

APPENDIX

Table 1.	Characteristics of subjects hospitalized with acute respiratory illness, by influenza virus infection status, Southeast Michigan, 2014-15
Table 2a-b.	Vaccination status definitions
Table 3a-c.	Characteristics of subjects hospitalized with acute respiratory illness, by vaccination status, Southeast Michigan, 2014-15
Table 4.	Vaccination status of subjects hospitalized with acute respiratory illness hospitalization, by influenza virus infection status, Southeast Michigan, 2014-15
Table 5.	Validity of self-reported influenza vaccination status against documented vaccination (n = 490)
Table 6.	Characteristics of subjects hospitalized with acute respiratory illness reporting care within system ^a , by documented and self-reported vaccination agreement, Southeast Michigan, 2014-15
Table 7.	Influenza vaccine effectiveness by vaccination status definition

Table 1. Characteristics of subjects hospitalized with acute respiratory illness, by influenza virus infection status, Southeast Michigan, 2014-15				
Characteristic	Influenza Negative (n = 554)	Influenza Positive (n = 103)	Total (N = 657)	p value^a
Site, N(%)				
UM	301 (54)	54 (52)	355 (54)	0.72
HF	253 (46)	49 (48)	302 (46)	
Age (yr.)				
Mean (SD)	57 (16)	61 (18)	58 (17)	0.06
Age (yr.), N(%)				
18-49	148 (27)	30 (29)	178 (27)	<0.01
50-64	216 (39)	31 (30)	247 (38)	
65-79	147 (26)	23 (22)	170 (26)	
≥80	43 (8)	19 (19)	62 (9)	
Sex, N(%)				
Female	289 (52)	61 (59)	350 (53)	0.19
Race/ethnicity, N(%)				
White, non-Hispanic	291 (53)	53 (51)	344 (52)	0.95
Black, non-Hispanic	196 (35)	39 (38)	235 (36)	
Hispanic	44 (8)	7 (7)	51 (8)	
Other	23 (4)	4 (4)	27 (4)	
Charlson Comorbidity Index Category, N(%)				
0	46 (8)	8 (8)	54 (8)	0.36
1	148 (27)	36 (35)	184 (28)	
2	91 (16)	13 (13)	104 (16)	
≥3	269 (49)	46 (45)	315 (48)	
Frailty category ^b , N(%)				
1-3	452 (82)	95 (92)	547 (83)	<0.01
4,5	102 (18)	8 (8)	110 (17)	
Illness onset to specimen collection (days), N(%)				
0-2	139 (25)	30 (29)	169 (26)	0.01
3-4	191 (34)	43 (42)	234 (36)	
5-7	149 (27)	28 (27)	177 (27)	
8-10	75 (14)	2 (2)	77 (12)	
Reporting receiving routine healthcare within UM/HF system, N(%)				
Yes	410 (74)	80 (76)	490 (75)	0.43
Medical visits in year prior to current admission, N(%)				
0-2	125 (23)	20 (20)	145 (22)	0.83
3-11	152 (27)	28 (27)	180 (27)	
12-25	140 (25)	30 (29)	170 (26)	
26-105	137 (25)	25 (24)	162 (25)	
Self-reported general health status, N(%)				
Excellent/very good	97 (18)	20 (19)	117 (18)	0.77
Good	194 (35)	38 (37)	232 (35)	
Fair/poor	263 (47)	45 (44)	308 (47)	
Length of hospital stay (days)				
Median (IQR) ^c	3 (2-5)	3 (2-4)	3 (2-5)	0.04
ICU admission, N(%)	67 (12)	5 (5)	72 (11)	0.03

^aThe χ^2 statistic was used to test the differences in proportions between enrollees that were influenza positive compared to enrollees that were influenza negative for site, age group, sex, race/ethnicity, Charlson comorbidity index category, days from illness onset to specimen collection, receiving healthcare within system, EMR availability, self-reported general health status, frailty, medical visits in year prior to current admission, and ICU admission. A p value of <0.05 is considered statistically significant.

^bTo measure frailty, patients were asked 5 questions pertaining to ability to perform everyday activities (ability to walk 100 yards, difficulty carrying 10 pounds, little energy to perform desired activities, unexplained weight loss, and frequency of low/moderate activities) and each answer was assigned a numeric value with values closer to 0 indicating less frailty. The mean of these five responses was assigned as an enrollee's frailty level.

^clength of stay were not normally distributed. The Wilcoxon-rank sum test was used to assess the differences in proportions among enrollees that were influenza positive compared to enrollees that were influenza negative with regard to these continuous variables. A p value of <0.05 is considered statistically significant.

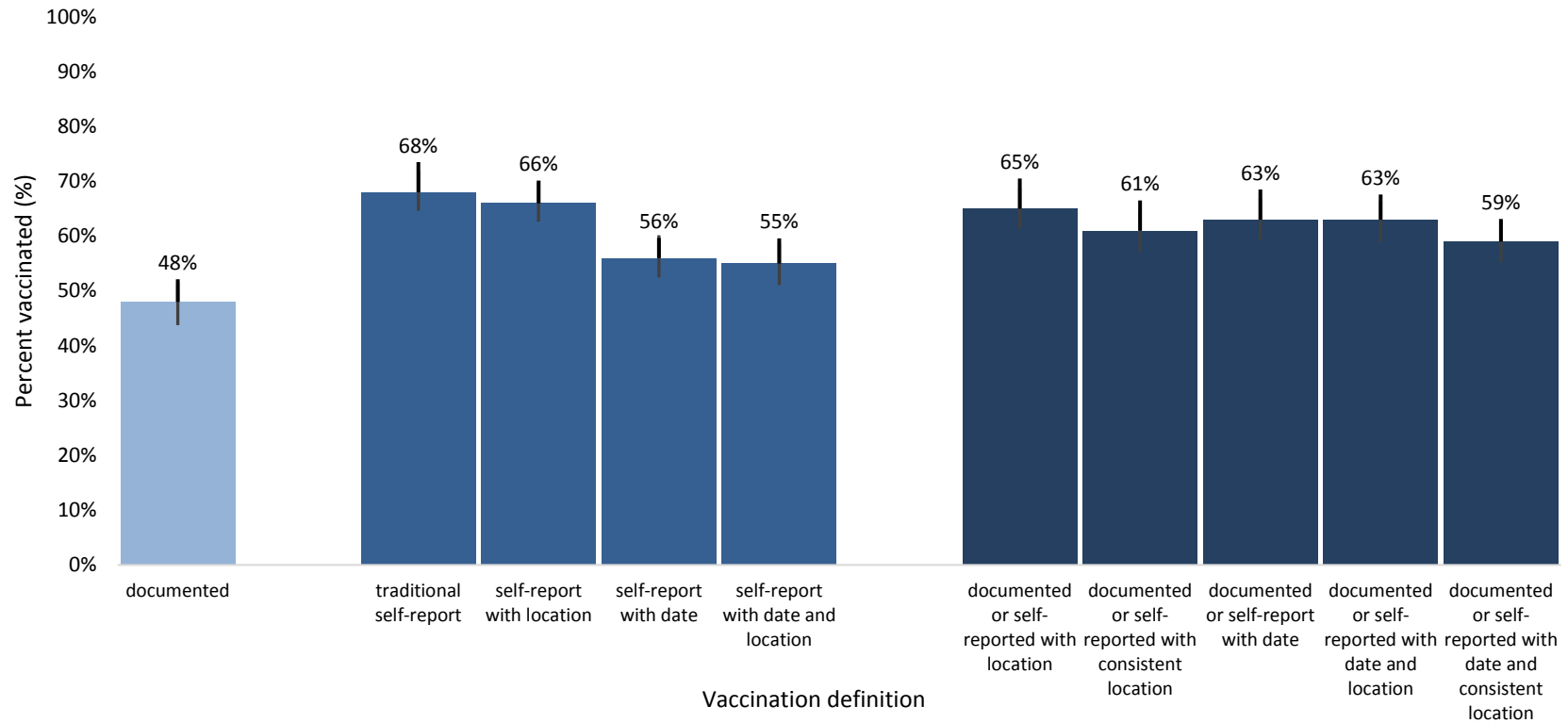
Table 2a. Vaccination status definitions					
	Definition	Description	n	Vaccination Status	Final Vaccination Status Total %
Documented vaccination	Documented (Documented)	Documented vaccination ≥ 14 days prior to symptom onset	313	Vaccinated	Unvaccinated 331 50%
		Documented vaccination 0-13 days prior to symptom onset	13	Excluded	Vaccinated 313 48%
		Documented vaccination after symptom onset	68	Unvaccinated	Excluded 13 2%
		No Documentation	263	Unvaccinated	total 657
Self-reported vaccination	Traditional self-report (Definition 2)	Self-reported receiving vaccination	449	Vaccinated	Unvaccinated 193 30%
		Self-reported not receiving vaccination	193	Unvaccinated	Vaccinated 449 68%
		Self-reported unknown/unsure of vaccination	15	Excluded	Excluded 15 2%
					total 657
	Self-report with location (Definition 3)	Self-reported receiving vaccination with location	436	Vaccinated	Unvaccinated 206 32%
		Self-reported receiving vaccination with no location	13	Unvaccinated	Vaccinated 436 66%
		Self-reported not receiving vaccination	193	Unvaccinated	Excluded 15 2%
		Self-reported unknown/unsure of vaccination	15	Excluded	total 657
	Self-report with date (Definition 4)	Self-reported receiving vaccination ≥ 14 days prior to symptom onset	370	Vaccinated	Unvaccinated 241 37%
		Self-reported receiving vaccination 0-13 days prior to symptom onset	31	Excluded	Vaccinated 370 56%
		Self-reported receiving vaccination after symptom onset	15	Unvaccinated	Excluded 46 7%
		Self-reported receiving vaccination with no date ^a	33	Unvaccinated	total 657
		Self-reported not receiving vaccination	193	Unvaccinated	
		Self-reported unknown/unsure of vaccination	15	Excluded	
	Self-report with date and location (Definition 5)	Self-reported receiving vaccination ≥ 14 days prior to symptom onset with a location	361	Vaccinated	Unvaccinated 250 38%
		Self-reported receiving vaccination ≥ 14 days prior to symptom onset without a location	9	Unvaccinated	Vaccinated 361 55%
		Self-reported receiving vaccination with a location and no date	30	Unvaccinated	Excluded 46 7%
		Self-reported receiving vaccination without date or location	3	Unvaccinated	total 657
		Self-reported receiving vaccination 0-13 days prior to symptom onset	31	Excluded	
		Self-reported receiving vaccination after symptom onset	15	Unvaccinated	
		Self-reported not receiving vaccination	193	Unvaccinated	
		Self-reported unknown/unsure of vaccination	15	Excluded	

^aself-reported date is estimated or approximated date of vaccination

Table 2b. Vaccination status definitions					
	Definition	Description	n	Vaccination Status	Final Vaccination Status Total %
Documented and self-reported vaccination	Documented or self-report with location (Definition 6)	Documented vaccination ≥ 14 days prior to symptom onset	313	Vaccinated	Unvaccinated 213 33%
		Documented vaccination 0-13 days prior to symptom onset	13	Excluded	Vaccinated 428 65%
		Documented vaccination after symptom onset	68	Unvaccinated	Excluded 16 2%
		No documentation; self-reported receiving vaccination with location	115	Vaccinated	total 657
		No documentation; self-reported receiving vaccination with no location	7	Unvaccinated	
		No documentation; self-reported not receiving vaccination	138	Unvaccinated	
		No documentation; self-reported unknown/unsure of vaccination	3	Excluded	
	Documented or self-report with consistent location (Definition 7)	Documented vaccination ≥ 14 days prior to symptom onset	313	Vaccinated	Unvaccinated 241 37%
		Documented vaccination 0-13 days prior to symptom onset	13	Excluded	Vaccinated 400 61%
		Documented vaccination after symptom onset	68	Unvaccinated	Excluded 16 2%
		No documentation; self-reported receiving vaccination with location (that is not on site)	87	Vaccinated	total 657
		No documentation; self-reported receiving vaccination with location listed as on site	28	Unvaccinated	
		No documentation; self-reported receiving vaccination with no location	7	Unvaccinated	
		No documentation; self-reported not receiving vaccination	138	Unvaccinated	
	Documented or self-report with date (Definition 8)	Documented vaccination ≥ 14 days prior to symptom onset	313	Vaccinated	Unvaccinated 218 33%
		Documented vaccination 0-13 days prior to symptom onset	13	Excluded	Vaccinated 415 63%
		Documented vaccination after symptom onset	68	Unvaccinated	Excluded 24 4%
		No documentation; self-reported receiving vaccination ≥ 14 days prior to symptom onset	102	Vaccinated	total 657
		No documentation; self-reported receiving vaccination 0-13 days prior to symptom onset	8	Excluded	
		No documentation; self-reported receiving vaccination after symptom onset	0	Unvaccinated	
		No documentation; self-reported receiving vaccination but with no date	12	Unvaccinated	
	Documented or self-report with date and location (Definition 9)	No documentation; self-reported not receiving vaccination	138	Unvaccinated	
		No documentation; self-reported unknown/unsure of vaccination	3	Excluded	
		Documented vaccination ≥ 14 days prior to symptom onset	313	Vaccinated	Unvaccinated 221 33%
		Documented vaccination 0-13 days prior to symptom onset	13	Excluded	Vaccinated 412 63%
		Documented vaccination after symptom onset	68	Unvaccinated	Excluded 24 4%
		No documentation; self-reported receiving vaccination ≥ 14 days prior to symptom onset with a location	99	Vaccinated	total 657
		No documentation; self-reported receiving vaccination ≥ 14 days prior to symptom onset with no location	3	Unvaccinated	
	Documented or self-report with date and consistent location (Definition 10)	No documentation; self-reported receiving vaccination with a location but no date	9	Unvaccinated	
		No documentation; self-reported receiving vaccination with no date or location	3	Unvaccinated	
		No documentation; self-reported receiving vaccination 0-13 days prior to symptom onset	8	Excluded	
		No documentation; self-reported receiving vaccination after symptom onset	0	Unvaccinated	
		No documentation; self-reported not receiving vaccination	138	Unvaccinated	
		No documentation; self-reported unknown/unsure of vaccination	3	Excluded	
		Documented vaccination ≥ 14 days prior to symptom onset	313	Vaccinated	Unvaccinated 245 37%
		Documented vaccination 0-13 days prior to symptom onset	13	Excluded	Vaccinated 388 59%
		Documented vaccination after symptom onset	68	Unvaccinated	Excluded 24 4%
		No documentation; self-reported receiving vaccination ≥ 14 days prior to symptom onset with a location (that is not on site)	75	Vaccinated	total 657
		No documentation; self-reported receiving vaccination ≥ 14 days prior to symptom onset with location listed as on site	24	Unvaccinated	
		No documentation; self-reported receiving vaccination ≥ 14 days prior to symptom onset with no location	3	Unvaccinated	
		No documentation; self-reported receiving vaccination with a location but no date	9	Unvaccinated	
		No documentation; self-reported receiving vaccination with no date or location	3	Unvaccinated	
		No documentation; self-reported receiving vaccination 0-13 days prior to symptom onset	8	Excluded	
		No documentation; self-reported receiving vaccination after symptom onset	0	Unvaccinated	
		No documentation; self-reported not receiving vaccination	138	Unvaccinated	
		No documentation; self-reported unknown/unsure of vaccination	3	Excluded	

^aself-reported date is estimated or approximated date of vaccination

Figure C. Percent vaccinated by vaccination status definition



Error bars represent the exact confidence intervals for samples from the Binomial distribution

Table 3a. Characteristics of subjects hospitalized with acute respiratory illness, by vaccination status, Southeast Michigan, 2014-15

Characteristic	Documented (N = 644)			Traditional self-report (N = 642)			Self-report with location (N = 642)			Self-report with date (N = 611)		
	Unvaccinated (n = 331)	Vaccinated (n = 313)	P value ^a	Unvaccinated (n = 193)	Vaccinated (n = 449)	P value	Unvaccinated (n = 206)	Vaccinated (n = 436)	P value	Unvaccinated (n = 241)	Vaccinated (n = 370)	P value
Site, N(%)												
UM	154 (47)	191 (61)	<0.01	87 (45)	261 (58)	<0.01	93 (45)	255 (58)	<0.01	101 (42)	228 (62)	<0.01
HF	177 (53)	122 (39)		106 (55)	188 (42)		113 (55)	181 (42)		140 (58)	142 (38)	
Age (yr.)												
Mean (SD)	54 (17)	62 (16)	<0.01	52 (17)	60 (16)	<0.01	52 (17)	61 (16)	<0.01	53 (16)	61 (16)	<0.01
Age (yr.), N(%)												
18-49	121 (37)	52 (17)	<0.01	85 (44)	90 (20)	<0.01	91 (44)	84 (19)	<0.01	94 (39)	71 (19)	<0.01
50-64	120 (36)	123 (39)		66 (34)	174 (39)		68 (33)	172 (40)		90 (37)	138 (37)	
65-79	71 (21)	96 (31)		32 (17)	135 (30)		35 (17)	132 (30)		44 (18)	117 (32)	
≥80	19 (6)	42 (13)		10 (5)	50 (11)		12 (6)	48 (11)		13 (6)	44 (12)	
Sex, N(%)												
Female	184 (56)	164 (52)	0.42	103 (53)	239 (53)	0.97	107 (52)	235 (54)	0.64	129 (54)	199 (54)	0.95
Race/ethnicity, N(%)												
White, non-Hispanic	152 (46)	183 (58)	<0.01	83 (43)	256 (57)	<0.01	87 (42)	252 (58)	<0.01	98 (41)	225 (61)	<0.01
Black, non-Hispanic	141 (43)	90 (29)		87 (45)	140 (31)		93 (45)	134 (31)		111 (46)	103 (28)	
Hispanic	21 (6)	30 (10)		16 (8)	34 (8)		17 (8)	33 (7)		21 (9)	28 (7)	
Other	17 (5)	10 (3)		7 (4)	19 (4)		9 (5)	17 (4)		11 (4)	14 (4)	
Charlson Comorbidity Index Category, N(%)												
0	40 (12)	13 (4)	<0.01	23 (12)	30 (7)	<0.01	24 (12)	29 (7)	<0.01	26 (11)	22 (6)	<0.01
1	110 (33)	70 (22)		65 (34)	118 (26)		68 (33)	115 (26)		77 (32)	93 (25)	
2	55 (17)	47 (15)		34 (17)	66 (15)		37 (18)	63 (14)		43 (18)	55 (15)	
≥3	126 (38)	183 (59)		71 (37)	235 (52)		77 (37)	229 (53)		95 (39)	200 (54)	
Frailty category, N(%) ^b												
1-3	275 (83)	260 (83)	0.99	167 (87)	372 (83)	0.24	177 (86)	362 (83)	0.35	202 (84)	311 (84)	0.94
4,5	56 (17)	53 (17)		26 (13)	77 (17)		29 (14)	74 (17)		39 (16)	59 (16)	
Illness onset to specimen collection (days), N(%)												
0-2	92 (28)	73 (23)	0.43	52 (27)	114 (25)	0.98	55 (27)	111 (25)	0.94	66 (27)	92 (25)	0.89
3-4	111 (33)	115 (37)		68 (35)	161 (36)		71 (34)	158 (36)		81 (34)	134 (36)	
5-7	86 (26)	91 (29)		51 (27)	120 (27)		54 (26)	117 (27)		65 (27)	101 (27)	
8-10	42 (13)	34 (11)		22 (11)	54 (12)		26 (13)	50 (12)		29 (12)	43 (12)	
Reporting receiving routine healthcare within UM/HF system, N(%)												
Yes	209 (63)	268 (86)	<0.01	122 (63)	356 (79)	<0.01	131 (64)	347 (80)	<0.01	162 (67)	289 (78)	<0.01
Medical visits in year prior to current admission, N(%)												
0-2	126 (38)	19 (6)	<0.01	72 (37)	68 (15)	<0.01	73 (36)	65 (15)	<0.01	83 (34)	52 (14)	<0.01
3-11	93 (28)	80 (26)		55 (29)	120 (27)		59 (29)	116 (26)		74 (31)	89 (24)	
12-25	67 (20)	100 (32)		39 (20)	130 (29)		44 (21)	125 (29)		51 (21)	113 (31)	
26-105	45 (14)	114 (36)		27 (14)	131 (29)		28 (14)	130 (30)		33 (14)	116 (31)	
Self-reported general health status, N(%)												
Excellent/very good	65 (20)	49 (16)	0.21	42 (22)	72 (16)	0.14	46 (22)	68 (16)	0.08	52 (22)	54 (15)	0.05
Good	121 (36)	107 (34)		61 (31)	169 (38)		65 (32)	165 (38)		78 (32)	145 (39)	
Fair/poor	145 (44)	157 (50)		90 (47)	208 (46)		95 (46)	203 (46)		111 (46)	171 (46)	
Length of hospital stay (days)												
Median (IQR) ^c	3 (2-5)	3 (2-5)	0.38	3 (2-5)	3 (2-5)	0.12	3 (2-5)	3 (2-5)	0.09	3 (2-5)	3 (2-5)	0.16
ICU admission, N(%)	40 (12)	31 (10)	0.38	24 (12)	48 (11)	0.52	24 (12)	48 (11)	0.81	31 (13)	35 (9)	0.19

Table 3b. Characteristics of subjects hospitalized with acute respiratory illness, by vaccination status, Southeast Michigan, 2014-15

Characteristic	Self-report with date and location (N = 611)			Documented or self-report with location (N = 641)			Documented or self-report with consistent location (N = 641)		
	Unvaccinated (n = 250)	Vaccinated (n = 361)	P value ^a	Unvaccinated (n = 213)	Vaccinated (n = 428)	P value	Unvaccinated (n = 241)	Vaccinated (n = 400)	P value
Site, N(%)									
UM	107 (43)	22 (61)	<0.01	91 (43)	252 (59)	<0.01	101 (42)	242 (61)	<0.01
HF	143 (57)	139 (39)		122 (57)	176 (41)		140 (58)	158 (39)	
Age (yr.)									
Mean (SD)	53 (17)	61 (16)	<0.01	52 (17)	61 (16)	<0.01	53 (17)	61 (16)	<0.01
Age (yr.), N(%)									
18-49	98 (39)	67 (18)	<0.01	95 (45)	77 (18)	<0.01	101 (42)	71 (18)	<0.01
50-64	90 (36)	138 (38)		70 (33)	172 (40)		83 (34)	159 (40)	
65-79	47 (19)	114 (32)		37 (17)	129 (30)		45 (19)	121 (30)	
≥80	15 (6)	42 (12)		11 (5)	50 (12)		12 (5)	49 (12)	
Sex, N(%)									
Female	131 (52)	197 (55)	0.6	118 (55)	229 (54)	0.65	135 (56)	212 (53)	0.48
Race/ethnicity, N(%)									
White, non-Hispanic	102 (41)	221 (61)	<0.01	85 (40)	249 (58)	<0.01	95 (39)	239 (60)	<0.01
Black, non-Hispanic	113 (45)	101 (28)		101 (47)	129 (30)		115 (48)	115 (29)	
Hispanic	22 (9)	27 (8)		17 (8)	34 (8)		19 (8)	32 (8)	
Other	13 (5)	12 (3)		10 (5)	16 (4)		12 (5)	14 (3)	
Charlson Comorbidity Index Category, N(%)									
0	26 (10)	22 (6)	<0.01	25 (12)	27 (6)	<0.01	26 (11)	26 (6)	<0.01
1	79 (32)	91 (25)		75 (35)	105 (25)		80 (33)	100 (25)	
2	45 (18)	53 (15)		37 (17)	64 (15)		43 (18)	58 (15)	
≥3	100 (40)	195 (54)		76 (36)	232 (54)		92 (38)	216 (54)	
Frailty category, N(%) ^b									
1-3	209 (84)	304 (84)	0.84	180 (85)	353 (82)	0.52	200 (83)	333 (83)	0.93
4,5	41 (16)	57 (16)		33 (15)	75 (18)		41 (17)	67 (17)	
Illness onset to specimen collection (days), N(%)									
0-2	69 (28)	89 (25)	0.72	60 (28)	104 (24)	0.77	66 (27)	98 (25)	0.78
3-4	82 (33)	133 (37)		72 (34)	153 (36)		83 (34)	142 (35)	
5-7	68 (27)	98 (27)		56 (26)	120 (28)		62 (26)	114 (28)	
8-10	31 (12)	41 (11)		25 (12)	51 (12)		30 (13)	46 (12)	
Reporting receiving routine healthcare within UM/HF system, N(%)									
Yes	168 (67)	283 (78)	<0.01	135 (63)	341 (80)	<0.01	158 (66)	318 (80)	<0.01
Medical visits in year prior to current admission, N(%)									
0-2	84 (34)	51 (14)	<0.01	81 (38)	62 (14)	<0.01	85 (35)	58 (15)	<0.01
3-11	77 (31)	86 (24)		66 (31)	107 (25)		73 (30)	100 (25)	
12-25	55 (22)	109 (30)		40 (19)	127 (30)		47 (20)	120 (30)	
26-105	34 (13)	115 (32)		26 (12)	132 (31)		36 (15)	122 (30)	
Self-reported general health status, N(%)									
Excellent/very good	55 (22)	51 (14)	0.03	47 (22)	67 (16)	0.09	50 (21)	64 (16)	0.27
Good	81 (32)	142 (39)		67 (31)	161 (37)		81 (33)	147 (37)	
Fair/poor	114 (46)	168 (47)		99 (47)	200 (47)		110 (46)	189 (47)	
Length of hospital stay (days)									
Median (IQR) ^c	3 (2-5)	3 (2-5)	0.13	3 (2-4)	3 (2-5)	0.11	3 (2-5)	3 (2-5)	0.22
ICU admission, N(%)	31 (12)	35 (10)	0.29	25 (12)	46 (11)	0.71	29 (12)	42 (11)	0.55

Table 3c. Characteristics of subjects hospitalized with acute respiratory illness, by vaccination status, Southeast Michigan, 2014-15									
	Documented or self-report with date (N = 633)			Documented or self-report with date and location (N = 633)			Documented or self-report with date and consistent location (N = 633)		
Characteristic	Unvaccinated (n = 218)	Vaccinated (n = 415)	P value*	Unvaccinated (n = 221)	Vaccinated (n = 412)	P value	Unvaccinated (n = 245)	Vaccinated (n = 388)	P value
Site, N(%)									
UM	91 (42)	248 (60)	<0.01	93 (42)	246 (60)	<0.01	103 (42)	236 (61)	<0.01
HF	127 (58)	167 (40)		128 (58)	166 (40)		142 (58)	152 (39)	
Age (yr.)									
Mean (SD)	52 (17)	61 (16)	<0.01	52 (17)	61 (16)	<0.01	52 (17)	61 (16)	<0.01
Age (yr.), N(%)									
18-49	94 (43)	76 (18)	<0.01	96 (43)	74 (18)	<0.01	102 (42)	68 (18)	<0.01
50-64	72 (33)	166 (40)		72 (33)	166 (40)		83 (34)	155 (40)	
65-79	40 (18)	125 (30)		41 (19)	124 (30)		47 (19)	118 (30)	
≥80	12 (6)	48 (12)		12 (5)	48 (12)		13 (5)	47 (12)	
Sex, N(%)									
Female	120 (55)	222 (53)	0.71	122 (55)	220 (53)	0.66	136 (56)	206 (53)	0.55
Race/ethnicity, N(%)									
White, non-Hispanic	88 (40)	243 (58)	<0.01	89 (40)	242 (59)	<0.01	98 (40)	233 (60)	<0.01
Black, non-Hispanic	103 (47)	123 (30)		104 (47)	122 (30)		116 (47)	110 (29)	
Hispanic	17 (8)	34 (8)		17 (8)	34 (8)		19 (8)	32 (8)	
Other	10 (5)	15 (4)		11 (5)	14 (3)		12 (5)	13 (3)	
Charlson Comorbidity Index Category, N(%)									
0	25 (12)	25 (6)	<0.01	25 (11)	25 (6)	<0.02	26 (11)	24 (6)	<0.01
1	74 (34)	103 (25)		75 (34)	102 (25)		80 (33)	97 (25)	
2	40 (18)	61 (15)		40 (18)	61 (15)		45 (18)	56 (15)	
≥3	79 (36)	226 (54)		81 (37)	224 (54)		94 (38)	211 (54)	
Frailty category, N(%) ^b									
1-3	181 (83)	344 (83)	0.97	183 (83)	342 (83)	0.95	202 (82)	323 (83)	
4,5	37 (17)	71 (17)		38 (17)	70 (17)		43 (18)	65 (17)	0.79
Illness onset to specimen collection (days), N(%)									
0-2	60 (27)	101 (24)	0.84	61 (28)	100 (24)	0.79	66 (27)	95 (24)	0.89
3-4	74 (34)	149 (36)		74 (33)	149 (36)		84 (34)	139 (36)	
5-7	58 (27)	116 (28)		59 (27)	115 (28)		65 (27)	109 (28)	
8-10	26 (12)	49 (12)		27 (12)	48 (12)		30 (12)	45 (12)	
Reporting receiving routine healthcare within UM/HF system, N(%)									
Yes	138 (63)	333 (80)	<0.01	139 (63)	332 (81)	<0.01	159 (65)	312 (80)	<0.01
Medical visits in year prior to current admission, N(%)									
0-2	83 (38)	55 (13)	<0.01	84 (38)	54 (13)	<0.01	87 (35)	51 (13)	<0.01
3-11	67 (31)	105 (25)		68 (31)	104 (25)		73 (30)	99 (26)	
12-25	42 (19)	123 (30)		43 (19)	122 (30)		49 (20)	116 (30)	
26-105	26 (12)	132 (32)		26 (12)	132 (32)		36 (15)	122 (31)	
Self-reported general health status, N(%)									
Excellent/very good	49 (23)	64 (15)	0.06	50 (22)	63 (15)	0.05	52 (21)	61 (16)	0.2
Good	68 (31)	157 (38)		70 (32)	155 (38)		82 (34)	143 (37)	
Fair/poor	101 (46)	194 (47)		101 (46)	194 (47)		11 (45)	184 (47)	
Length of hospital stay (days)									
Median (IQR) ^c	3 (2-5)	3 (2-5)	0.25	3 (2-5)	3 (2-5)	0.21	3 (2-5)	3 (2-5)	0.33
ICU admission, N(%)	27 (12)	43 (10)	0.44	27 (12)	43 (10)	0.5	29 (12)	41 (11)	0.62

*The χ^2 statistic was used to test the differences in proportions between enrollees that were influenza positive compared to enrollees that were influenza negative for site, age group, sex, race/ethnicity, Charlson comorbidity index category, days from illness onset to specimen collection, receiving healthcare within system, EMR availability, self-reported general health status, frailty, medical visits in year prior to current admission, and ICU admission. A p value of <0.05 is considered statistically significant.

^bTo measure frailty, patients were asked 5 questions pertaining to ability to perform everyday activities (ability to walk 100 yards, difficulty carrying 10 pounds, little energy to perform desired activities, unexplained weight loss, and frequency of low/moderate activities) and each answer was assigned a numeric value with values closer to 0 indicating less frailty. The mean of these five responses was assigned as an enrollee's frailty level.

^cLength of stay were not normally distributed. The Wilcoxon-rank sum test was used to assess the differences in proportions among enrollees that were influenza positive compared to enrollees that were influenza negative with regard to these continuous variables. A p value of <0.05 is considered statistically significant.

Table 4. Vaccination status of subjects hospitalized with acute respiratory illness hospitalization, by influenza virus infection status, Southeast Michigan, 2014-15

Vaccination Definition	Influenza Status			P value ^a
	Influenza Negative (n = 554)	Influenza Positive (n = 103)	Total (N = 657)	
1) Documented				
Unvaccinated	282 (51)	49 (48)	331 (50)	0.29
Vaccinated	263 (47)	50 (48)	313 (48)	
Excluded	9 (2)	4 (4)	13 (2)	
2) Traditional self-report				
Unvaccinated	159 (29)	34 (33)	193 (30)	0.58
Vaccinated	383 (69)	66 (64)	449 (68)	
Excluded	12 (2)	3 (3)	15 (2)	
3) Self-report with location				
Unvaccinated	170 (31)	36 (35)	206 (31)	0.59
Vaccinated	373 (67)	64 (62)	436 (67)	
Excluded	12 (2)	3 (3)	15 (2)	
4) Self-report with date				
Unvaccinated	201 (36)	40 (39)	241 (37)	0.20
Vaccinated	318 (58)	52 (51)	370 (56)	
Excluded	35 (6)	11 (11)	46 (7)	
5) Self-report with date and location				
Unvaccinated	208 (38)	42 (41)	250 (38)	0.17
Vaccinated	311 (56)	50 (48)	361 (55)	
Excluded	35 (6)	11(11)	46 (7)	
6) Documented or self-report with location				
Unvaccinated	176 (32)	37 (36)	213 (32)	0.37
Vaccinated	366 (66)	62 (60)	428 (65)	
Excluded	12 (2)	4 (4)	16 (3)	
7) Documented or self-report with consistent location				
Unvaccinated	202 (37)	39 (38)	241 (37)	0.54
Vaccinated	340 (61)	60 (58)	400 (61)	
Excluded	12 (2)	4 (4)	16 (2)	
8) Documented or self-report with date				
Unvaccinated	180 (32)	38 (37)	218 (33)	0.03
Vaccinated	358 (65)	57 (55)	415 (63)	
Excluded	16 (3)	8 (8)	24 (4)	
9) Documented or self-report with date and location				
Unvaccinated	183 (33)	38 (37)	221 (33)	0.03
Vaccinated	355 (64)	57 (55)	412 (63)	
Excluded	16 (3)	8 (8)	24 (4)	
10) Documented or self-report with date and consistent location				
Unvaccinated	206 (37)	39 (38)	245 (37)	0.05
Vaccinated	332 (60)	56 (54)	388 (59)	
Excluded	16 (3)	8 (8)	24 (4)	

^aThe χ^2 statistic was used to assess the differences in proportions of influenza positive enrollees and influenza negatives with respect to vaccination status for each definition of plausible self-report

Table 5. Validity of self-reported influenza vaccination status against documented vaccination (n = 490)

Self-report	Documented		Percent agreement	Kappa (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	
	yes	no							
Traditional self-report	yes	254	89	79.4	56.2 (48.9,63.4)	97.3 (95.4,98.9)	56.4 (50.0,63.3)	74.1 (69.4,78.8)	94.3 (90.1,98.4)
	no	7	115						
Self-report with location	yes	249	85	79.1	55.9 (48.6,63.3)	95.4 (92.9,97.9)	58.3 (51.6,65.1)	74.6 (70.0,79.2)	90.8 (85.9,95.8)
	no	12	119						
Self-report with date	yes	223	65	79.5	57.7 (50.1,65.2)	89.2 (85.4,93.1)	67.3 (60.8,73.9)	77.4 (72.6,82.3)	83.2 (77.5,89.0)
	no	27	134						
Self-report with date and location	yes	218	64	78.6	56.0 (48.3,63.7)	87.2 (83.1,91.3)	67.8 (61.4,74.3)	77.3 (72.4,82.2)	80.9 (74.9,86.8)
	no	32	135						
Influenza positive (n = 80)	Documented		Percent agreement	Kappa (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	
	yes	no							
Traditional self-report	yes	42	10	86.3	70.7 (54.6, 86.8)	100 (91.6, 100)	67.7 (51.3, 84.2)	80.8 (70.0, 91.5)	100 (83.9, 100)
	no	0	21						
Self-report with location	yes	40	10	83.6	65.2 (47.7, 82.7)	95.2 (88.8, 100)	67.7 (51.3, 84.2)	80.0 (68.9, 91.1)	91.3 (79.8, 100)
	no	2	21						
Self-report with date	yes	39	4	91.2	81.3 (67.1, 95.6)	95.1 (88.5, 100)	85.2 (71.8, 98.6)	90.7 (82.0, 99.4)	92.0 (81.4, 100)
	no	2	23						
Self-report with date and location	yes	37	4	88.2	75.4 (59.5, 91.4)	90.2 (81.2, 99.3)	85.2 (71.8, 98.6)	90.2 (81.2, 99.3)	85.2 (71.8, 98.6)
	no	4	23						
Influenza negative (n = 410)	Documented		Percent agreement	Kappa (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	
	yes	no							
Traditional self-report	yes	212	79	78.1	53.5 (45.5, 61.5)	96.8 (94.5, 99.1)	54.3 (46.9, 61.8)	72.9 (67.7, 78.0)	93.1 (88.1, 98.0)
	no	7	94						
Self-report with location	yes	209	75	78.3	54.2 (46.2, 62.3)	95.4 (92.7, 98.2)	56.7 (49.3, 64.0)	73.6 (68.5, 78.7)	90.7 (85.3, 96.2)
	no	10	98						
Self-report with date	yes	184	61	77.4	53.6 (45.1, 62.0)	88.0 (83.6, 92.4)	64.5 (57.4, 71.7)	75.1 (69.7, 80.5)	81.6 (75.1, 88.1)
	no	25	111						
Self-report with date and location	yes	181	60	76.9	52.6 (44.1, 61.1)	86.6 (82.0, 91.2)	65.1 (58.0, 72.2)	75.1 (69.7, 80.6)	80.0 (73.4, 86.6)
	no	28	112						

Table 6. Characteristics of subjects hospitalized with acute respiratory illness reporting care within system ^a , by documented and self-reported vaccination agreement, Southeast Michigan, 2014-15			
Characteristic	Agreement		p value ^b
	Documented and self-report vaccination discordant (n = 92)	Documented and self-report vaccination agreement (n = 357)	
Site, N(%)			
UM	42 (46)	188 (53)	0.23
HF	50 (54)	169 (47)	
Age (yr.)			
Mean (SD)	59 (14)	59 (17)	0.89
Age (yr.), N(%)			
18-49	17 (19)	90 (25)	0.05
50-64	47 (51)	126 (35)	
65-79	21 (23)	98 (28)	
≥80	7 (7)	43 (12)	
Sex, N(%)			
Female	52 (57)	201 (56)	0.97
Race/ethnicity, N(%)			
White, non-Hispanic	44 (48)	179 (50)	0.84
Black, non-Hispanic	36 (39)	126 (35)	
Hispanic	7 (8)	35 (10)	
Other	5 (5)	17 (5)	
Charlson Comorbidity Index Category, N(%)			
0	8 (9)	18 (5)	0.47
1	19 (21)	91 (25)	
2	14 (15)	59 (17)	
≥3	51 (55)	189 (53)	
Frailty category, N(%) ^c			
1-3	75 (82)	301 (84)	0.52
4,5	17 (18)	56 (16)	
Illness onset to specimen collection (days), N(%)			
0-2	21 (23)	87 (24)	0.65
3-4	34 (37)	132 (37)	
5-7	23 (25)	100 (28)	
8-10	14 (15)	38 (11)	
Medical visits in year prior to current admission, N(%)			
0-2	17 (18)	35 (10)	0.12
3-11	22 (24)	100 (28)	
12-25	29 (32)	110 (31)	
26-105	24 (26)	112 (31)	
Self-reported general health status, N(%)			
Excellent/very good	11 (12)	57 (16)	0.07
Good	43 (47)	121 (34)	
Fair/poor	38 (41)	179 (50)	
Length of hospital stay (days)			
Median (IQR) ^d	3 (2-6)	3 (2-5)	0.51
ICU admission, N(%)			
Yes	10 (11)	34 (10)	0.70
Influenza status			
Influenza positive	6 (7)	62 (17)	<0.01
Influenza negative	86 (93)	295 (83)	

^aSelf-report with date

^bThe χ^2 statistic was used to test the differences in proportions between enrollees that were influenza positive compared to enrollees that were influenza negative for site, age group, sex, race/ethnicity, Charlson comorbidity index category, days from illness onset to specimen collection, receiving healthcare within system, EMR availability, self-reported general health status, frailty, medical visits in year prior to current admission, and ICU admission. A p value of <0.05 is considered statistically significant.

^cTo measure frailty, patients were asked 5 questions pertaining to ability to perform everyday activities (ability to walk 100 yards, difficulty carrying 10 pounds, little energy to perform desired activities, unexplained weight loss, and frequency of low/moderate activities) and each answer was assigned a numeric value with values closer to 0 indicating less frailty. The mean of these five responses was assigned as an enrollee's frailty level.

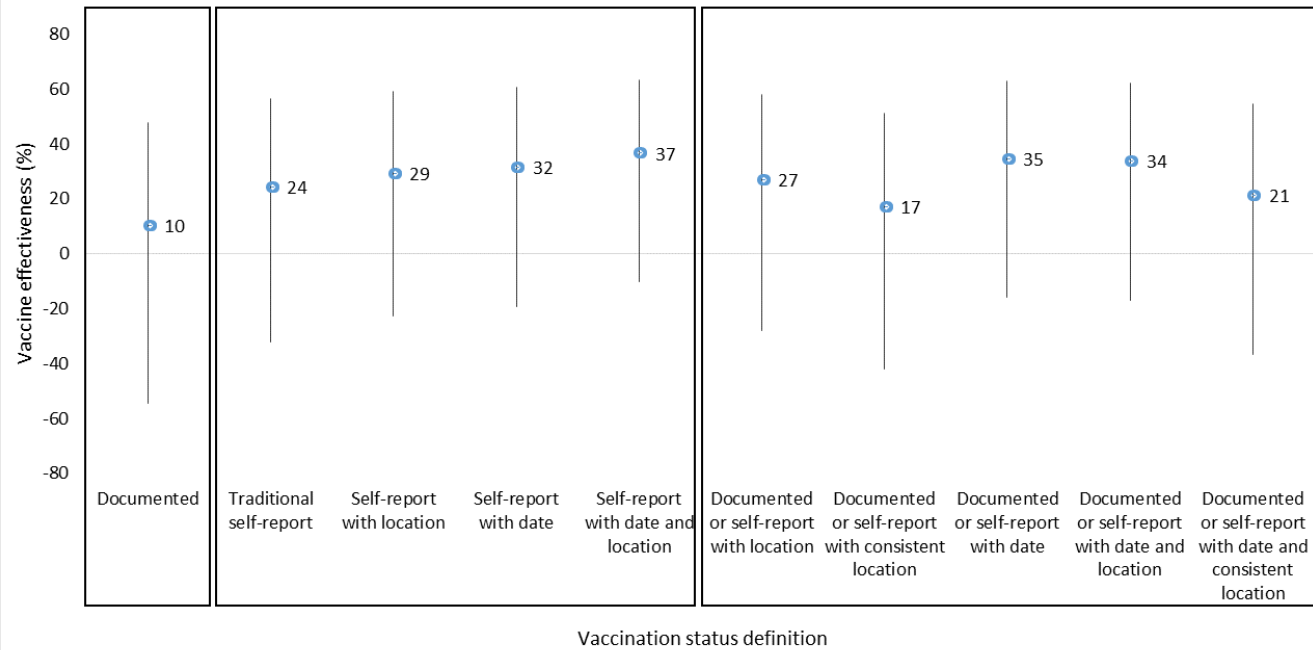
^dLength of stay were not normally distributed. The Wilcoxon-rank sum test was used to assess the differences in proportions among enrollees that were influenza positive compared to enrollees that were influenza negative with regard to these continuous variables. A p value of <0.05 is considered statistically significant.

Table 7. Influenza vaccine effectiveness by vaccination status definition

Vaccination Definition	Total (N)	Controls (vaccinated/total) (%)	Cases (vaccinated/total)(%)	Unadjusted Vaccine	Adjusted Vaccine
				Effectiveness (VE) % (95% CI)	Effectiveness (VE) % (95% CI)
1) Documented	644	263/545 (48.3)	50/99 (50.5)	-9 (-68, 29)	10 (-54, 48)
2) Traditional self-report	642	383/542 (70.7)	66/100 (66.0)	19 (-27, 49)	24 (-32, 57)
3) Self-report with location	642	372/542 (68.6)	64/100 (64.0)	19 (-27, 48)	29 (-23, 59)
4) Self-report with date	611	318/519 (61.3)	52/92 (56.5)	18 (-29, 48)	32 (-19, 61)
5) Self-report with date and location	611	311/519 (59.9)	50/92 (54.4)	20 (-24, 49)	37 (-10, 64)
6) EMR or self-report with location	641	366/542 (67.5)	62/99 (62.6)	19 (-26, 48)	27 (-28, 58)
7) EMR or self-report with consistent location	641	340/542 (62.7)	60/99 (60.6)	9 (-42, 41)	17 (-42, 51)
8) EMR or self-report with date	633	358/538 (66.5)	57/95 (60.0)	25 (-18, 52)	35 (-16, 63)
9) EMR or self-report with date and location	633	355/538 (66.0)	57/95 (60.0)	23 (-21, 51)	34 (-17, 62)
10) EMR or self-report with date and consistent location	633	332/538 (61.7)	56/95 (59.0)	11 (-39, 43)	21 (-37, 55)

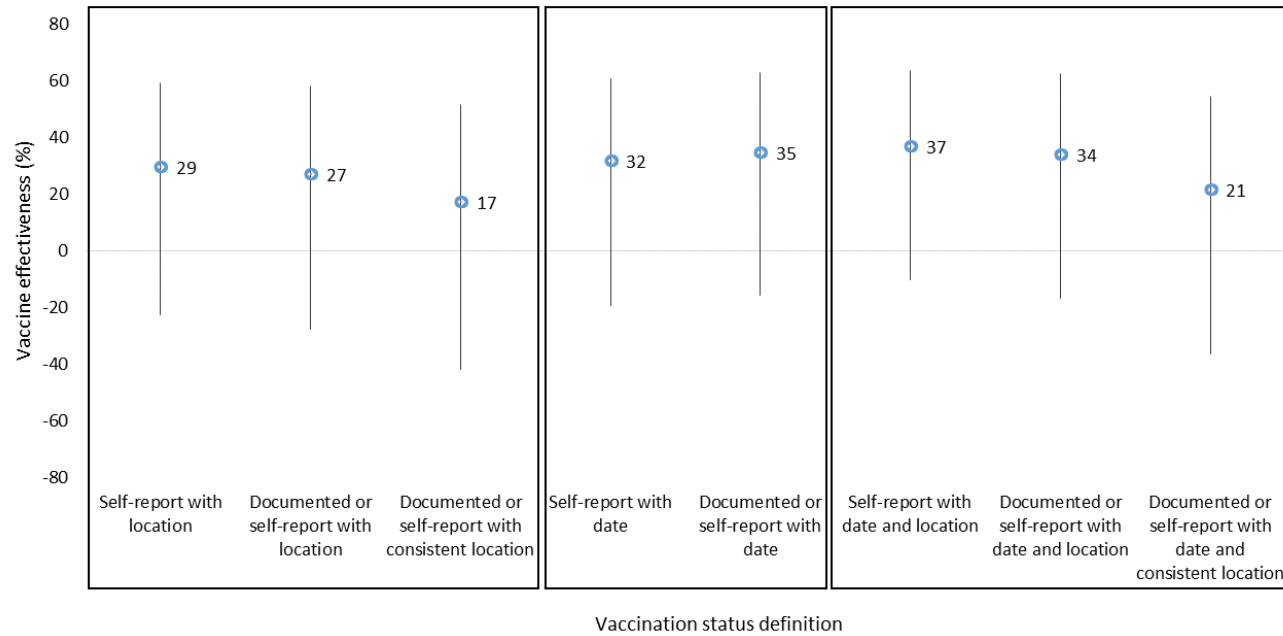
Models are adjusted for enrollment clinic, age, timing of illness onset, days from illness onset to specimen collection, sex, race, Charlson Comorbidity Index score, frailty, self-reported health status, number of medical visits in year prior to current admission, and ICU admission.

Figure D. Vaccine effectiveness by vaccination status definition



Error bars represent 95% confidence intervals around estimated VE

Figure E. Comparison of vaccine effectiveness between analogous vaccination definitions



Error bars represent 95% confidence intervals around estimated VE