks to others for the correct action to take. The more individuals doing that action, the more likely that individual is to consider it to be the correct action.¹⁶ Social Proof may also be key in increasing vaccination rates as vaccinated leads to more vaccinated.

Because vaccine hesitancy is not a static measure, Subsequent research and studies should be considered as the sociopolitical climate changes and new variants emerge. If undertaken, it may be useful in future studies to find a better distribution method of the survey to increase the response rate as well as the overall representation of the general population of Billings.

References:

1. CDC. "Basics of COVID-19." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, <https://www.cdc.gov/coronavirus/2019-ncov/your-health/about-covid-19/basics-covid-19.html>.
2. WHO. "Covid-19 Vaccine Tracker and Landscape." *World Health Organization*, World Health Organization, <https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines>.
3. Office of the Commissioner. "FDA Approves First COVID-19 Vaccine." *U.S. Food and Drug Administration*, FDA, <https://www.fda.gov/news-events/press-announcements/fda-approves-first-covid-19-vaccine>.
4. CDC. "CDC COVID Data Tracker." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, https://covid.cdc.gov/covid-data-tracker/#vaccinations_vacc-people-fully-percent-total.
5. WHO. "Who Coronavirus (COVID-19) Dashboard." *World Health Organization*, World Health Organization, <https://covid19.who.int/>.
6. WHO. "Ten Threats to Global Health in 2019." *World Health Organization*, World Health Organization, <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>.
7. C-Span. "Covid-19 Vaccine Hesitancy." *C-Span*, 9 Apr. 2021, <https://www.c-span.org/video/?510642-1%2F covid-19-vaccine-hesitancy>.
8. AHAhospitals. "Addressing COVID-19 Vaccine Hesitancy in Your Community." *YouTube*, YouTube, 16 July 2021, <https://www.youtube.com/watch?v=kR1HtSIuSgs>.
9. Montana DPHHS. "MONTANA Vaccine Uptake for Eligible Montanans by Age Group as of 9/17/2021 ." *Montana DPHHS*, <https://dphhs.mt.gov/assets/publichealth/CDEpi/DiseasesAtoZ/2019-nCoV/EpiProfile/MTUptakeGraphs2021-09-19.pdf>.
10. R Core Team (2021). R: A language and environment for statistical computing. *R Foundation for Statistical Computing*, Vienna, Austria. <https://www.R-project.org/>.
11. HUD. "U.S. Department of HUD State: Montana House Income 2021." *U.S. Department of Housing and Urban Development*, https://www.huduser.gov/portal/datasets/home-datasets/files/HTF_IncomeLmts_State_MT_2021.pdf.

12. U.S. Census Bureau. "Census QuickFacts: Billings City, Montana." *U.S. Census Bureau*, U.S. Census Bureau, <https://www.census.gov/quickfacts/fact/table/billingscitymontana/PST045219>.
13. HUD Exchange. "Data Snapshots: Populations In Need ." *Healthcare and Housing (H2) Systems Integration Initiative Montana*, HUD Exchange, <https://www.hudexchange.info/sites/onecpd/assets/File/MT-H2-Data-Snapshot-Populations-in-Need.pdf>.
14. Hamel, Liz, et al. "KFF COVID-19 Vaccine Monitor: June 2021." *Kaiser Family Foundation*, 30 June 2021, <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-june-2021/>.
15. Beleche, T., Ruhter, J., Kolbe, A., Marus, J., Bush, L., and Sommers, B. COVID-19 Vaccine Hesitancy: Demographic Factors, Geographic Patterns, and Changes Over Time. Washington, DC: Office of the Assistant Secretary for Planning and Evaluation, *U.S. Department of Health and Human Services*. May 2021
16. Cialdini, Robert B. *Influence: The Psychology of Persuasion*. Collins, 2007.

Appendix A:

COVID-19 Vaccine Hesitancy Survey



While the COVID-19 vaccine is readily available to everyone age 12 and older, many people are hesitant about receiving the vaccine. According to the Montana Department of Public Health and Human Services, as of August 5, 2021, the proportion of fully vaccinated eligible Montanans is 48% while only 47% of eligible Yellowstone County residents are fully vaccinated. The purpose of this survey is to gather information on concerns you may have about COVID-19 vaccination. This survey is intended for those individuals who are not yet vaccinated for COVID-19 and is anonymous.

Demographics:

1. **Age:** Please check only one.

☐ 12-17 ☐ 18-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ 70-79 ☐ 80+ ☐ Prefer not to say

2. **Race:** Please check any that apply.

☐ White ☐ American Indian or Alaska Native ☐ Asian ☐ Other _____
☐ Black or African American ☐ Native Hawaiian or Other Pacific Islander ☐ Multi-Racial ☐ Prefer not to say

3. **Ethnicity:**

☐ Hispanic or Latino ☐ Non-Hispanic or Latino ☐ Prefer not to say

4. **Are you:** If none of the options apply, please select does not apply.

☐ Disabled ☐ Pregnant ☐ Currently Experiencing Homelessness ☐ Does not apply
☐ Veteran ☐ Immunocompromised ☐ Single Head of Household with Dependents ☐ Prefer not to say

5. **How many individuals are in your household?** _____

6. **Using the table below, please select the letter for your total household income including anyone 18 years or older.**

<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	<input type="checkbox"/> E	<input type="checkbox"/> Prefer not to say
Size of Household	A	B	C	D	E
1	\$0 to \$16,800	\$16,801 to \$28,000	\$28,001 to \$33,600	\$33,601 to \$44,800	\$44,801 or above
2	\$0 to \$19,200	\$19,201 to \$32,000	\$32,001 to \$38,400	\$38,401 to \$51,200	\$51,201 or above
3	\$0 to \$21,600	\$21,601 to \$36,000	\$36,001 to \$43,200	\$43,201 to \$57,600	\$57,601 or above
4	\$0 to \$24,000	\$24,001 to \$40,000	\$40,001 to \$48,000	\$48,001 to \$64,000	\$64,000 or above
5	\$0 to \$25,950	\$25,951 to \$43,200	\$43,201 to \$51,840	\$51,841 to \$69,150	\$69,151 or above
6	\$0 to \$27,850	\$27,851 to \$46,400	\$46,401 to \$55,680	\$55,681 to \$74,250	\$74,251 or above
7	\$0 to \$29,800	\$29,801 to \$49,600	\$49,601 to \$59,520	\$59,521 to \$79,400	\$79,401 or above
8+	\$0 to \$31,700	\$31,051 to \$52,800	\$52,801 to \$63,360	\$63,360 to \$84,500	\$84,501 or above

7. **Using the map, where do you live?** Please check the best option for you.

☐ Downtown ☐ Heights ☐ South Side ☐ North Side ☐ Outside of Billings City Limits
☐ Central ☐ West End ☐ Shiloh ☐ Prefer not to say Please Specify: _____



Questions:

8. Has anyone in your household been vaccinated against COVID-19?

- ☐ Yes ☐ No ☐ Prefer not to say

9. Below are common hesitations or beliefs about the COVID-19 vaccine. Please check all that apply to you:

- ☐ I believe that the pandemic is almost over and the vaccine is unnecessary.
- ☐ I am concerned about possible side effects of the COVID-19 vaccine.
- ☐ I plan to wait and see if the vaccine is safe; if so I may get it later.
- ☐ I plan to wait until the vaccine is fully approved by the FDA because I do not fully trust the emergency approval process.
- ☐ I believe the vaccine is not effective.
- ☐ I do not trust "big pharma" and/or other vaccine profit motives.
- ☐ I believe the vaccine research and development were too rushed.
- ☐ There is so much conflicting guidance; I do not know what is true about COVID-19 vaccines.
- ☐ I have trust issues with the healthcare system due to discrimination or inequality that I experienced in the past.
- ☐ I do not believe I need a COVID-19 vaccine.
- ☐ I already had COVID-19; the vaccine is unnecessary.
- ☐ I do not see the point in getting vaccinated if people are still catching COVID-19 after being fully vaccinated.
- ☐ I am concerned about having an allergic reaction to the COVID-19 vaccine.
- ☐ I do not trust COVID-19 vaccines or I do not want to put anything into my body that I do not fully understand.
- ☐ I already use other methods, such as natural remedies and activities, to combat the COVID-19 infection and they have worked so far.
- ☐ I believe there is not enough information out about the effects on someone in my condition.
- ☐ I do not have health insurance and I do not think I can afford the COVID-19 vaccine.
- ☐ I believe there has not been enough time to study the long-term effectiveness of the vaccine.
- ☐ I have no sick leave and am concerned the side effects of getting vaccinated may cause me to miss work.

10. Please describe any additional hesitations or comments if the above options do not fully explain your situation.

11. On a scale of 1 (I'm considering getting vaccinated) to 5 (I'm never going to get vaccinated), how likely are you to get vaccinated at this point? _____

12. If you were to choose to get vaccinated in the future, what days and times would work best for you to attend a vaccine clinic? Select any that apply to you.

- ☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday ☐ Sunday
☐ 8-10 am ☐ 10 am-12 pm ☐ 12-2 pm ☐ 2-4 pm ☐ 4-6 pm ☐ 5-7 pm

13. Please share any other thoughts or concerns about the COVID-19 pandemic or response efforts that you may have.

Thank you for completing our survey! If you would like additional information on the COVID-19 vaccine, please visit <https://covid.riverstonehealth.org> or www.billingsmt.gov/vaccine



Flyers and Social Media Releases:



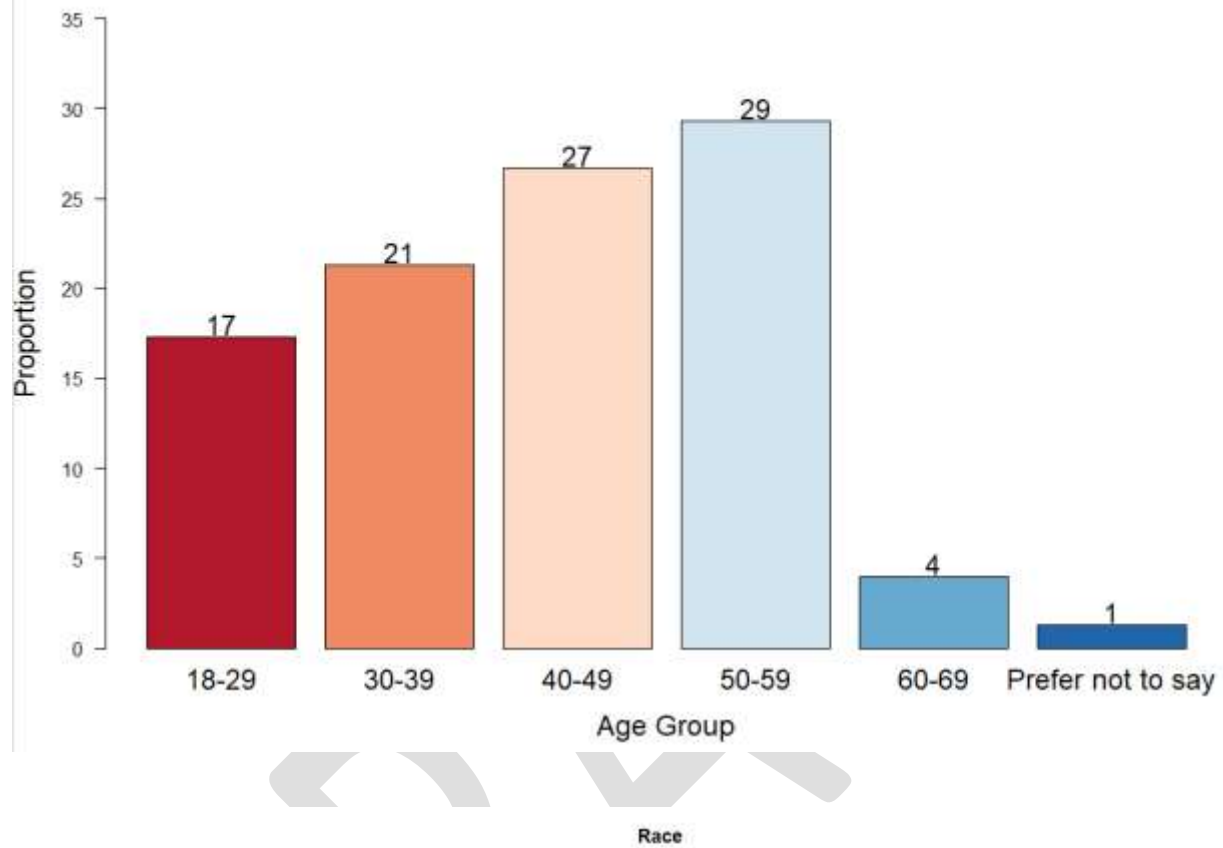
Flyer Distribution List:

- **Parks:** Stewart Park, Lillis Park, Gorham Park, Rose Park, Centennial Park, Hawthorne Park, Castle Rock Park, High Sierra Dog Park, Swords Park, North Park, Central Park, Pioneer Park, Terry Park, Veteran's Park, South Park, Highland Park, Amend Park, Optimist Park, Downtown Skate Park
- **Laundromats:** Speedy Wash, Koinonia, BYO Laundry, Big Sky Bubble, Spin Fresh Laundry, Laundry Time
- **Restaurants:** Bernie's Diner, Big Dipper Ice Cream, Dickey's BBQ Pit, Hooligan's Sports Bar/Montana Brewing, Sassy Biscuit, Sourdough Bagel, Stacked, Well Pared, Jimmy Johns, Sarah's, Imperial Thai Cuisine, Café Zydeco, La Tinga, Athenian, Guadalajara, Soup and Such
- **Coffee Shops:** Ebon Coffee Collective, Legacy Coffee Roasters, Rail Line Coffee, Rock Creek Coffee Roasters, The Annex, Harper & Madison, various Mazevo, various Starbucks, various City Brew, Big Sky Coffee Roasters, Black Dog Coffee House
- **Shops/Theaters:** Barjon's Books, Global Village, GIA, Lil' Market Groceries, Western Pawnbrokers, Art House
- **Service Providers:** United Way of Yellowstone County, Billings Public Library, Billings MET transit, St. Vincent de Paul, YMCA, Family Service, RiverStone Health, Crisis Center
- **HomeFront Properties:** Westchester, Aristocrat, Whitetail, Pheasant Home, Falcon Run, Red Fox, Pleasantview, Woody Drive, St. John's, Phyllis Circle, Spring Garden, Byrd, Bunting, Morgan, Old Town, Southside
- **Email:** distributed to all of the United Way of Yellowstone County beneficiaries, distributed to all City of Billings Employees

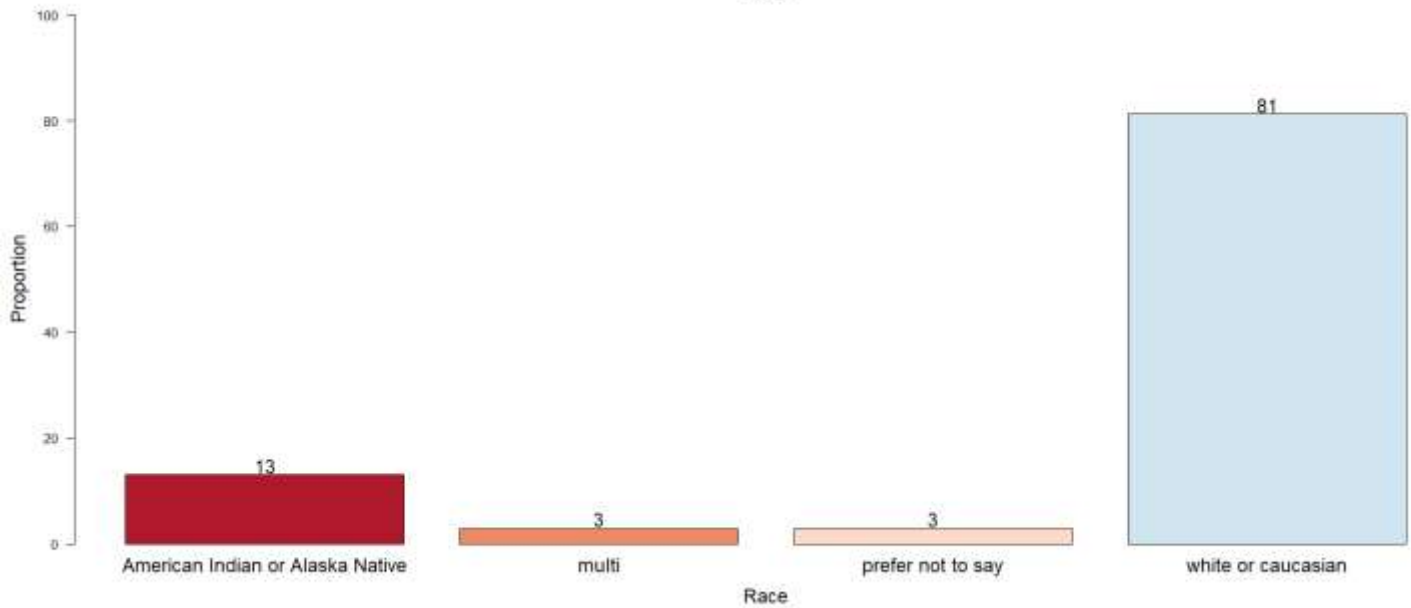
Appendix B:

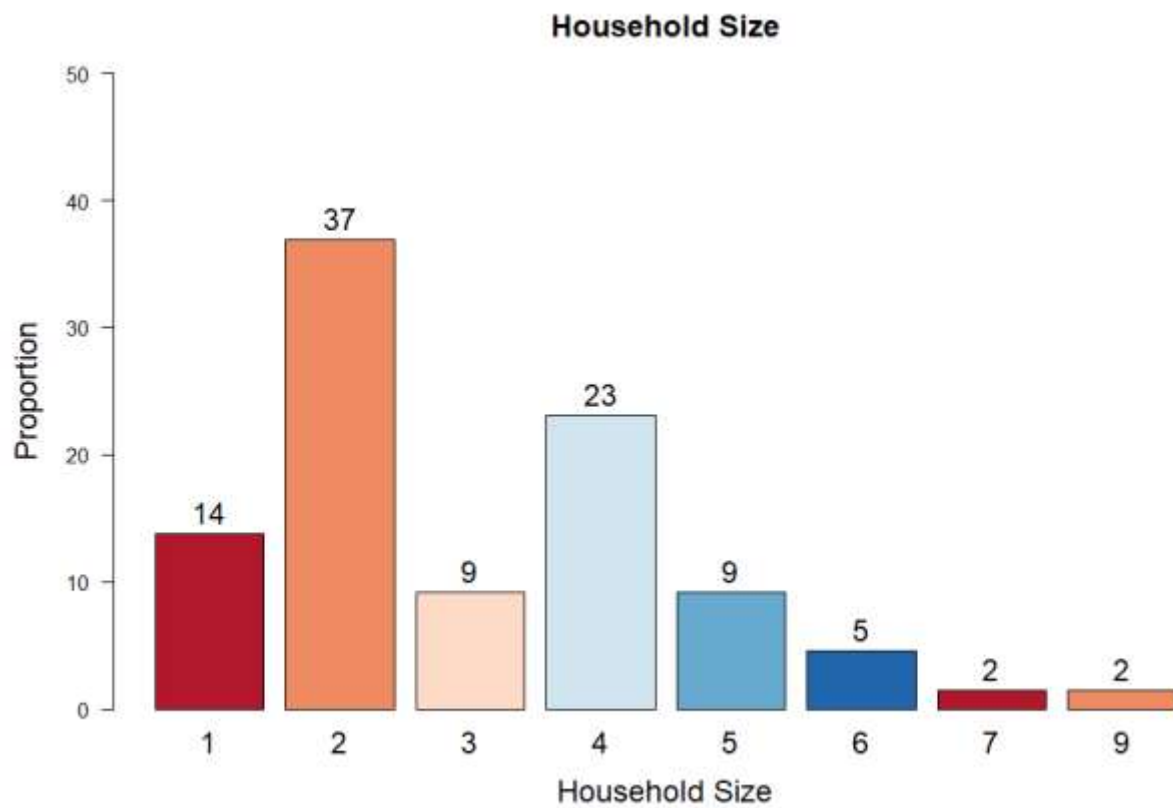
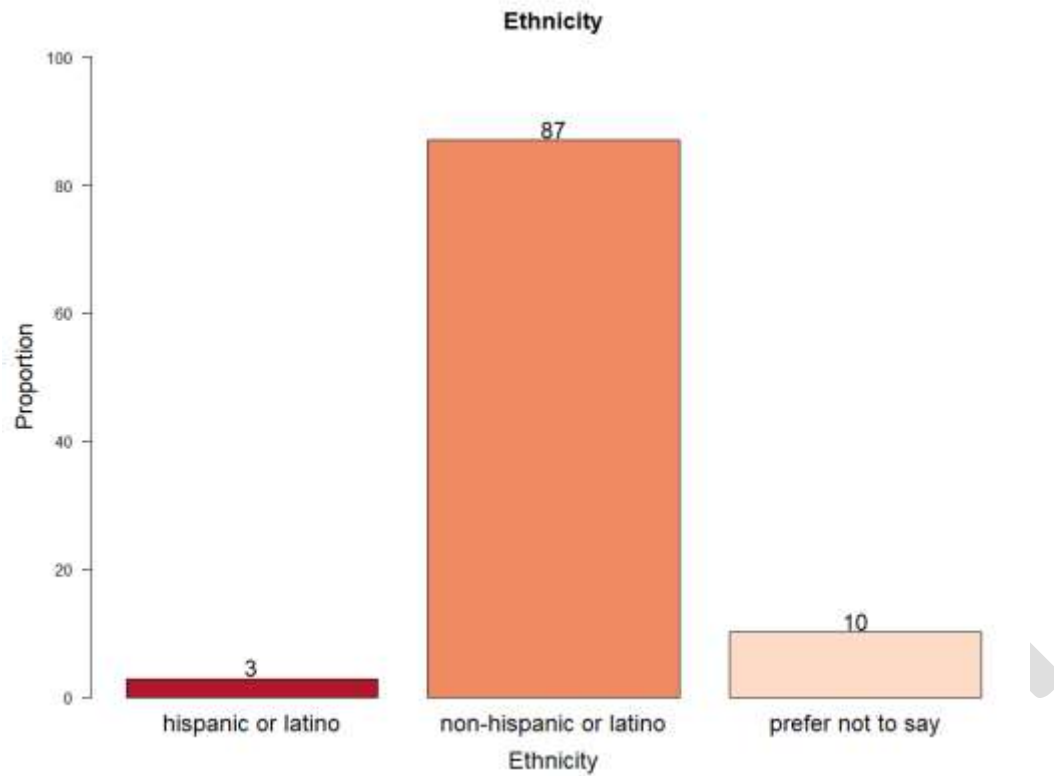
Demographics:

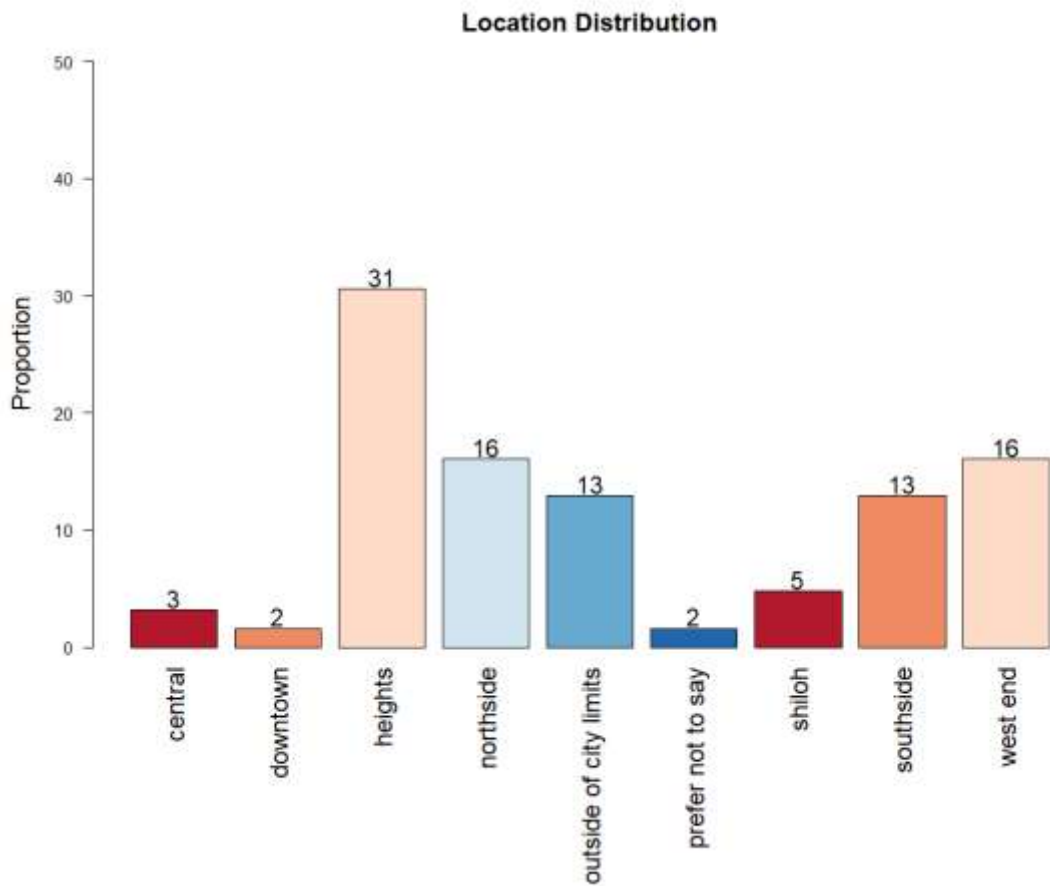
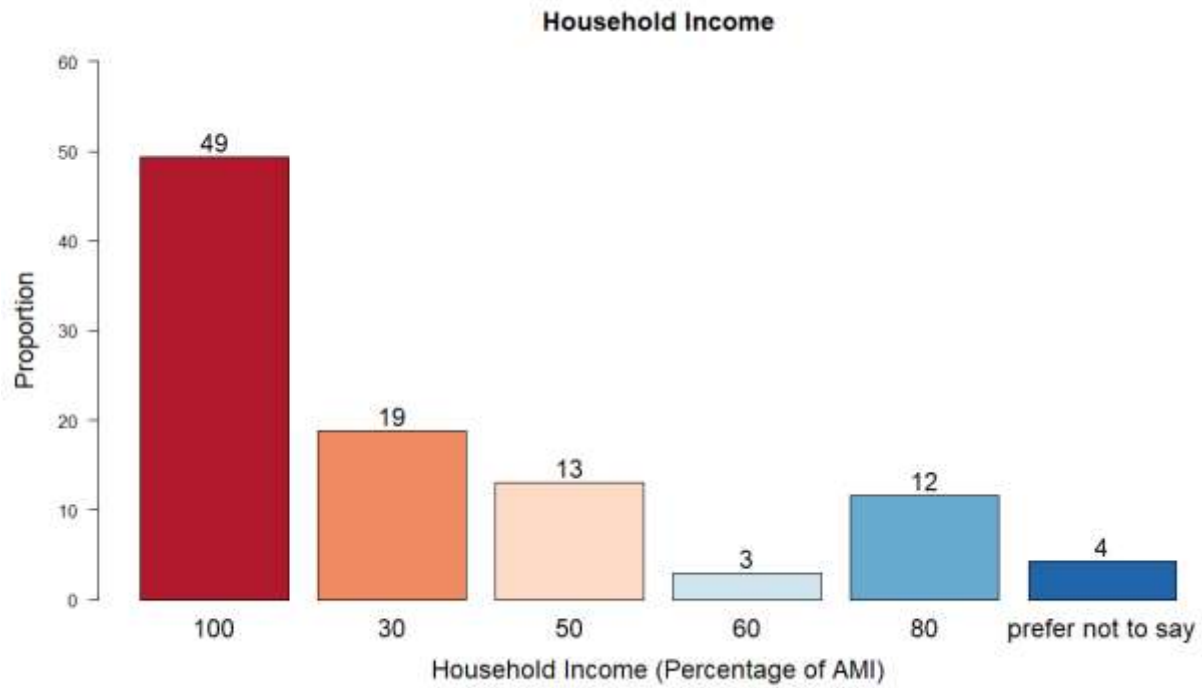
Age Distribution

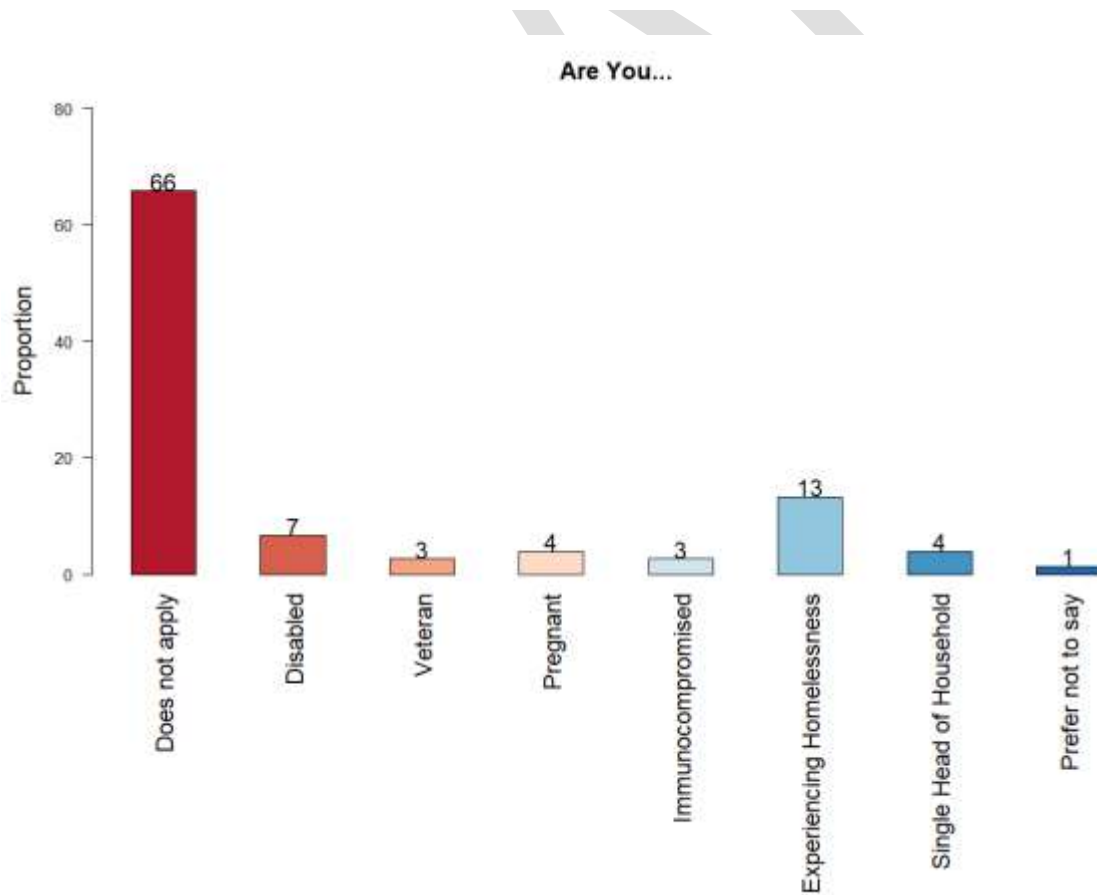
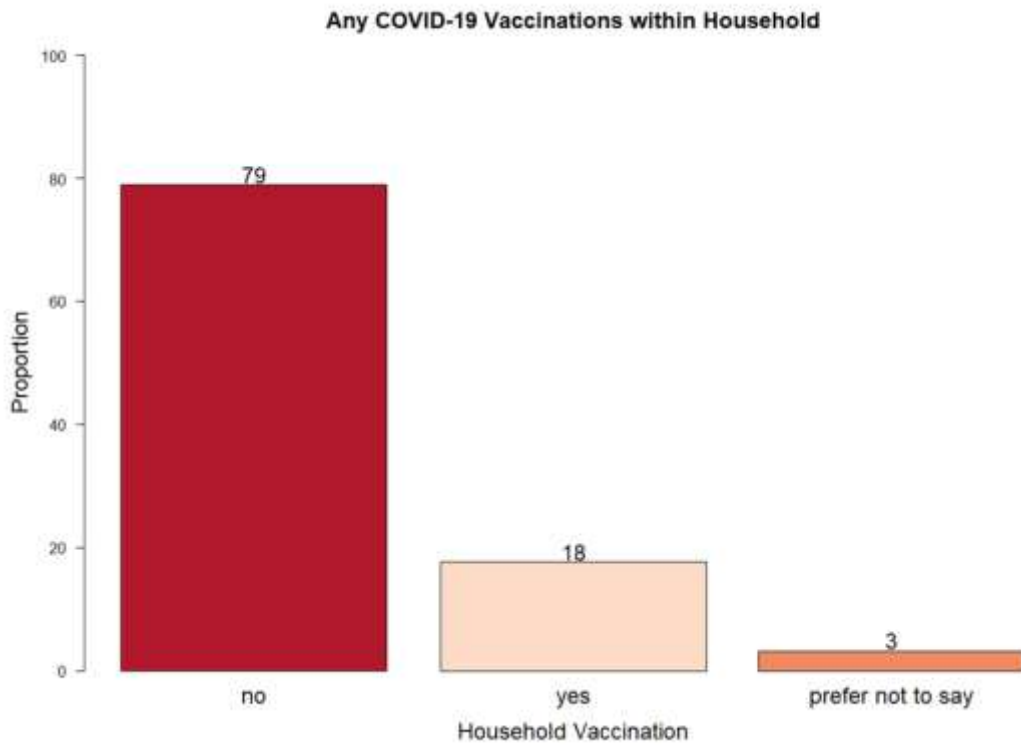


Race

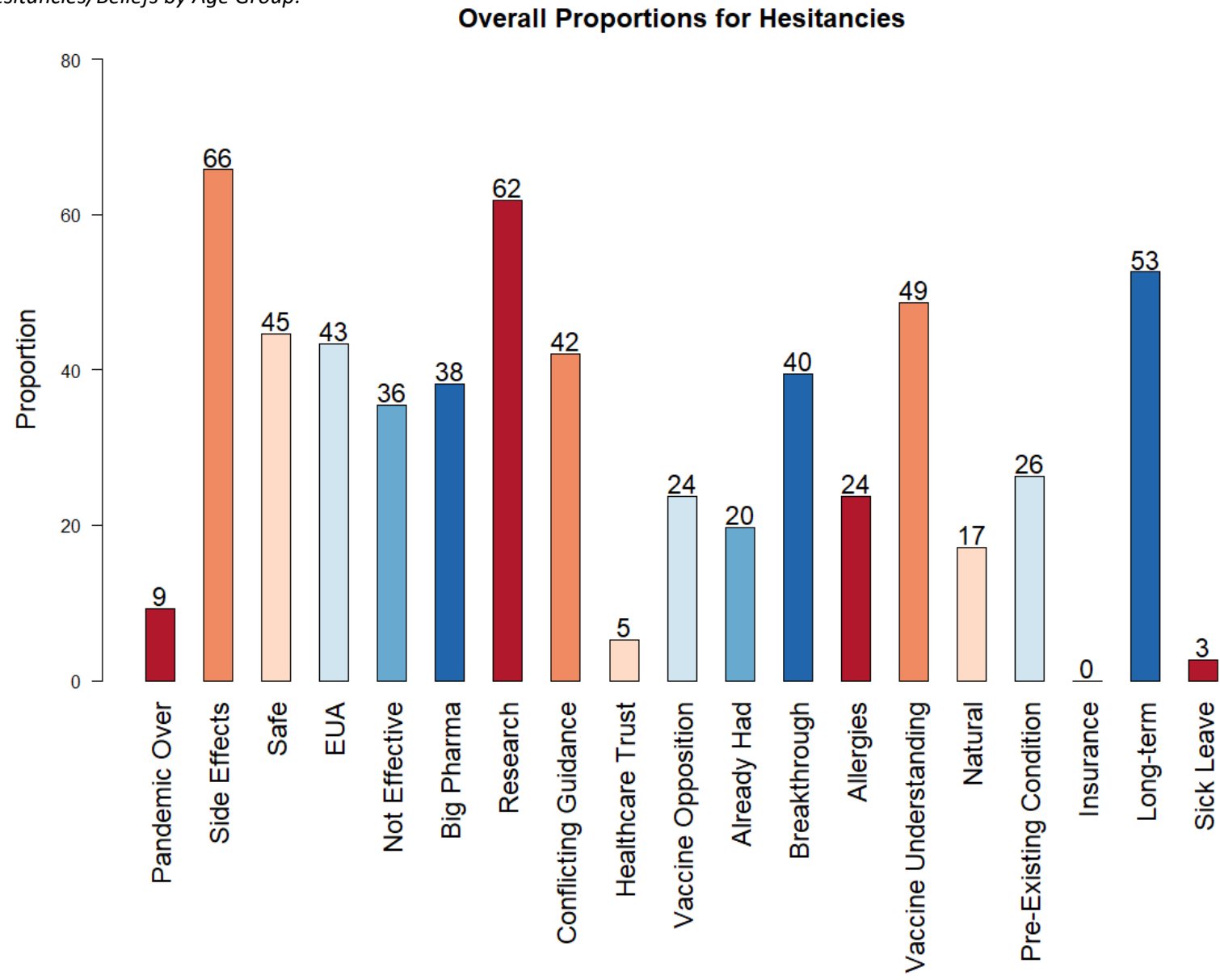




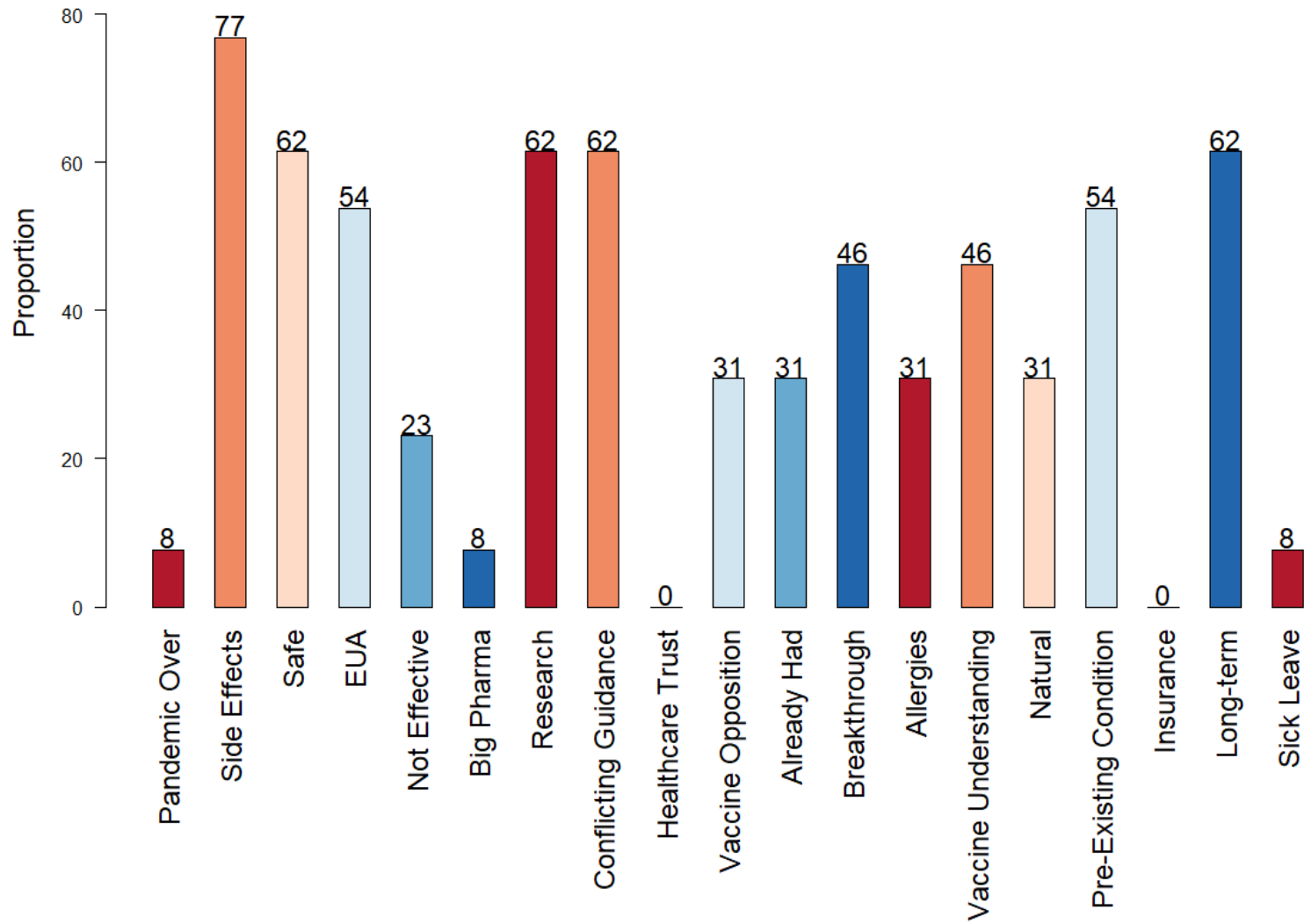




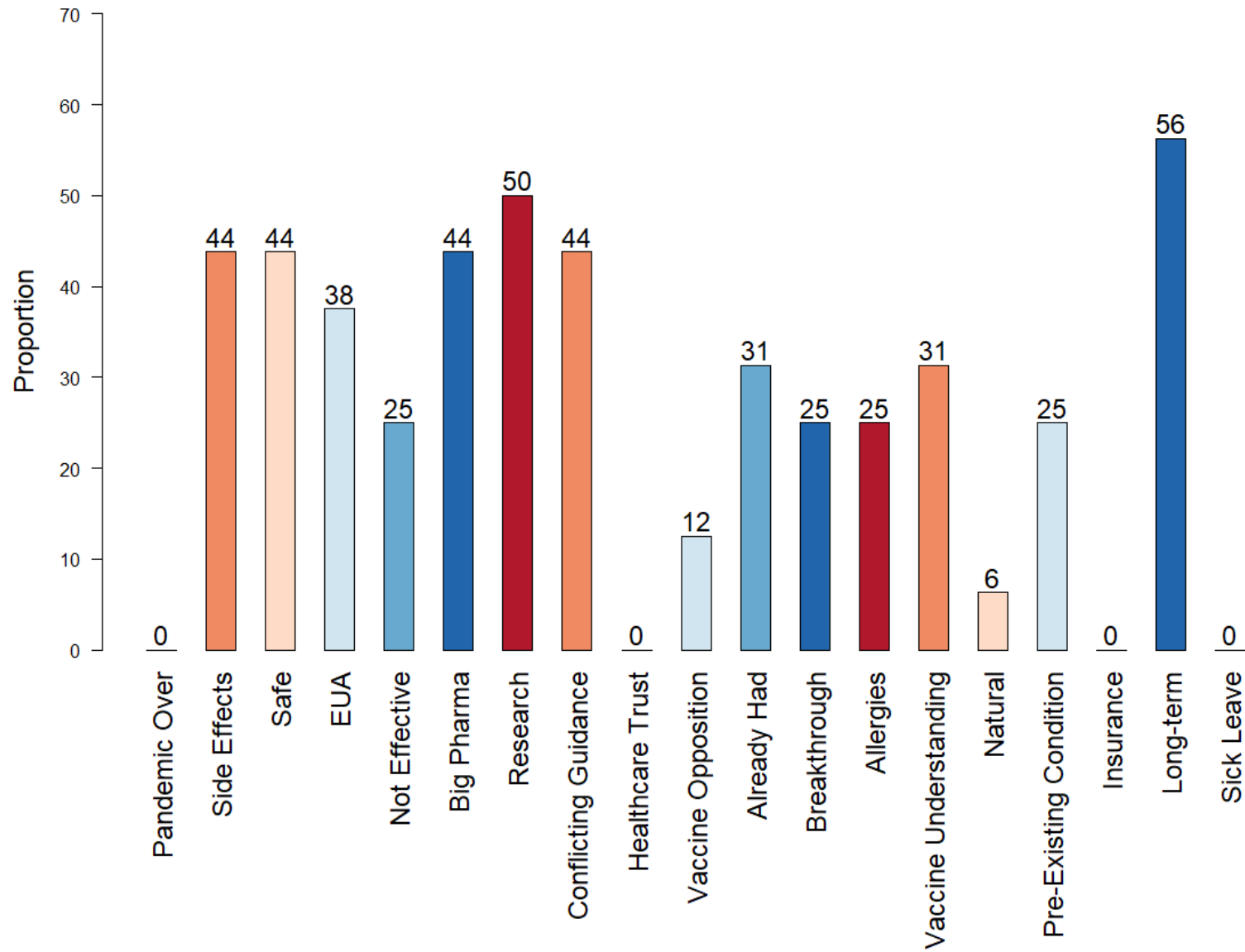
Overall Hesitancies/Beliefs by Age Group:



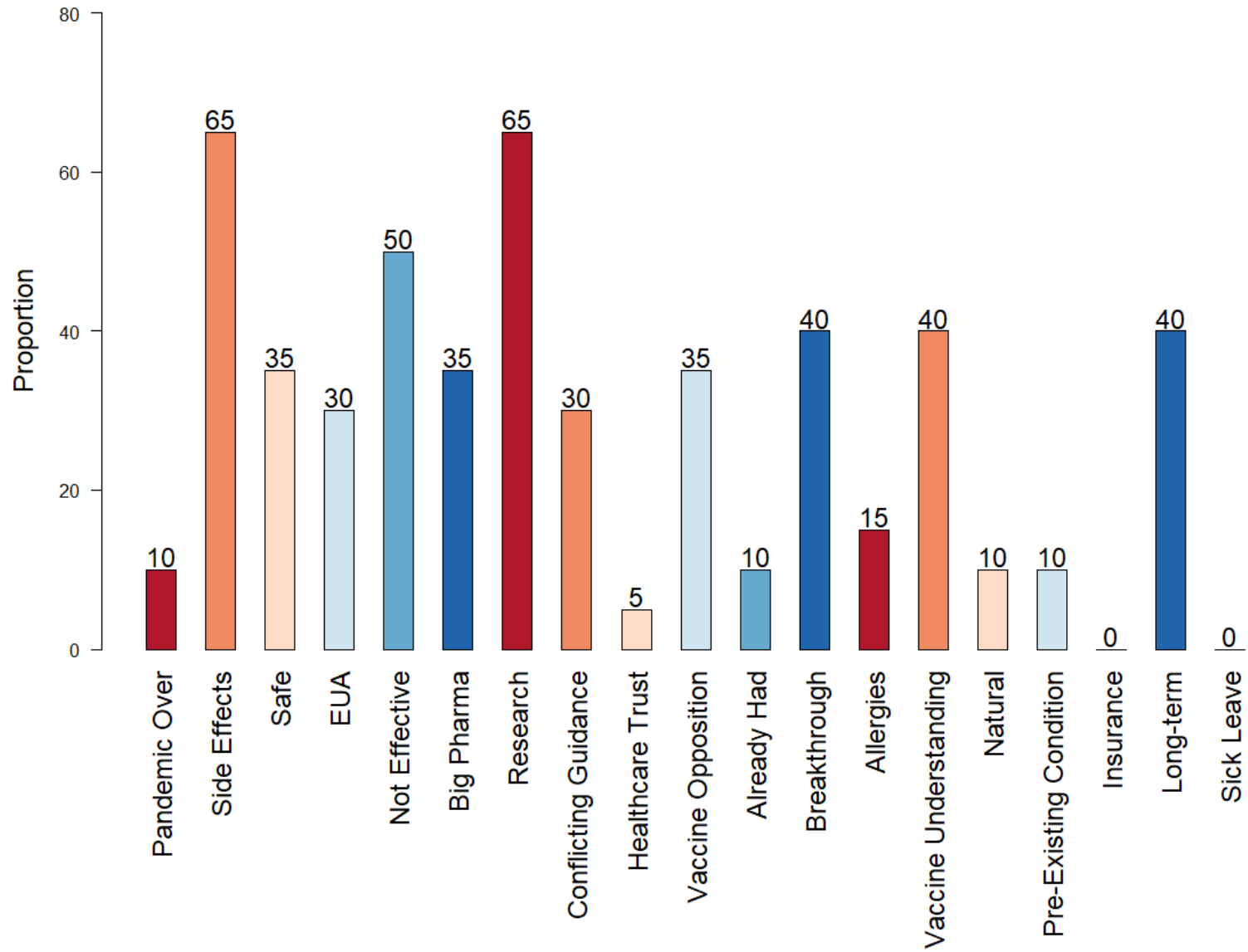
Overall Proportions by Hesitancy for 18-29 Year Olds



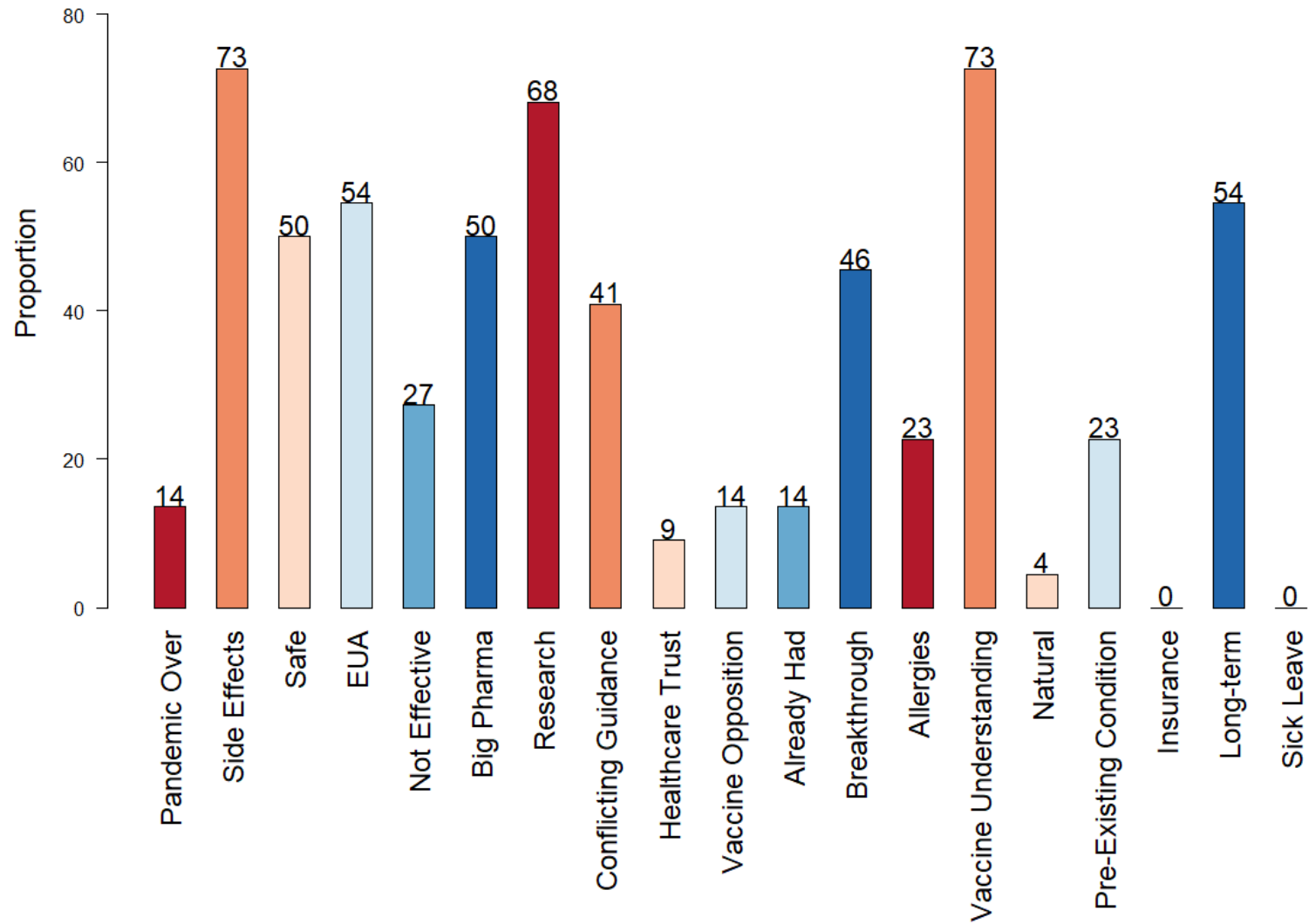
Overall Proportions by Hesitancy for 30-39 Year Olds



Overall Proportions by Hesitancy for 40-49 Year Olds

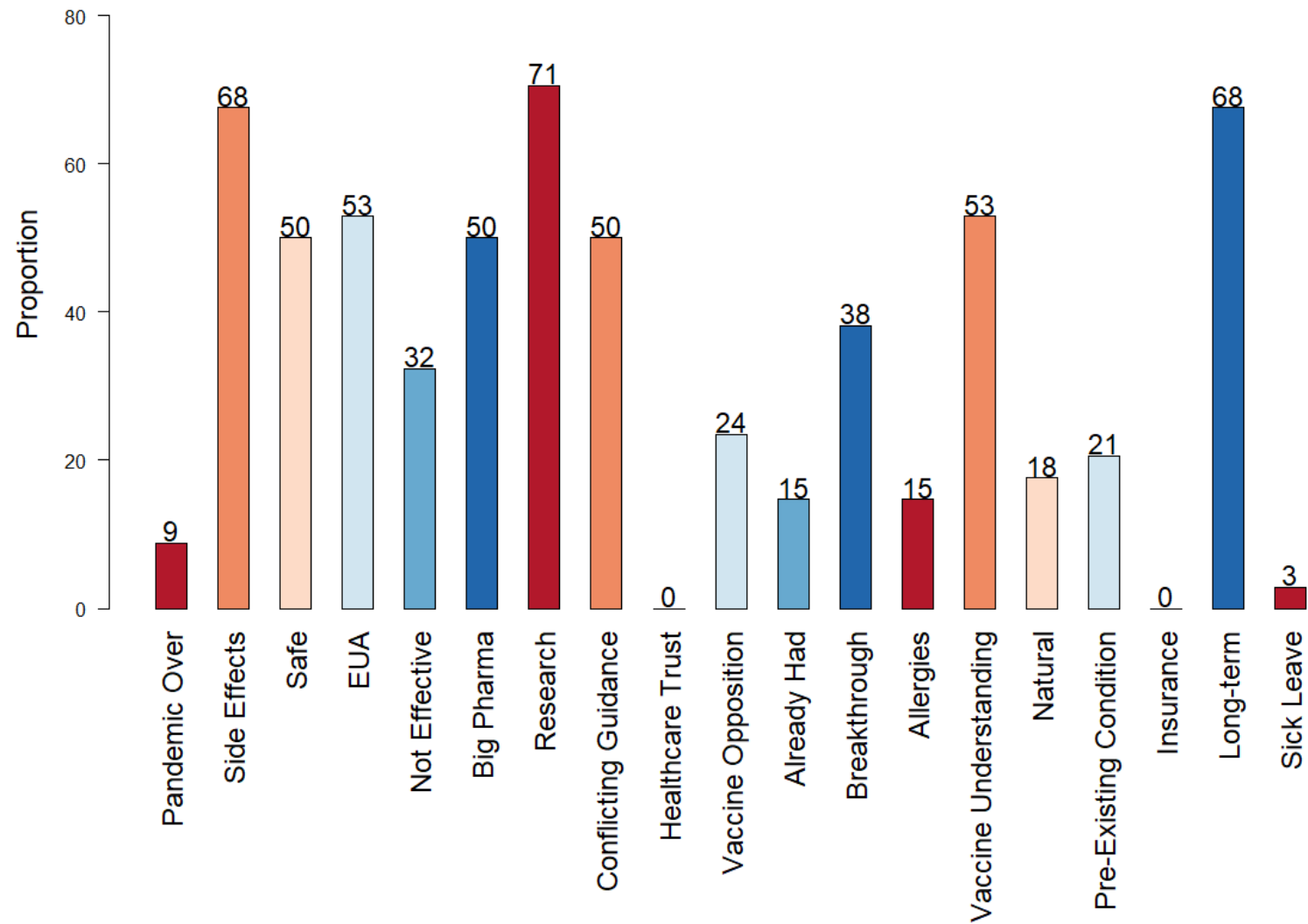


Overall Proportions by Hesitancy for 50-59 Year Olds

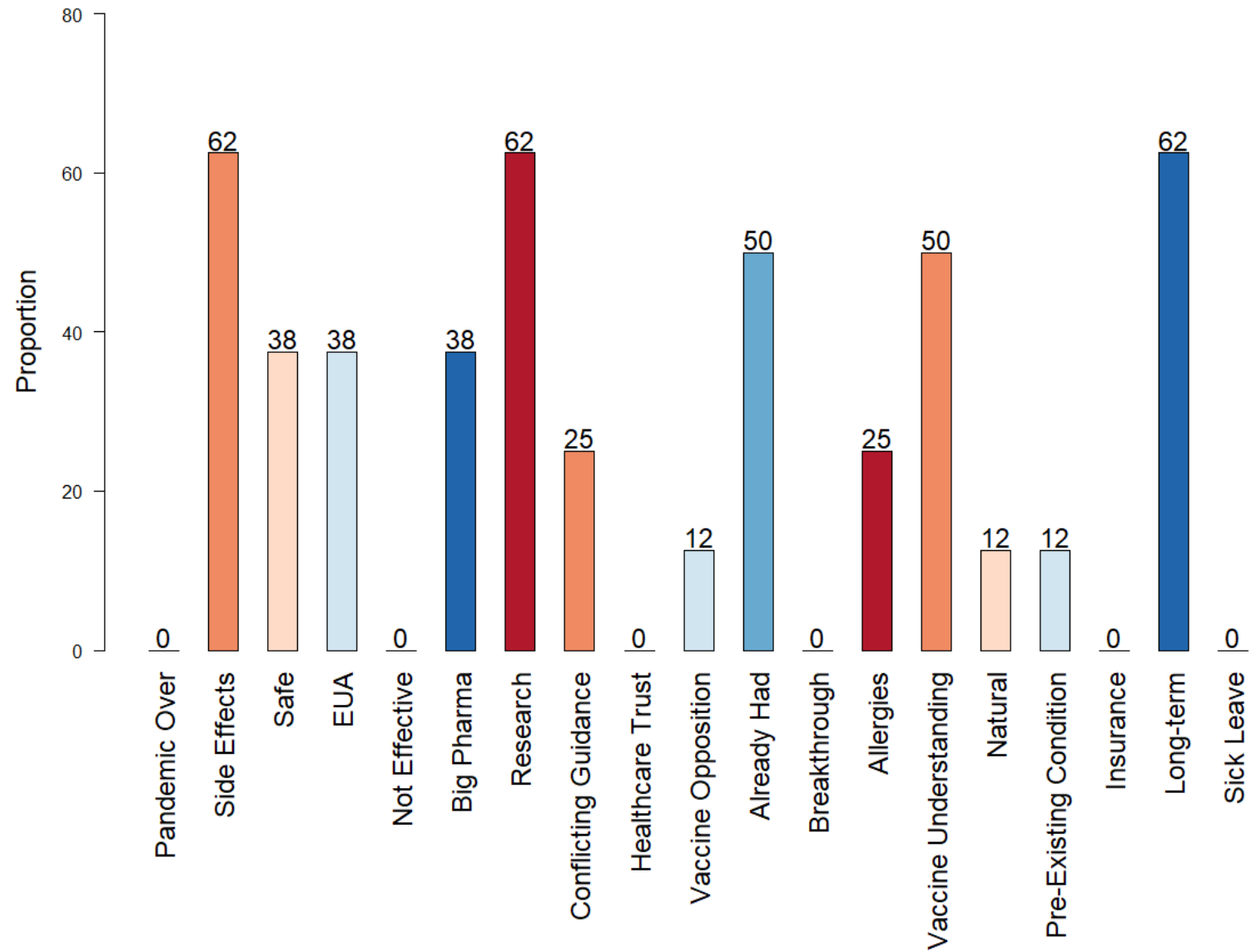


Overall Hesitancies/Beliefs by Household Income:

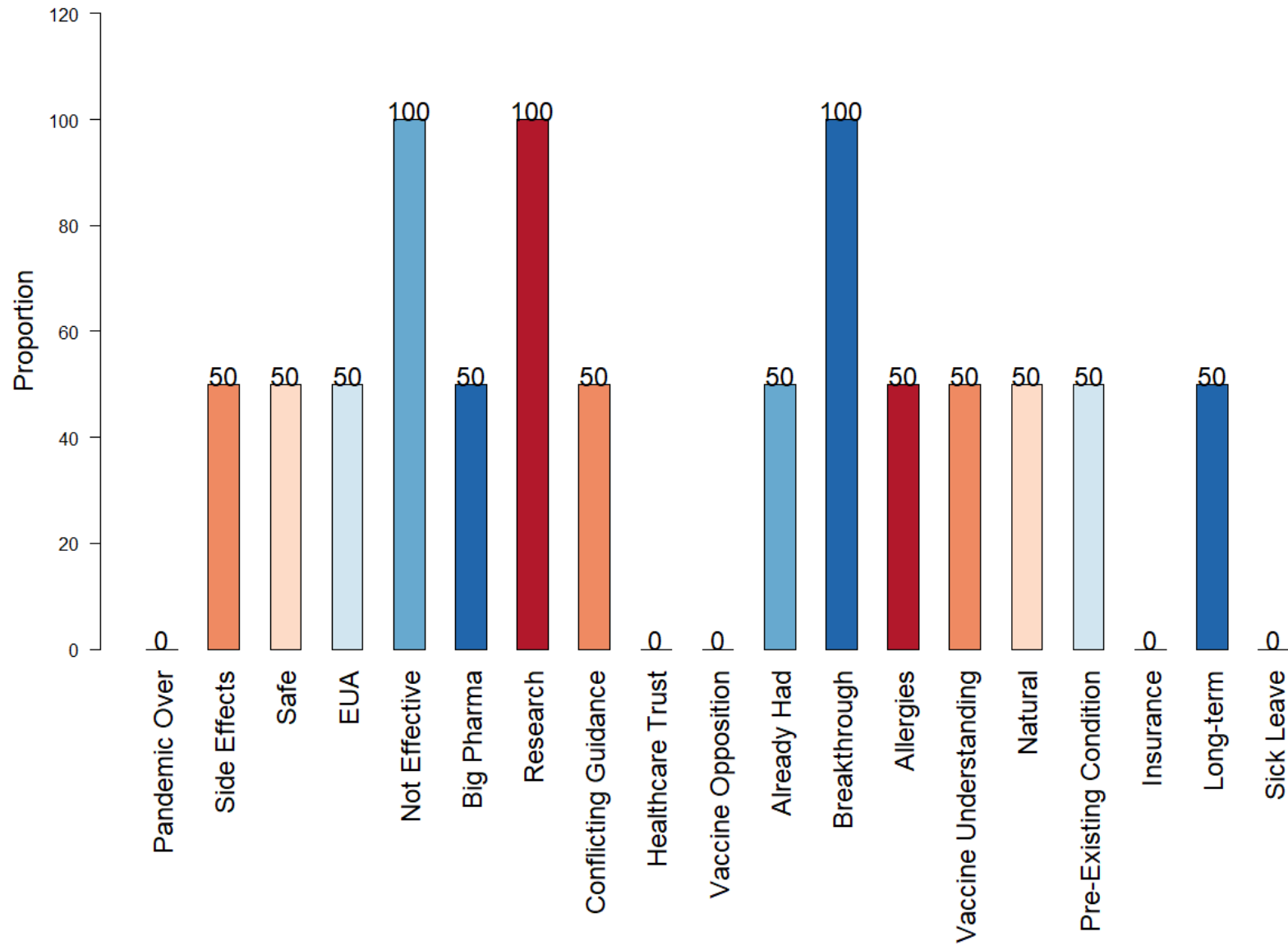
Overall Proportions by Hesitancy for Household Income of 100% AMI or Higher



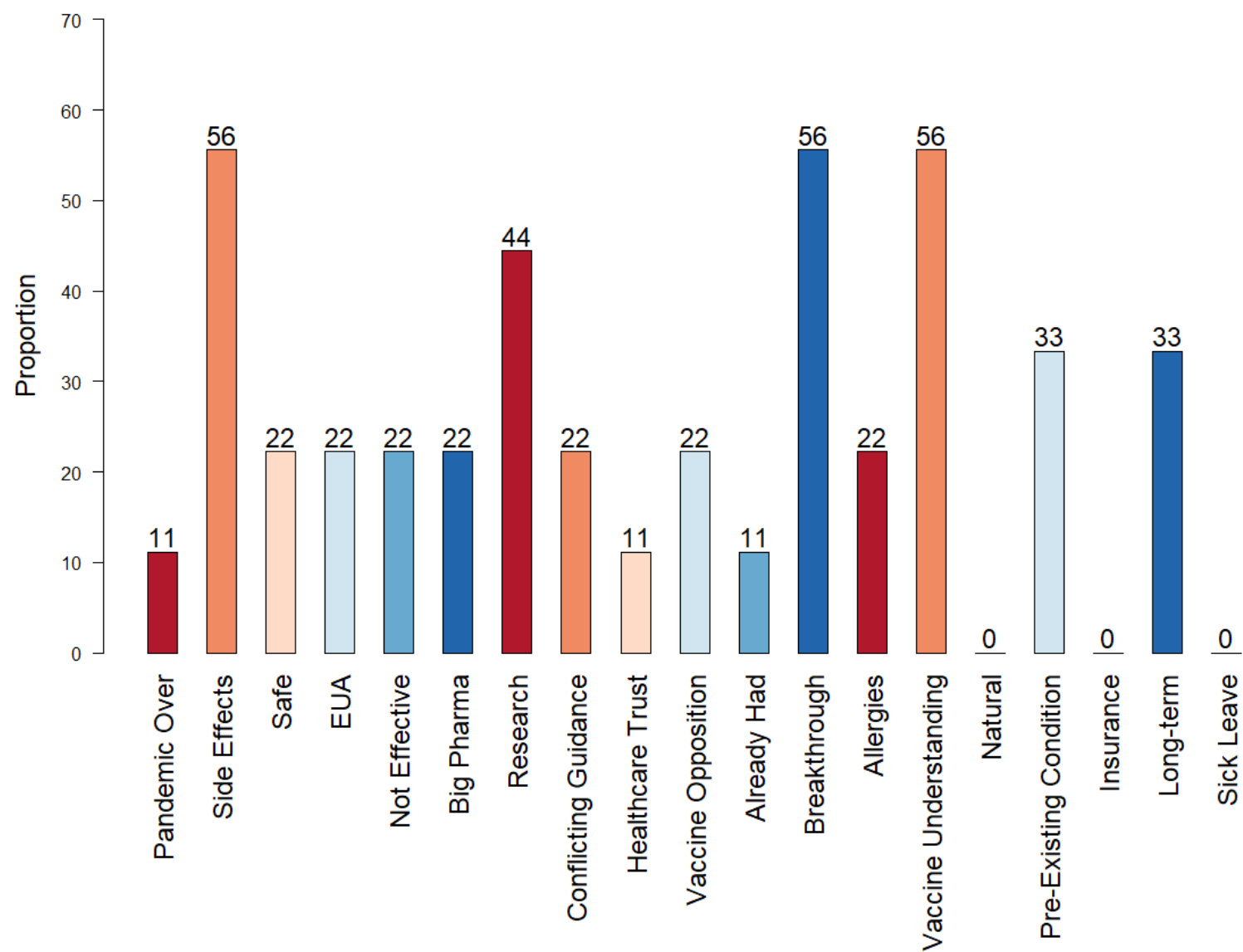
Overall Proportions by Hesitancy for Household Income of 80% AMI



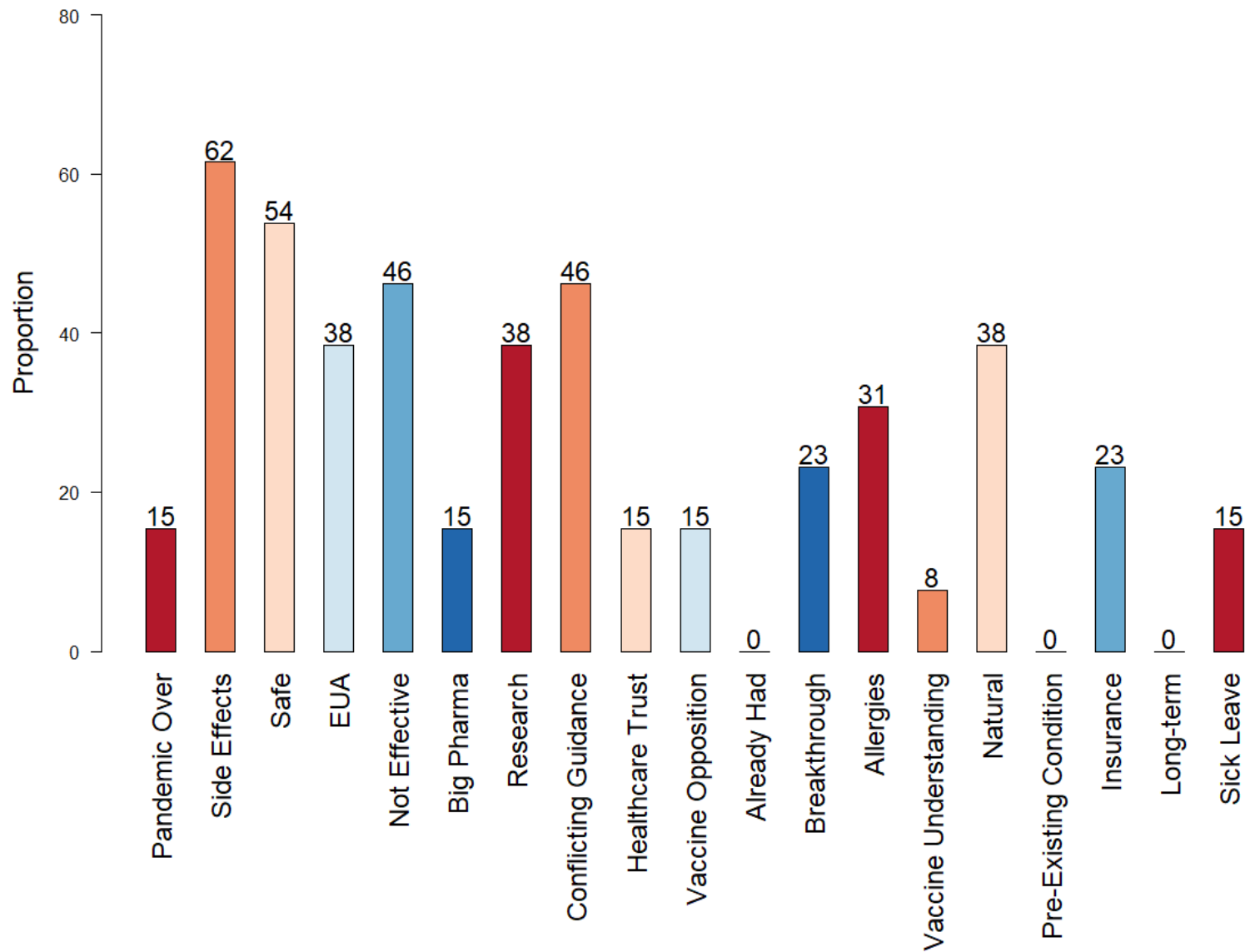
Overall Proportions by Hesitancy for Household Income of 60% AMI



Overall Proportions by Hesitancy for Household Income of 50% AMI



Overall Proportions by Hesitancy for Household Income of 30% AMI



Statistical Significance between Average to High Income (group 0) and Low Income (group 1):

Hesitancy	mean group 0	mean group 1	t	df	p-value	95% CI
<i>Long-term</i>	0.676	0.375	2.533	64	0.014	(0.064, 0.539)
<i>Big Pharma</i>	0.5	0.25	2.13	64	0.037	(0.016, 0.484)
<i>Healthcare Trust</i>	0	0.094	-1.85	64	0.069	(-0.195, 0.008)
<i>Research</i>	0.705	0.5	1.72	64	0.090	(-0.033, 0.445)
<i>EUA</i>	0.529	0.344	1.52	64	0.133	(-0.058, 0.429)
<i>Allergies</i>	0.147	0.281	-1.33	64	0.188	(-0.336, 0.067)
<i>Conflicting Guidance</i>	0.5	0.344	1.28	64	0.205	(-0.088, 0.400)
<i>Pre-Existing Condition</i>	0.206	0.313	-0.98	64	0.330	(-0.323, 0.110)
<i>Natural</i>	0.176	0.094	0.97	64	0.335	(-0.088, 0.253)
<i>Sick Leave</i>	0.029	0	0.97	64	0.336	(-0.031, 0.090)
<i>Vaccine Opposition</i>	0.235	0.156	0.80	64	0.428	(-0.119, 0.277)
<i>Safe</i>	0.5	0.406	0.76	64	0.452	(-0.154, 0.341)
<i>Vaccine Understanding</i>	0.529	0.438	0.74	64	0.463	(-0.157, 0.341)
<i>Side Effects</i>	0.676	0.594	0.69	64	0.493	(-0.157, 0.322)
<i>Breakthrough</i>	0.382	0.313	0.59	64	0.559	(-0.168, 0.307)
<i>Already Had</i>	0.147	0.188	-0.43	64	0.665	(-0.226, 0.145)
<i>Not Effective</i>	0.324	0.313	0.09	64	0.925	(-0.222, 0.244)
<i>Pandemic Over</i>	0.088	0.094	-0.08	64	0.939	(-0.149, 0.138)
<i>Insurance</i>	0	0	na	64	na	na