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Seasonal and H1N1 influenza vaccine compliance and intent to be vaccinated among emergency medical services personnel

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Background: Only limited data are available on emergency medical technicians' (EMT) influenza vaccination compliance.

Methods: A questionnaire was administered to St. Louis EMTs during March to June 2011 to assess compliance with the 2010/2011 and 2009/2010 seasonal and pandemic H1N1 influenza vaccinations, factors that predicted uptake of 2010/2011 seasonal influenza vaccine, and intent to be vaccinated.

Results: In all, 265 EMTs participated. EMTs' attitudes and beliefs toward influenza vaccines differed significantly when comparing vaccinated to nonvaccinated EMTs. EMTs whose employer had a mandatory vaccination policy were significantly more likely to receive the seasonal influenza vaccine (100% vs 75.6%, respectively) or the H1N1 vaccine (100% vs 66.8%, respectively) compared with those without such a policy ($\chi^2 = 8.8, P < .001$ and $\chi^2 = 6.7, P < .01$, respectively). In logistic regression controlling for demographics, determinants of 2010/2011 seasonal influenza vaccination included belief that EMTs should be vaccinated every year, perceived importance of vaccination, perception that influenza vaccine has few adverse effects, and past vaccine-seeking behavior. In logistic regression controlling for demographics, determinants of intent to be vaccinated included having the vaccine available on-site and free of charge and belief that EMTs should be vaccinated every year.

Conclusion: EMT-targeted interventions should be used to increase vaccine compliance, including implementing a mandatory vaccination policy and addressing EMTs' beliefs and attitudes about vaccine in an education campaign.

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Influenza is a serious disease that causes approximately 36,000 deaths per year in the United States.¹ Vaccination is the best prevention against developing influenza, and annual immunization is recommended for all individuals over the age of 6 months.¹ Immunization of health care personnel is especially critical to help decrease health care-associated influenza transmission and reduce worker illness. Research indicates that vaccination of health care workers can decrease patient morbidity and mortality, as well as reduce staff absenteeism.²⁻⁴ The Advisory Committee on

Immunization Practices recommends annual influenza vaccination for all health care personnel.¹ In addition to receiving annual seasonal influenza vaccination, it may also be necessary for health care personnel to receive vaccines created in response to an influenza pandemic, such as the 2009 H1N1 pandemic.

Emergency medical technicians (EMT), paramedics, and emergency medical services (EMS) professionals (both will be referred to as EMTs) are essential health care personnel and may play a role in health care-associated influenza transmission if vaccination is not implemented among these providers.⁵ Despite the importance of EMT vaccination, only 3 previously published studies have focused on EMTs' influenza vaccine compliance and reported factors that may influence EMTs' uptake of influenza vaccine.⁵⁻⁷ These studies reported EMT vaccination uptake rates of only 21%⁵ and 48%⁷ for US EMTs and 87.5% for Canadian EMTs.⁶ The US EMT uptake rates were far lower than research examining other groups of US health care responders.⁸⁻¹¹ A 2006 study of EMTs in New York⁵ found that

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offering vaccine on-site and free of charge were important interventions to increase vaccine uptake. In addition, perceived frequency of exposure to infected patients and concerns about spreading influenza to family were also found to be factors that may influence EMTs' decision to receive the seasonal influenza vaccine.⁵ A 2008 study of EMTs in North Carolina⁷ reported that previous influenza infection, perceived susceptibility, perceived vaccine effectiveness, belief that benefits of immunization outweigh the risk of adverse effects, employer encouragement, and age are potential predictors of vaccine uptake. In addition, EMTs' attitudes and beliefs regarding influenza vaccine have been reported to differ when comparing vaccinated versus nonvaccinated EMTs,⁷ and education campaigns can address these attitudes to increase vaccine compliance.^{6,7} No studies were found that examine US EMTs' uptake of the pandemic H1N1 vaccine, except 1 study that did not separate EMTs from other groups of health care workers.¹²

The purposes of this study were to (1) determine EMT uptake rates for 2010/2011 seasonal influenza vaccine, pandemic H1N1 Influenza A vaccine (H1N1 influenza vaccine), and 2009/2010 seasonal influenza vaccine and (2) determine predictors for uptake/compliance with the 2010/2011 seasonal vaccine and intent to be vaccinated during the 2011/2012 season.

METHODS

This study consisted of a survey provided to EMTs in the St. Louis region in March to June 2011. The survey was administrated through Qualtrics (Provo, UT), an online survey software program; paper surveys were also made available to subjects who did not have Internet access. Subjects consisted of EMTs working for emergency response agencies in the St. Louis region and members of EMS organizations, such as the Greater St. Louis Fire Chiefs Association. Participants were recruited using 2 methods: (1) 2 recruitment e-mails (sent 2 weeks apart) were distributed to staff working at participating emergency response agencies or members of EMS organizations who agreed to assist in recruiting subjects, and (2) paper surveys were administered to EMTs working for participating emergency response agencies that did not have internal e-mail distribution capability. In all, 14 organizations and agencies assisted with subject recruitment. (A list of participating organizations/agencies is available on request.) The Saint Louis University Institutional Review Board approved this study.

Instrument

Surveys used in earlier studies examining influenza vaccine compliance were used as the basis for this questionnaire.^{10,13-15} In addition, questions were added that were specific to the purposes of this study. A group of 10 US influenza vaccine researchers provided feedback on content validity. The content validity index (CVI) was computed for each item (CVI aims to quantify the extent to which an instrument item accurately measures the construct of interest).¹⁶ No items had a CVI below 0.80, so none were deleted.¹⁶ The final survey contained 34 questions plus demographic items. Twenty St. Louis area health care workers and EMTs pilot tested the instrument. The survey assessed the following: (1) vaccine uptake of 2010/2011 seasonal influenza vaccine, H1N1 vaccine during the 2009 pandemic, and seasonal influenza vaccine during the 2009 pandemic (2009/2010); (2) employer's stance/policy on seasonal and H1N1 influenza vaccines; (3) EMTs' perceived barriers to vaccination; (4) EMTs' attitudes and beliefs about seasonal and H1N1 influenza vaccines; and (5) EMTs' intent to get vaccinated during the upcoming 2011/2012 influenza season. Temporal stability of the instrument (the extent to which respondents answer an item the same way over time, ie, the item's stability) was

assessed using a 2-week test-retest procedure among 163 health care workers and EMTs. The questionnaire had good temporal stability, with correlation coefficients varying from .74 to .94.

Statistical analysis

The Statistical Package for the Social Sciences version 19.0 (SPSS Inc, Chicago, IL) was used for all analyses. Descriptive statistics were computed for each question and used to describe vaccine compliance, employer's stance/policy on influenza vaccination, and EMTs' attitudes and beliefs about influenza vaccines. McNemar tests were used to compare compliance rates across the 3 types of vaccine: seasonal 2010/2011, H1N1, and seasonal 2009/2010. The χ^2 tests were used to compare vaccine compliance rates when comparing dichotomous groups (example: gender or race). A Kruskal-Wallis 1-way analysis of variance test was used to evaluate the relationship between seasonal influenza vaccine compliance by age and years of work experience; significant findings were followed by Mann-Whitney *U* post hoc tests. Two hierarchical logistic regressions were used to determine predictive models for 2010/2011 seasonal influenza vaccination and intent to be vaccinated.¹⁷ Good model fit, indicated by a nonsignificant χ^2 value, was calculated with the Hosmer and Lemeshow goodness-of-fit test¹⁸ for each regression. Nonsignificant variables were not included in the final models; only final models are reported.

RESULTS

In all, 265 EMTs responded to the survey. The majority of respondents was of white ethnic group (87.5%, *n* = 232), male (84.8%, *n* = 212), had 11 or more years of work experience (73.1%, *n* = 182), and had an associate's degree or less education (68.7%, *n* = 175). Most respondents were between the ages of 31 and 60 years (83.7%, *n* = 210).

Vaccine compliance

Compliance was highest for the 2010/2011 seasonal influenza vaccine (73.6%, *n* = 195), followed by uptake of the 2009/2010 seasonal influenza vaccine (71.0%, *n* = 181), and lowest for the H1N1 influenza vaccine (68.5%, *n* = 178); however, only the difference between 2010/2011 seasonal influenza vaccine and H1N1 vaccine uptake was statistically significant (*P* = .05). Almost three-quarters of all EMTs (71.2%, *n* = 183) reported that they plan to receive the 2011/2012 seasonal influenza vaccine, 16.7% (*n* = 43) indicated that they do not plan to be vaccinated, and 12.1% (*n* = 31) reported that they had not decided yet.

2010/2011 seasonal influenza vaccine

Of the EMTs who received the 2010/2011 seasonal influenza vaccine (*n* = 195), almost all (99.0%, *n* = 190) reported getting the vaccine via intramuscular injection, and most indicated that they received the vaccine free of charge from their employer or another source (88.5%, *n* = 150). Very few EMTs (11.4%, *n* = 22) were offered a choice regarding vaccine administration method. Of those EMTs who expressed a preferred vaccine delivery method (*n* = 209), most (80.9%, *n* = 169) reported a preference for intramuscular injection vaccine. Most EMTs reported that the 2010/2011 seasonal influenza vaccine was offered to them on-site (77.5%, *n* = 195). Whites were significantly more likely to report receiving the 2010/2011 seasonal influenza vaccine (76.7%, *n* = 178) compared with respondents of all other races (51.5%, *n* = 17; χ^2 = 9.4, *P* < .01). There were no significant differences between vaccination uptake and EMTs' gender, age, education level, or years of work experience.

H1N1 pandemic influenza vaccine

Whites were significantly more likely to report receiving the H1N1 influenza vaccine (70.7%, $n = 162$) compared with respondents of all other races (51.6%, $n = 16$; $\chi^2 = 4.6$, $P < .05$). Differences in H1N1 vaccine uptake were also identified by age and years of work experience (Table 1). The youngest EMTs were significantly less likely than the oldest EMTs to receive the H1N1 vaccine (Table 1). Those with less work experience were significantly less likely to get vaccinated compared with those with more work experience (Table 1). There were no significant differences between H1N1 vaccination uptake and EMTs' gender or education level.

Mandatory vaccination policies

Very few EMTs reported that their employer had a mandatory vaccination policy related to either the 2010/2011 seasonal influenza vaccine (2.8%, $n = 7$) or the H1N1 vaccine (5.5%, $n = 14$). EMTs whose employer had a mandatory vaccination policy were significantly more likely to receive the seasonal influenza vaccine (100% vs 75.6%, respectively) or the H1N1 vaccine (100% vs 66.8%, respectively) compared with those without such a policy ($\chi^2 = 8.8$, $P < .001$ and $\chi^2 = 6.7$, $P < .01$, respectively). EMTs who reported that their employer had a mandatory vaccination policy were asked to describe the extent to which this policy was enforced; participants could select multiple ways in which enforcement occurred. Most EMTs reported that neither the seasonal influenza (85.7%, $n = 6$) nor H1N1 (92.9%, $n = 13$) mandatory vaccination policy was enforced; 14.3% ($n = 1$) and 7.1% ($n = 1$) reported that staff were fired for noncompliance for seasonal and H1N1 vaccine, respectively. No other types of mandatory vaccination enforcement were reported.

EMTs who do not have mandatory seasonal influenza ($n = 242$) or H1N1 ($n = 240$) vaccination policies were asked to report the extent to which they were informed of, or encouraged to receive, the influenza vaccines. Approximately half (53.7%, $n = 130$) reported that they were highly encouraged to receive the 2010/2011 seasonal influenza vaccine, 36% ($n = 87$) were informed about the vaccine but not encouraged to receive it, and 10.3% ($n = 25$) indicated that they were neither encouraged to get immunized nor informed about the vaccine. A little more than half (59.2%, $n = 142$) reported that they were highly encouraged to receive the H1N1 vaccine, 27.5% ($n = 66$) were informed about the vaccine but not encouraged to receive it, and 13.3% ($n = 32$) indicated that they were neither encouraged to get immunized nor informed about the vaccine. Of the EMTs who reported having an occupational health nurse/officer ($n = 126$), 64.9% ($n = 126$) indicated that their occupational health nurse/officer encouraged 2010/2011 seasonal influenza vaccination. Of the EMTs who work for agencies that have an infection preventionist (51.9%, $n = 135$), 68.9% ($n = 93$) reported that the infection preventionist encouraged 2010/2011 seasonal influenza vaccination.

Attitudes and beliefs regarding influenza vaccines

EMTs' attitudes and beliefs regarding seasonal and H1N1 influenza vaccines are reported in Table 2. EMTs' attitudes and beliefs toward influenza vaccines differed significantly when comparing vaccinated with nonvaccinated EMTs (Table 2). Vaccinated EMTs were significantly more likely than nonvaccinated EMTs to agree that seasonal influenza ($\chi^2 = 7.0$, $P < .01$) and H1N1 ($\chi^2 = 8.4$, $P < .01$) are serious diseases, that EMTs should be vaccinated every year ($\chi^2 = 72.1$, $P < .001$), that vaccination is important to them ($\chi^2 = 93.2$, $P < .001$), that nonimmunized EMTs play a role in influenza transmission ($\chi^2 = 21.8$, $P < .001$), that they would receive the

Table 1
H1N1 vaccine compliance by age, race, and years of experience

Variables	No.	Mean*	SD	Kruskal-Wallis
Age				
≤30	17	.47	.51	10.3 [†]
31-40	44	.66	.48	
41-50	61	.75	.43	
≥51	48	.74	.44	
Race				4.6 [†]
White	229	.71	.46	
Non-white	14	.52	.50	
Years of work experience				21.8 [‡]
≤4	19	.26	.45	
5-10	48	.58	.50	
≥11	179	.75	.43	

SD, Standard deviation.

NOTE. Age: significant difference between those ≤30 years and those 41-50 or ≥51 years; years of experience: significant difference between ≤4 years and all other groups; ≥11 years and all other groups.

*0, No; 1, yes; all significant differences determined by Mann-Whitney *U* test.

[†] $P < .05$.

[‡] $P < .001$.

vaccine every year if it was offered at no cost ($\chi^2 = 67.8$, $P < .001$) and/or free and on-site ($\chi^2 = 62.5$, $P < .001$), and that public health officials can be trusted when they indicate that a vaccine is safe ($\chi^2 = 9.2$, $P < .01$; Table 2). Nonvaccinated EMTs were significantly more likely than vaccinated EMTs to report that they believe the seasonal influenza vaccine has a lot of adverse effects ($\chi^2 = 23.3$, $P < .001$) and that they fear influenza vaccine adverse effects ($\chi^2 = 10.0$, $P < .01$). Few respondents (15.4%, $n = 36$) reported that employment should be dependent on annual vaccination or that their immune system has become built up from working in the health care field (18.1%, $n = 42$); there were no differences between vaccinated and nonvaccinated EMTs and these reported beliefs.

Determinants of 2010/2011 seasonal and intent to be vaccinated in the future

Of the EMT respondents, 73.6% reported receiving the 2010/2011 seasonal influenza vaccine. Of the EMTs whose employers had a seasonal influenza mandatory vaccination policy ($n = 7$), 100% reported receiving the vaccine covered by the policy. Logistic regression was used to determine significant predictors of 2010/2011 seasonal influenza vaccine uptake for EMTs who did not fall under a mandatory vaccination policy ($n = 242$). After controlling for gender, age, and race, the following determinants of 2010/2011 seasonal influenza vaccination were identified (in order of decreasing importance): belief that EMTs should be vaccinated every year, perceived importance of immunization, working in a suburban or rural setting, perception that influenza vaccine has few adverse effects, and past behavior (ie, those who received the 2010/2011, 2009/2010, and H1N1 vaccines vs those who did not; Table 3). After controlling for gender, age, and race, the following were found to be determinants of intent to be vaccinated in 2011/2012 (in order of decreasing importance): having the vaccine offered on-site and free of charge, belief that EMTs should be vaccinated every year, and working in a suburban or rural setting (Table 3). The final models correctly classified 66% of seasonal influenza vaccine uptake and 65% of intent to be vaccinated (Table 3).

DISCUSSION

The findings of this study indicate that many St. Louis area EMTs are getting vaccinated with the seasonal influenza vaccine and intend to be vaccinated during the 2011/2012 season. EMTs'

Table 2

Vaccinated versus unvaccinated workers' attitudes and beliefs about seasonal and H1N1 influenza vaccines

Statement	All respondents, N = 262		Vaccinated vs unvaccinated, N = 262				P value [†]
	% Who strongly agreed or agreed	n	Vaccinated, n = 195*		Unvaccinated, n = 67		
			% Who strongly agreed or agreed	n	% Who strongly agreed or agreed	n	
H1N1 is a serious disease that can cause death	81.3	191	86.7	137	71.1	54	<.01
Seasonal influenza is a serious disease that can cause death	72.5	169	77.2	132	59.7	37	<.01
EMTs should be vaccinated against influenza every year	68.7	160	84.2	144	25.8	16	<.001
It is important to me to get vaccinated every year	67.7	157	85.4	146	18.0	11	<.001
I would receive the influenza vaccine every year if it was free	70.1	164	84.9	146	29.0	18	<.001
I would receive the influenza vaccine every year if it was free and on-site	72.3	167	86.4	146	33.9	21	<.001
All EMTs should receive influenza vaccine or risk losing their job	15.4	36	15.1	26	16.1	10	NS
Seasonal influenza vaccine has a lot of side effects	15.1	35	8.2	14	33.9	21	<.001
I am afraid of seasonal influenza vaccine side effects	16.3	38	11.7	20	29.0	18	<.01
I trust public health authorities when they say influenza vaccine is safe	55.1	129	61.0	105	38.7	24	<.01
EMTs can play role in influenza transmission if not vaccinated	69.5	162	77.9	134	45.9	28	<.001
My immune system is built up; I am not likely to get the influenza	18.1	42	17.0	29	21.3	13	NS

NS, nonsignificant.

*“Vaccinated” = received the 2010/2011 seasonal influenza vaccine for all questions except “H1N1 is a serious disease that can cause death,” for which “vaccinated” = received the H1N1 vaccine.

[†]Determined by the χ^2 test.

seasonal influenza vaccine compliance for the 2010/2011 season (74%) was found to be higher in this study than in previously published studies (21%⁵ and 48%⁷) examining EMT vaccine uptake. Despite this, seasonal influenza vaccine compliance for St. Louis EMTs still remains far below the Healthy People 2020 target of 90% uptake.¹⁹ Similar to a previously published study examining health care worker uptake of the pandemic H1N1 vaccine,¹² this study found that EMTs were less likely to receive the pandemic H1N1 vaccine compared with the seasonal influenza vaccine. This has important implications for future pandemics or outbreaks of emerging infectious diseases, during which rapid development and administration of a new vaccine will likely be critical interventions to prevent infection transmission in all health care settings, including pre-hospital care. It is essential that public health and EMS agencies continue to work toward higher seasonal influenza and pandemic vaccine uptake among EMTs to decrease patient, family, and community morbidity and mortality.

This study found that past behavior was a strong determinant for seasonal influenza vaccination. This potential influencing factor has not been examined in EMTs before, although studies conducted among hospital-based health care workers^{13,20,21} have indicated that past behavior is a strong predictor for future behavior. Implications of this finding include the need for EMS agencies to target previously noncompliant EMTs for vaccination to increase the likelihood that vaccine uptake behavior will be replicated in the future.

Very few EMTs in this study reported working for an agency that had a mandatory vaccination policy for seasonal or pandemic H1N1 influenza. Mandatory vaccination policies are relatively new in health care but have been reported to have a significant impact on vaccine compliance rates among health care workers.^{11,22,23} Although mandatory vaccination could not be assessed in the multivariate analysis in this study because of low cell counts, univariate analysis indicated that existence of a mandatory vaccination policy for seasonal and H1N1 vaccines had a significant effect on

EMT vaccine uptake. The Society for Healthcare Epidemiology of America has asserted that mandatory vaccination of all health care workers should be a condition of employment.²⁴ The evidence regarding the positive impact of mandatory vaccination policies on compliance behavior should be sufficient to encourage EMS agencies to implement similar policies. It should be noted that, in contrast to studies involving hospital-based workers,²⁵⁻²⁸ very few EMTs in this study indicated that they believe that vaccination should be a condition of employment. This may present obstacles that should be addressed in an immunization education campaign by EMS agencies intending to implement a mandatory vaccination policy.

In addition to implementing mandatory vaccination policies, previous research⁶ indicates that education campaigns can be an effective method of increasing EMT influenza vaccine uptake. In this study, EMTs' attitudes and beliefs about seasonal influenza vaccine were strong predictors of vaccination. Therefore, future education campaigns should aim to dispel myths about influenza vaccine, such as the true risk of adverse effects related to immunization, and promote the importance of EMT personal and professional responsibility for vaccination compliance. These findings reinforce past research that indicates that EMT vaccine compliance is influenced by perceived vaccine safety and effectiveness^{5,7} and perceived importance of immunization.⁷ In addition, EMT vaccination campaigns should include no-cost access to worksite influenza vaccination, which is a strong predictor of EMTs' intent to be vaccinated. Evidence to support this finding has been reported as an important intervention method in previous research involving hospital-based health care workers⁸⁻¹⁰ and EMTs⁵ to increase influenza vaccination uptake behavior among emergency responders.

A few limitations of this study must be noted. Limitations include the potential issues of responder and/or social desirability biases. Nonresponders were probably less likely to be vaccinated compared with respondents, given the assumption that responders were more interested in influenza vaccination compared with

Table 3
Factors related to EMT 2010/2011 seasonal influenza and intent to be vaccinated from logistic regression*

Variable	Seasonal influenza vaccine		Intent to be vaccinated	
	OR (95% CI)	P value	OR (95% CI)	P value
Belief that EMTs should be vaccinated against influenza every year	10.3 (2.4-44.4)	<.001	6.8 (1.6-28.1)	<.01
Perceived importance of vaccination	8.3 (2.3-30.3)	<.01	NIM	NA
Working in a suburban or rural setting	7.3 (2.4-22.4)	<.001	3.9 (1.2-12.6)	<.05
Perception that influenza vaccine has few side effects	6.0 (1.8-19.7)	<.01	NIM	NA
Past behavior (received 2010/2011, 2009/2010, and H1N1 vaccines)	4.1 (1.5-11.1)	<.01	NIM/NA	NA
Would take the vaccine each year if offered on-site and free of charge	NIM	NA	21.1 (4.7-92.7)	<.001

CI, confidence interval; NA, not applicable; NIM, not included in model because it was nonsignificant; NIM/NA, not included in model because of low cell counts; NS, nonsignificant; OR, odds ratio.

*Controlled for gender, age, and race.

nonresponders. Perceived social desirability may also have influenced responders to indicate that they were vaccinated, although this bias should be minimized because the survey was anonymous. Another limitation is the possibility of recall bias among the respondents. Participants were asked about 3 vaccines, 2 of which would have been offered/received the previous year (H1N1 and 2009/2010 seasonal influenza vaccines). This increases the possibility that workers may not recall correctly if they received these vaccines a year ago. However, given the controversy regarding the H1N1 vaccine and the fact that these vaccines were offered during the first pandemic in the past few decades, this recall bias is likely to be low. One final limitation is that only St. Louis area EMTs were included in this study; thus, the findings may not be generalizable to all EMTs nationwide. Further studies should be conducted to verify these results for other parts of the United States or in other countries.

CONCLUSION

Influenza vaccination is the most effective intervention to decrease influenza transmission in health care settings, including pre-hospital care. Despite this, studies indicate that emergency medical services personnel fall short of full vaccination compliance. Emergency response agencies should implement a comprehensive program to prevent influenza transmission. This should include a mandatory vaccination policy, no-cost worksite vaccination, and an education campaign using findings from this study to target EMT attitudes and beliefs regarding vaccination compliance, including vaccine safety and efficacy.

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