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'What have you HEARD about the HERD?' Does education about local influenza vaccination coverage and herd immunity affect willingness to vaccinate?

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ABSTRACT

Background: Vaccination protects individuals directly and communities indirectly by reducing transmission. We aimed to determine whether information about herd immunity and local vaccination coverage could change an individual's vaccination plans and concern about influenza.
Methods: We surveyed Minnesota residents ≥18 years during the 2016 Minnesota State Fair. Participants were asked to identify the definition of herd immunity, to report their history of and plans to receive influenza vaccine, to report their concern about influenza, and to estimate the reported influenza vaccination coverage in their county. After providing educational information about herd immunity and local vaccination rates, we reassessed vaccination plans and concerns. We used logistic regression to estimate predicted percentages for those willing to be vaccinated, for concern about influenza, and for changes in these outcomes after the intervention. We then compared those individuals with and without prior knowledge of herd immunity, accounting for other characteristics.
Results: Among 554 participants, the median age was 57 years; most were female (65.9%), white (91.0%), and non-Hispanic/Latino (93.9%). Overall, 37.2% of participants did not know about herd immunity and 75.6% thought that the influenza vaccination coverage in their county was higher than it was reported. Those not knowledgeable about herd immunity were significantly less likely than those knowledgeable about the concept to report plans to be vaccinated at baseline (67.8% versus 78.9%; p = 0.004). After learning about herd immunity and influenza vaccination coverage, the proportion of those not knowledgeable about herd immunity who were willing to be vaccinated increased significantly by 7.3 percentage points (p = 0.001). Educating participants eliminated the significant difference in the proportion planning to be vaccinated between these two groups (80.1% of those knowledgeable and 75.1% of those who were not initially knowledgeable became willing; p = 0.148).
Conclusions: Education about herd immunity and local vaccination coverage could be a useful tool for increasing willingness to vaccinate, generating benefits both to individuals and communities.

1. Background and significance

Influenza is a vaccine-preventable infectious disease that is responsible for an estimated 3–5 million cases of severe illness and 250,000–500,000 deaths each year primarily among young children, the elderly, and pregnant women [1,2]. The annual incidence depends on many factors including the variability of circulating strains, the proportion of individuals in the population who have acquired natural immunity or who have been immunized, and the efficacy of the annual vaccine [3]. Maintaining high vaccination coverage is important because the effectiveness of the influenza vaccine is relatively low and not everyone can be vaccinated [4–6]. Beginning in 2010 in the United States, annual influenza vaccination was recommended for all individuals aged 6 months or older with the exception of those with medical contraindications [7]. Despite this universal recommendation and the Healthy People 2020 target of 70% vaccinated, the Centers for Disease Control and Prevention estimate that only 45.6% of the

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U.S. population and 49.7% of Minnesota residents were vaccinated against influenza during the 2015–16 influenza season [8–10].

Vaccination protects individuals directly by inducing an immune response and protects communities indirectly by reducing transmission and the risk of infection. Indirect protection at the community level provides additional benefit beyond what would be expected from direct protection alone [3,11]. This concept of "herd immunity" or "community immunity" demonstrates that vaccinating a high proportion of the population can prevent outbreaks and protect both vaccinated and unvaccinated individuals. The degree to which vaccination can reduce transmission in a population depends upon several factors, including the transmissibility of the pathogen, the network of human interactions and frequency of contacts, and the effectiveness and distribution of the vaccine. Herd immunity is best thought of as a continuum rather than a threshold [12]. Estimates of the influenza vaccination coverage needed to maximize the benefits of herd immunity and reduce disease transmission vary widely; under various scenarios vaccinating 33–73% of the population can prevent outbreaks [3,12].

Previous studies have demonstrated that individuals consider community-level benefits of vaccination in addition to personal benefits when choosing whether to be vaccinated [13]. While willingness to vaccinate was highest when individuals themselves were at risk, Vietri *et al.* found that college students were more willing to be vaccinated when they were told that 95% of the community would benefit from their decision compared to a scenario where only 10% would benefit [14,15]. A systematic review found that between 1 and 6% of parents chose benefit to others as their primary motive for vaccinating their children while 37% ranked benefit to others as their secondary motive [16,17]. Since maximizing community-level benefits of vaccination requires high levels of vaccine uptake, some vaccination campaigns have sought to increase willingness to be vaccinated by emphasizing the added communal benefits. For example, 'Do It For The Herd' is a frequent phrase used to promote free influenza vaccination clinics for University of Minnesota students, faculty, staff, and others which is aimed at increasing vaccination coverage by emphasizing the population-level benefits of decreasing transmission [18].

Despite these efforts, little is known about whether individuals are aware of the impact of their vaccination decision on their community and whether receiving education about the community-level benefits of immunization and the vaccination coverage in their county will influence their willingness to be vaccinated. To address this, we aimed to determine (1) whether participants were familiar with both (a) the concept of herd immunity and the vaccination coverage needed for community-wide protection and (b) the vaccination coverage in their county, and (2) whether individual plans to get vaccinated and/or concern about getting influenza would change after providing education about herd immunity and reported, local vaccination rates.

2. Research methods

2.1. Setting and study design

We conducted a cross-sectional survey in the University of Minnesota's (UMN) Driven to Discover (D2D) Research Facility over a 4-day period at the 2016 Minnesota State Fair, a 12-day event held annually in August and attended by 1.9 million individuals. The UMN D2D Facility is a building on the grounds of the state fair where researchers can conduct studies by recruiting individuals attending the fair. Prior to implementing the survey, we conducted a small pilot study to refine the questions and the educational information provided.

2.2. Participant recruitment

Potential participants were eligible if they were 18 years of age or older, residents of Minnesota for at least six months of the year, and could read, speak, and understand English. Eligibility and consent were determined prior to participants self-administering the 5–10 minute survey using Apple iPads.

2.3. Survey methodology

The survey consisted of a maximum of 26 questions (Table 1) about demographic characteristics, county of residence, knowledge of herd immunity, history and frequency of influenza vaccination, willingness to get vaccinated, and concern about influenza. Participants were then asked to estimate the percentage of the population of their county that would need to be vaccinated for the community to benefit from herd immunity (by preventing outbreaks, thus protecting everyone even those who are not vaccinated) and to estimate the percentage of the population in their county that had received the influenza vaccine in the previous year. After entering these estimates, participants were presented with written statements via the iPads to educate themselves about (1) the definition of herd immunity; (2) the reported 2015–2016 influenza vaccine uptake among individuals 6 months and older

Table 1
Demographic characteristics of the 554 participants who completed the survey.

Characteristics	Responses	n*	%*
Age	Years, median (IQR)	57	29–66
Sex	Male	184	33.2
	Female	365	65.9
	Other	1	0.2
	Missing	4	0.7
Race	American Indian or Alaska Native	7	1.3
	Asian	14	2.5
	Black or African American	6	1.1
	Hawaiian or Other Pacific Islander	1	0.2
	White	504	91.0
	Multiracial	8	1.4
	Other	12	2.2
	Missing	2	0.4
Ethnicity	Hispanic or Latino	13	2.4
	Not Hispanic or Latino	520	93.9
	Missing	21	3.8
Highest education completed	Elementary School	5	0.9
	High School Diploma or GED	133	24.0
	Associates Degree	98	17.7
	Bachelor's Degree	191	34.5
	Graduate Degree	124	22.4
	Missing	3	0.5
County of residence (derived from zip code)	Live within Minneapolis/St. Paul metro area (Hennepin, Carver, Scott, Washington, Dakota, Anoka, and Ramsey counties)	416	75.1
	Live outside metro area (all other counties)	138	24.9
Household makeup	Number of Adults ≥ 18 years, mean (SD)	2.1	1.2
	Number of Children < 18 years, median (range)	0	0–4
Attending college in the Fall	Yes, full-time	80	14.4
	Yes, part-time	17	3.1
	No	453	81.8
	Missing	4	0.7

Abbreviations: n = frequency, % = percentage, IQR = interquartile range, SD = standard deviation.

* Categorical variables presented as n (%); normally distributed continuous variables presented as mean (SD); non-normally distributed continuous variables presented as median (IQR) or median (range).

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