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The Illinois Institute for Rural Affairs (IIRA) works to improve the quality of life for rural residents by partnering with public and private agencies on local development and enhancement efforts.

Western Illinois University

Coronavirus Vaccine Refusal and Hesitancy: Metro versus Nonmetro Differences

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Abstract

This paper highlights Covid-19 vaccine behavior among Medicare beneficiaries. Data are from the Winter 2021, Covid-19 supplement to the Medicare Beneficiary Survey. Results of data analysis suggest that slightly more than one-in-three metro and nonmetro residents do not want to get vaccinated; vaccine side effects are a major concern. It is recommended that marketing communications highlight that the vaccine is safe and effective.

Introduction

Negative attitude towards vaccination has existed for centuries; a prominent example would be the smallpox vaccination that was made available to the general public in 1796. The misbelief about the smallpox vaccination was that it turned vaccine recipients into cows[2] . In general, antivaccine activists rely on arguments grounded in religious beliefs and personal liberty; this is in-spite of the US Supreme Court assertion in 1905 that “upon the principle of self-defense, of paramount necessity, a community has the right to

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[2] Riedel, S. (2005) Edward Jenner and the History of Smallpox and Vaccination, *Baylor University Medical Center Proceedings*, 18:1, 21-25.

protect itself against an epidemic of disease which threatens the safety of its members"[3].

The Covid-19 pandemic has once again stimulated the vaccine refusal and hesitancy[4] behavior of the general public[5]. In Illinois, Covid-19 first appeared in Cook County on January 24, 2020. Since then it has infected more than 1.89 million Illinoisans and has claimed 28,835 lifes, as at December 11, 2021; metro Illinois was the worst affected, 86% of the cases and 84% of the deaths were from the metro. In spite of this, the vaccine uptake in Illinois is 55% for the metro and 46% for the nonmetro, median values. Appendix 1 lists the vaccination rates of Illinois counties. Appendix 2 shows the vaccination rates for all the US states, for both the metro and the nonmetro.

What proportion of the metro and the nonmetro population in the nation refuses the coronavirus vaccination? What is the salient vaccine-hesitancy belief of the metro and the nonmetro residents? Several segments of the population have specific vaccine requirements, notably the elderly; how do these groups differ from the overall population in terms of vaccine uptake, rejection, hesitancy, and beliefs about coronavirus vaccine? This paper addresses these and other related questions. The paper concludes with a discussion of behavioral economics principles that could be used to increase or improve vaccination coverage.

Theory

Exposure to information such as coronavirus is contagious and deadly will lead the resident to experience a need, in memory. A need is some event, internal or external to the customer, that establishes motivation. Physiologically, some persons may be more vulnerable to coronavirus because of age, immune-compromised status, etc. Also, imbalances that arise from conflicts with self-concept such as pressure to conform with social norms could motivate the vaccination behavior. External events that could energize a person to get vaccinated include physician's recommendation, government mandates, workplace requirements, etc.

Motives are fundamental and relatively permanent dispositions of the buyer to act, and they are manifested through *arousal* (readiness to respond). Arousal

[3] It could be said that the US Supreme Court paved the way for governments to mandate vaccines; see Parmet, W. E., Goodman, R. A., & Farber, A. (2005). Individual rights versus the public's health—100 years after Jacobson v. Massachusetts. *New England Journal of Medicine*, *352*(7), 652-654.

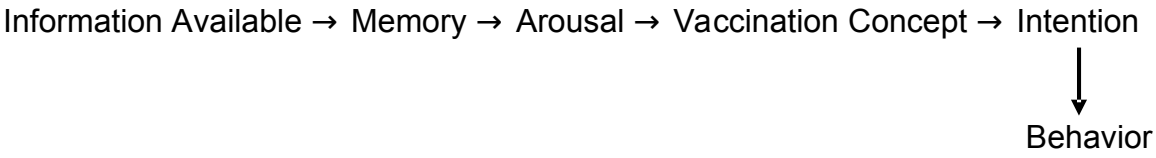
[4] Vaccine hesitancy refers to delay in acceptance or refusal of vaccines despite availability of vaccination services; see SAGE Working Group. (2014). Report of the SAGE working group on vaccine hesitancy. *Geneva: World Health Organization*.

[5] The earlier "stimulus" for vaccine refusal behavior was for MMR; a report published in *The Lancet* linked the vaccine with autism. See, Saint-Victor, D. S., & Omer, S. B. (2013). Vaccine refusal and the endgame: walking the last mile first. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *368*(1623), 20120148.

elicits the response, the *Vaccination concept*. It is the degree of preference for Covid-19 vaccination and is based on benefit perceptions or beliefs. The vaccination concept also contains an evaluative element, liking of the object, which leads to behavioral intention followed by behavior.

In summary, need creates an insistent stimulus (arousal) that will continue until the demand is satisfied. In our case, the "demand" could be getting vaccinated, deciding not to get vaccinated, or delaying the vaccination. The linkages among the concepts are shown in Figure 1[6]:

Figure 1: The Conceptual Model for Vaccination Behavior



Methodology

Data for the study came from the 2021 Winter, Covid-19 supplement to the Medicare Beneficiary Survey[7]. The public use file, released by the Center for Medicare Services on November 5, 2021, contained individual-level data on topics ranging from telemedicine to coronavirus vaccination[8]. In all, the cross-sectional survey polled 11,107 Medicare beneficiaries, weighted number of respondents = 57,387,274.

Table 1 shows the variables used in the data analysis. Metro and nonmetro groupings of the respondents were based on Core Based Statistical Area, defined by the Office of Management and Budget[9].

[6] This model is often used in consumer behavior; see, for example, Athiyaman, A. (2018). Developing the US Biomass Residential Heating Market: Insights from Research. *International Journal of Social Ecology and Sustainable Development,* 9(4), 16-34.

[7] https://www.cms.gov/research-statistics-data-and-systems/downloadable-public-use-files/mcbs-public-use-file.

[8] An earlier *Research Brief* looked at the awareness and use of telemedicine among the Medicare beneficiaries; see Athiyaman, A. (2021). Supplier-induced demand: The case of telemedicine in rural Illinois, *Research Brief*, 3(20), December 6, 1-10.

[9] https://www.federalregister.gov/documents/2021/07/16/2021-15159/2020-standards-for-delineating-core-based-statistical-areas.

Table 1: Variables and Operational Definitions

Variable	Operational Definition
PKV_CVDVAC: Has gotten Covid-19 vaccine	yes =1; No = 0.
PKV_PRSUMVAC: Would get the vaccine if available.	Definitely and probably = 1; Probably not and definitely not = 2; Not sure = 3. For the purposes of this paper, response 2 = refusal and response 3 = hesitant to get vaccinated.
REASON: Reason for rejecting or hesitating to get the Cov-19 vaccine.	Don't know it is needed = 1; Vaccine causes Cov-19 = 2; Causes side effects = 3; Wouldn't prevent Cov-19 = 4; Cov-19 not serious = 5; Physician didn't recommend = 6; Physician recommended against it = 7; Dislike needles = 8; Couldn't get to site = 9; Couldn't find site = 10; Forgot = 11; Can't afford it = 12; Had vaccine before = 13; Not available = 14; Not worth the money = 15; Didn't have time = 16; Not at high risk = 17; Medical reasons = 18; Don't trust government = 19; Other = 20.
Gender	Female = 1; Male = 2.
Race	Black = 1; Hispanic = 2; White = 3.
Age	LT 65 = 1; 65-74 = 2; 75+ = 3.

Statistical tools in data analysis include cross-breaks of variables and Chi-square analysis and Logit models. For the question about proportion of the metro and the nonmetro population in the nation that refuses the coronavirus vaccination, crosstabulation of "location" variable with "PKV_CVDVAC" (see Table 1) was performed; to eliminate chance associations between variables, the χ^2 statistical test was constructed. The question about salient vaccine-hesitancy belief of the metro and the nonmetro residents was addressed by constructing a linear model of the form:

$$U_{i,n} = V_{i,n} + \epsilon_{i,n}$$ [10]

where, *U* is the utility of hesitating to get the Covid-19 vaccine and the other nth option is to get vaccinated; V is the matrix of predictors, see the variable REASON in Table 1. Finally, differences among groups (age and race), in vaccine uptake, rejection, and hesitancy were examined using descriptive statistics and tests of goodness of fit.

Results

Nonmetro lags behind the metro in vaccine uptake (Table 2); although the difference is statistically insignificant at the conventional <0.05 level, for practical purposes, it is of concern that more nonmetro residents remain unvaccinated.

Table 2: Covid-19 Vaccine Uptake, Metro and Nonmetro

Has Gotten Cov-19 Vaccine	Metro	Nonmetro	Nation
Yes	65%	59%	64%
No	35%	41%	36%
Number of Respondents	45,911,660	11,463,148	57,374,808

Note: Nonresponses were excluded from the analysis; χ^2 = 0.883; critical value = 5.991.

Table 3 shows the proportion of metro and nonmetro residents who would decline the vaccine or are hesitant to take the vaccine. While hesitancy is evenly spread among people of different ages from both the metro and the nonmetro, the percentage of elderly people who would decline the vaccine is higher in the nonmetro, again, a concern since governments are fighting to stem the spread of Covid-19[11]. Appendix 3 provides additional crosstabulations, demographics with vaccination behavior.

[10] For details on model calibration, see Athiyaman, A. (2012). *Need for a business incubator in Logan County, Illinois*. Macomb, IL, IIRA: Consulting Report; see Appendix 1.

[11] It appears that the fear of the new variant of Cov-19, Omicron, could influence the unvaccinated to get vaccinated; see, https://thehill.com/changing-america/well-being/prevention-cures/584229-fear-of-omicron-is-causing-unvaccinated-people.

Table 3: Impact of Age on Vaccine Rejection and Hesitation

Age	Metro Declined	Nonmetro Declined	Metro Hesitant	Nonmetro Hesitant
<65 Years Old	33%	26%	37%	35%
65-74 Years	36%	56%	43%	41%
75+ Years	30%	17%	20%	24%
All Ages (N)	807,819	440,199	692,867	191,115

Note: χ^2 = 11.252; df = 6; critical value = 12.592; p = 0.081.

The vaccination concept shown in Figure 1 is a precursor to behavior; if we feel a certain way about the Covid-19 vaccination, the feeling determines how we act when we get the opportunity to get vaccinated. In marketing, the target audience for advertising is often defined as the customer segment that has neutral feelings or attitude towards the product[12]. The reasoning is that customers with positive feelings have a high probability of patronizing the product, customers with negative feelings will most certainly reject it, but it is the segment that is neutral that gives the most leverage for advertising.

The segment that is neutral to vaccination is the "hesitant", the cluster that is unsure about getting the vaccination. If we know the types of beliefs held by this cluster, then marketing programs can be initiated to appeal to the beliefs and influence the cluster's behavior, to get vaccinated.

Table 4 shows the salient beliefs associated with the vaccine-hesitant behavior. The beliefs can be clustered into three groups: product related, logistics or distribution of the vaccine, and environmental influences. Parameter estimates suggest that product-related beliefs include concerns about the side effects of the vaccine and dislike of needles and shots; these beliefs increase one's probability of being unvaccinated.

Logistical issues such as unavailability and distribution of the vaccines also deter one from getting vaccinated. Finally, distrust of the government increases one's probability of rejecting the vaccine.

[12] Athiyaman, A. (2018). Developing the US Biomass Residential Heating Market: Insights from Research. *International Journal of Social Ecology and Sustainable Development,* 9(4), 16-34.

Table 4: Log Odds of Getting Vaccinated: Beliefs about Cov-19 Vaccination, the "Hesitant" Segment of the Medicare Respondents

Variable	Coefficient	Std. Error	z	p>|z|
Constant	-1.37	0.16	-8.25	0.00
x1: Nonmetro	0.39	0.24	1.64	0.10
x2: Side effects	2.18	0.29	7.49	0.00
x3: Dislike needles	2.54	0.77	3.29	0.00
x4: No access to site	-0.99	0.50	-1.97	0.04
x5: Couldn't find site	-2.48	0.63	-3.89	0.00
x6: Not available	-1.00	0.25	-3.96	0.00
x7: Don't trust Gov.	1.96	0.38	5.10	0.00

Note: n = 781; method = MLE; R^2 = 0.27; zero-order correlations with the criterion variable were used to choose predictors.

Summary and Conclusion

This paper analyzed the Winter, 2021, Covid-19 supplement of the MCBS. Questions that were addressed include the following:

1. What proportion of the metro and the nonmetro population in the nation refuses the coronavirus vaccination?

   Slightly more than one-in-three metro and nonmetro residents do not want to get vaccinated.

2. What is the salient vaccine-hesitancy belief of the metro and the nonmetro residents?

   Vaccine side effects are the major concern, for both the metro and the nonmetro residents.

3. Several segments of the population have specific vaccine requirements, notably the elderly; how do these groups differ from the overall population in terms of Covid-19 vaccine uptake, rejection, hesitancy, and beliefs about the vaccine?

   Vaccine uptake is around 66%; hesitancy is evenly spread among people of different ages from both the metro and the nonmetro, and the percentage of elderly people who would decline the vaccine is higher in the nonmetro.

Covid-19 has been present in the nation since early 2020. It is highly likely that the public has learned to live with the disease; perceived risks of disease and life-threatening outcomes decline with time. This is why it is essential that

public health departments and health professionals target the “hesitant” and influence them to get vaccinated.

Marketing communications from health departments should highlight that the vaccine is safe and effective.

Furthermore, if ethical, healthcare providers can ‘nudge’ the unvaccinated using a presumptive form of discussion such as “Today you will get a Covid-19 shot” instead of asking the patient whether she wants the vaccination.

Appendix 1: Illinois Counties, Vaccination Rates as at December 11, 2021

Metro County	Pop. Fully Vaccinated	Percent Vaccinated	Rank
Alexander	1,616	28.1	40
Bond	8,367	50.9	32
Boone	30,036	56.1	17
Calhoun	2,223	46.9	38
Champaign	124,854	59.5	10
Clinton	20,139	53.6	22
Cook	3,393,357	65.9	3
De Witt	7,766	49.7	33
DeKalb	55,051	52.5	27
DuPage	658,083	71.3	2
Ford	6,827	52.7	26
Grundy	27,084	53	25
Henry	27,299	55.8	20
Jackson	27,818	49	36
Jersey	11,381	52.3	28
Kane	326,259	61.3	7
Kankakee	52,396	47.7	37
Kendall	80,329	62.3	4
Lake	500,051	71.8	1
Macon	51,657	49.7	33
Macoupin	23,279	51.8	29
Madison	150,421	57.2	13
Marshall	6,112	53.4	24
McHenry	191,261	62.1	5
McLean	102,959	60	9
Menard	6,572	53.9	21
Mercer	8,623	55.9	18
Monroe	19,897	57.4	12
Peoria	102,360	57.1	14
Piatt	9,184	56.2	16
Rock Island	80,266	56.6	15
Sangamon	119,193	61.2	8
St. Clair	151,314	58.3	11
Stark	2,639	49.4	35
Tazewell	73,668	55.9	18
Vermilion	32,276	42.6	39
Will	427,346	61.9	6
Williamson	34,520	51.8	29
Winnebago	151,397	53.6	22
Woodford	19,912	51.8	29
Median		54.85	

Note: Rank pertains to vaccination rates; highest rate (Lake County) is assigned rank 1.

Nonmetro County	Pop. Fully Vaccinated	Percent Vaccinated	Rank
Adams	32,951	50.4	18
Brown	3,171	48.2	21
Bureau	17,570	53.8	11
Carroll	8,488	59.3	2
Cass	6,795	55.9	4
Christian	14,405	44.6	39
Clark	7,000	45.3	33
Clay	4,811	36.5	59
Coles	21,645	42.8	41
Crawford	8,596	46	31
Cumberland	3,975	36.9	57
Douglas	8,790	45.2	35
Edgar	7,688	44.8	38
Edwards	2,349	36.7	58
Effingham	15,471	45.5	32
Fayette	7,110	33.3	61
Franklin	16,322	42.4	42
Fulton	18,507	53.9	10
Gallatin	2,424	50.2	19
Greene	4,901	37.8	52
Hamilton	2,799	34.5	60
Hancock	8,027	45.3	33
Hardin	1,443	37.8	52
Henderson	2,761	41.5	45
Iroquois	12,734	47	25
Jasper	3,849	40.1	47
Jefferson	15,937	42.3	43
Jo Daviess	15,633	73.6	1
Johnson	5,796	46.7	26
Knox	27,384	55.1	6
LaSalle	59,318	54.6	7
Lawrence	6,169	39.3	48
Lee	18,987	55.7	5
Livingston	17,047	47.8	24
Logan	14,643	51.2	16
Marion	15,689	42.2	44
Mason	6,751	50.5	17
Massac	5,139	37.3	55
McDonough	13,805	46.5	28
Montgomery	13,675	48.1	23
Morgan	17,351	51.6	15
Moultrie	5,905	40.7	46
Ogle	27,132	53.6	13
Perry	9,657	46.2	30
Pike	5,988	38.5	51
Pope	1,320	31.6	62

Pulaski	2,001	37.5	54
Putnam	3,089	53.8	11
Randolph	15,320	48.2	21
Richland	6,848	44.1	40
Saline	10,595	45.1	36
Schuyler	3,371	49.8	20
Scott	1,948	39.3	48
Shelby	8,487	39.2	50
Stephenson	25,102	56.4	3
Union	8,784	52.7	14
Wabash	5,200	45.1	36
Warren	7,829	46.5	28
Washington	7,587	54.6	7
Wayne	6,052	37.3	55
White	6,328	46.7	26
Whiteside	30,029	54.4	9
Median		45.75	

Note: Rank pertains to vaccination rates; highest proportion of vaccination (Jo Daviess County) is assigned rank 1; Pope County is ranked last, rank 62, with a 32% vaccination rate.

Appendix 2: Vaccination Rates of US States as at December 11, 2021, by Metro and Nonmetro; Median Values

State	Metro %	Nonmetro %
AK	52	62
AL	41.5	39.9
AR	43.3	42.9
AZ	55	57.4
CA	60.8	39.3
CO	58	48.4
CT	72.2	71.7
DC	62.9	
DE	62.7	
FL	57.15	39.1
GA	24.3	21.1
HI	0	0
IA	56.1	50.1
ID	39.6	39.45
IL	54.85	45.75
IN	49.95	42.7
KS	45	43.9
KY	47.3	45.4
LA	45.1	39
MA	64.3	3.8
MD	65	54.4
ME	74.5	66.7
MI	52.9	52.4
MN	56.7	53.3
MO	42.35	36.1
MS	47.3	45.1
MT	48.3	41.7
NC	51.5	48.95
ND	45.1	44
NE	48.7	37.5
NH	59.4	61.6
NJ	64.6	
NM	66.3	57
NV	56.1	38.8
NY	65	56.15
OH	52.55	42.4
OK	43.6	40.6
OR	59.7	52.7
PA	57.9	45.85
PR	70.5	70.4
RI	73.8	
SC	45.15	45.4
SD	51.8	49.65
TN	46.85	39.1
TX	45.5	39.7

UT	50.8	44.2
VA	46.75	41.4
VT	68.2	48.5
WA	57.6	52.5
WI	57.3	52.6
WV	56.3	51.9
WY	45.35	39.4

Note: Blanks indicate non-availability of information.

Appendix 3: Demographic Analysis of the Respondents

Race	Metro Declined	Nonmetro Declined	Metro Hesitant	Nonmetro Hesitant
Black	10%	5%	25%	9%
Hispanics	12%	0	14%	3%
White	78%	94%	62%	88%
All Race	769,337	427,278	632,645	163,847

Region	Metro Declined	Nonmetro Declined	Metro Hesitant	Nonmetro Hesitant
Midwest	24%	22%	16%	19%
Northeast	11%	3%	15%	6%
South	47%	64%	46%	63%
West	19%	11%	23%	13%
All, US (N)	807,819	440,199	692,867	191,115