

Themes among dentists' attitudes about vaccines: factor analysis and regression modeling of CARAD study data

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Background

- Vaccine hesitancy
 - Review – dentists' COVID-19 vax acceptance is high (81%) (Lin et al. 2022)
 - Higher among dental students (Lin 2022; Choi 2023)
 - HCW's hesitancy related to demog, perceived risk, safety, social factors, vaccine history, and distrust (McCready et al. 2023)
- Vaccine delivery
 - Dentist's value PH role, barriers include process mgt and payment regs (Gruß et al. 2022)
 - Lack of knowledge, patient acceptance, clinic time, and relevance to practice were concerns (Naleway et al. 2018)
 - Indiana dentist survey (Shukla et al. 2022)
 - 58% would consider vax delivery if allowed (any type)
 - More support among academic, FQHC, and older dentists



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Study purpose

- Assess dentists' attitudes about vaccines and vaccine delivery
 - Personal attitudes about vaccines
 - Professional attitudes about vaccine delivery
- Identify predictors of variations in attitudes
 - Dentist demographics (age group, gender, race-ethnicity)
 - Practice setting and patient type (adults only, includes children)
 - Practice location (region; urban/suburban/rural, HPSA)
 - Personal attitudes as predictors of professional attitudes
- All vaccine types are included (flu, HPV, Covid, etc.)
- Issue:
 - Simplify the regression modeling (16 attitude Qs)



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Measuring dentists' attitudes about vaccines

- Personal attitudes based on 5C scale of vaccine hesitancy (Betsch et al., 2018) (7 measures)
 - Confidence (3Qs: safe, effective, gov't trust)
 - Collective responsibility (1Q)
 - risk Calculation (1Q)
 - Constraints (1Q)
 - Complacency (1Q)
- Professional attitudes developed by study team and NIDCR (9 measures)
 - Providing vaccines in office/community settings (4Qs)
 - Capabilities to manage vaccine delivery (2Q)
 - Importance of staff vaccination (1Q)
 - How practitioners can influence patient demand (2Qs)



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Practitioner characteristics	Participants (N=537)	Eligible (N=2079)
Age, median (range)	51 (27-80)	51 (27-89)
Female	38%	38%
Hispanic/Latino	5%	7%
Race		
Asian	12%	12%
Black/African American	5%	6%
White	74%	72%
All other races	9%	11%
General dentist	95%	92%
Adult patients only	29%	NA*
Setting		
Private, solo	42%	41%
Private group	35%	35%
MC/PO/Corp	9%	10%
Academic/Hospital	4%	5%
CHC/PH/Fed/Military	9%	9%
Location		
Urban	29%	NA*
Suburban	38%	NA*
Rural	15%	NA*
Health Professional Shortage Area	15%	NA*



*Not part of the EQ questionnaire

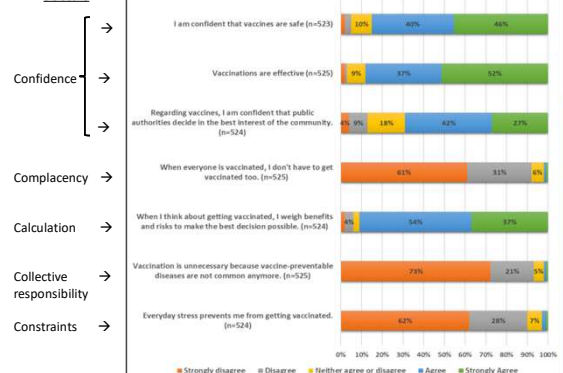


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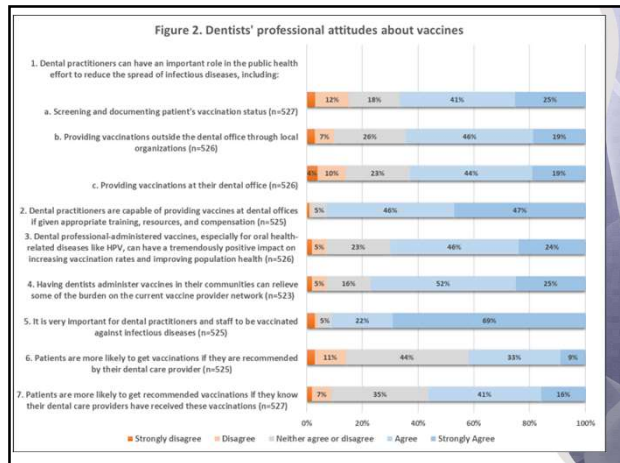
Some column percentages may not equal 100 due to rounding.

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5C scale



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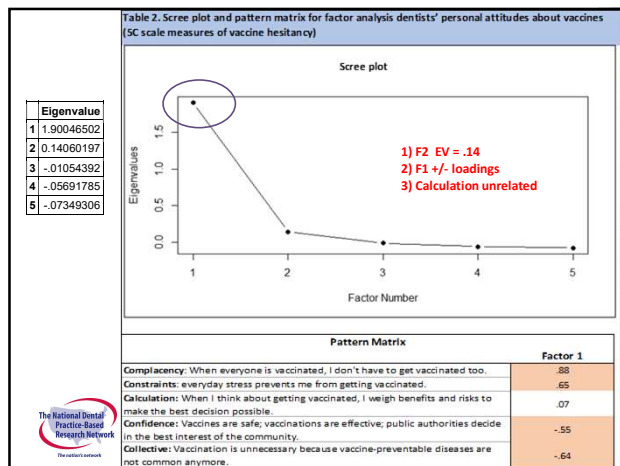


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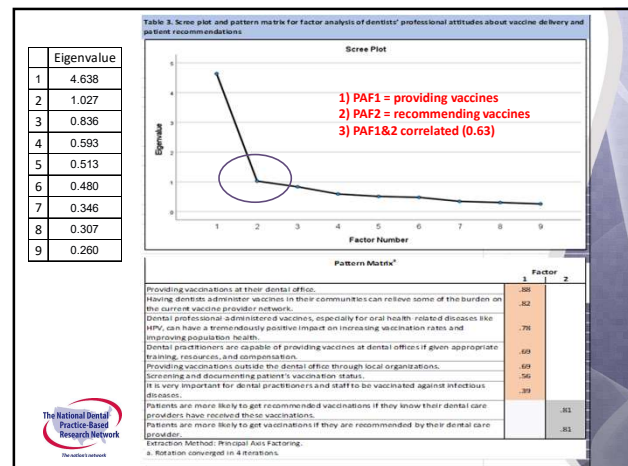
Explore attitudes with factor analysis

- Goals for factor analysis
 - Reduce the number of dependent variables
 - Identify underlying latent (unmeasured) themes btw measures
- Approach: principal axis factoring (PAF)
 - Extracts factors with shared variance
 - Unique & error variance treated separately
- Steps
 - Estimate corr matrix of communalities (shared variance)
 - Iteratively refine loadings → reduced stable factor structure
 - Calculate eigenvalues (variance explained by each factor)
 - Factors w/ EVs > 1 retained (factor var > single measure var)
 - Scree plot useful (look for elbows in plot)
 - If > 1 factor, use **factor rotation** to clarify factors/min cross-loadings (we used Oblimin – account for correlated factors)

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Predictors of dentists' vax attitudes

- Factor analysis = 4 dependent vars
 - Personal attitudes
 - 4C scale (6Qs)
 - Calculation (1Q)
 - Professional attitudes
 - Delivering vaccines (5Qs)
 - Recommending vaccines to patients (2Qs)
- Created unit-based factor scores
 - Means on 1-5 scale (str. disagree to str. agree)
 - Component Qs using 75-80% rule
- Multiple linear regression models
 - Dentist demographic, practice, and location factors
 - F-tests for model significance
 - Report factor means and par. estimates (95% CIs)

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4C scale
Measure of vaccine hesitancy

Model stats
 F value: 1.56
 Pr>F: 0.0487
 N=515

Calculation
 F value: 1.25
 Pr>F: 0.196
 N=513
 Regression results not shown

Table 4. 4C scale score of vaccine hesitancy among National Dental PBRN dentists

Dentist characteristics	N	Mean (95%CI)	Estimate	95% CI	p-value
Age group					
27-34	57	4.5 (4.3, 4.6)	0.01	(0.01, 0.02)	0.890
35-44 years	124	4.4 (4.3, 4.5)	0.02	(0.01, 0.02)	0.864
45-54 years	112	4.4 (4.3, 4.6)	0.08	(0.07, 0.08)	0.376
55-64 years	111	4.6 (4.5, 4.7)	0.17	(0.16, 0.18)	0.002
65+ years	96	4.4 (4.3, 4.5)	ref		
Gender					
Female	198	4.5 (4.4, 4.6)	0.02	(0.01, 0.02)	0.773
Male	328	4.4 (4.4, 4.5)	ref		
Race-ethnicity					
Hispanic	25	4.2 (3.9, 4.5)	-0.31	(-0.38, -0.26)	0.001
Asian	61	4.3 (4.2, 4.5)	-0.13	(-0.14, -0.12)	0.126
Black/African American	26	4.5 (4.4, 4.7)	0.14	(0.12, 0.15)	0.278
Other	40	4.4 (4.2, 4.5)	-0.12	(-0.13, -0.11)	0.219
White	369	4.5 (4.4, 4.5)	ref		
Practice setting					
Private practice, solo	223	4.4 (4.3, 4.5)	ref		
Private practice, group	186	4.5 (4.4, 4.6)	0.14	(0.14, 0.15)	0.001
ACCO/PCO/Corporate	48	4.5 (4.2, 4.7)	0.16	(0.15, 0.16)	0.107
Dental school/hospital	21	4.6 (4.5, 4.8)	0.27	(0.26, 0.28)	0.006
CHC/public health/Federal/military	48	4.5 (4.3, 4.7)	0.12	(0.11, 0.13)	0.232
Patients include children					
Children (c18) or all ages	261	4.5 (4.4, 4.5)	0.00	(0.00, 0.00)	0.999
Adult patients only	265	4.4 (4.4, 4.5)	ref		
Network region					
Midwest	71	4.5 (4.4, 4.7)	-0.03	(-0.04, -0.02)	0.757
Northeast	101	4.6 (4.5, 4.6)	0.02	(0.01, 0.02)	0.865
South Atlantic	91	4.4 (4.2, 4.5)	-0.17	(-0.17, -0.16)	0.180
South Central	75	4.4 (4.2, 4.5)	-0.12	(-0.13, -0.11)	0.081
Southwest	101	4.4 (4.3, 4.5)	-0.08	(-0.07, -0.06)	0.457
Western	87	4.4 (4.3, 4.6)	ref		
Practice location					
Urban	151	4.4 (4.3, 4.5)	-0.05	(-0.05, -0.04)	0.422
Rural	81	4.5 (4.4, 4.7)	0.08	(0.07, 0.08)	0.344
Suburban	294	4.5 (4.4, 4.5)	ref		
Health Professional Shortage Area					
Yes	79	4.5 (4.3, 4.6)	0.01	(0.01, 0.02)	0.877
No/I don't know	77	4.4 (4.3, 4.6)	-0.02	(-0.03, -0.01)	0.799
No	320	4.4 (4.3, 4.5)	ref		

MO: Managed care organization. PCO: preferred provider organization. CHC: community health center. Some categories had missing responses and were excluded.

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PAF1: Beliefs about providing vaccines

Model stats
F value: 7.49
Pr>F: <.0001
N=511
R²= 0.28

Table 5. PAF1 score among National Dental PBRN dentists (draft 05/0)

Dentist characteristic	N	Mean (95%CI)	Estimate	95% CI	p-value
Age group					
27-34	57	3.9 (3.7, 4.0)	-0.38	(-0.19, -0.17)	0.092
35-44 years	124	4.0 (3.9, 4.1)	-0.03	(-0.04, -0.02)	0.747
45-54 years	112	4.0 (3.9, 4.2)	0.03	(0.02, 0.03)	0.782
55-64 years	132	4.0 (3.9, 4.1)	-0.06	(-0.06, -0.05)	0.509
≥65 years	95	3.9 (3.8, 4.0)	ref	ref	
Gender					
Female	198	4.0 (3.9, 4.1)	0.05	(0.04, 0.05)	0.445
Male	328	3.9 (3.9, 4.0)	ref	ref	
Race-ethnicity					
Hispanic	25	3.8 (3.5, 4.1)	0.20	(0.09, 0.11)	0.464
Asian	61	4.1 (3.9, 4.3)	0.17	(0.16, 0.17)	0.074
Black/African American	26	4.2 (4.1, 4.4)	0.28	(0.27, 0.29)	0.006
Other	40	4.0 (3.8, 4.3)	0.14	(0.13, 0.15)	0.179
White	369	3.9 (3.9, 4.0)	ref	ref	
Practice setting					
Private practice, solo	222	3.9 (3.8, 4.0)	ref	ref	
Private practice, group	187	3.9 (3.8, 4.0)	0.09	(0.00, 0.01)	0.895
MCO/PPQ/Corporate	48	4.2 (4.0, 4.3)	0.19	(0.18, 0.20)	0.069
Dental school/hospital	21	4.4 (4.2, 4.6)	0.32	(0.30, 0.33)	0.001
CHC/public health/federal/military	48	4.2 (4.1, 4.4)	0.42	(0.41, 0.43)	0.000
Patients include children					
Children (≤18) or all ages	261	4.0 (3.9, 4.0)	-0.05	(-0.01, 0.00)	0.882
Adult patients only	265	4.0 (3.9, 4.1)	ref	ref	
Network region					
Midwest	71	4.0 (3.9, 4.2)	0.06	(0.05, 0.07)	0.540
Northeast	101	4.0 (3.9, 4.1)	-0.02	(-0.03, -0.01)	0.855
South Atlantic	91	3.9 (3.7, 4.0)	-0.11	(-0.12, -0.10)	0.246
South Central	75	4.0 (3.9, 4.1)	0.04	(0.03, 0.05)	0.696
Southwest	102	3.9 (3.7, 4.1)	-0.20	(-0.11, -0.09)	0.294
Western	86	4.1 (3.9, 4.2)	ref	ref	
Practice location					
Urban	150	4.1 (3.9, 4.2)	0.03	(0.02, 0.03)	0.685
Rural	81	3.8 (3.7, 4.0)	-0.22	(-0.23, -0.21)	0.001
Suburban	295	4.0 (3.9, 4.0)	ref	ref	
Health Professional Shortage Area					
Yes	79	4.0 (3.9, 4.0)	-0.07	(-0.08, -0.06)	0.432
Don't know	77	4.0 (3.8, 4.2)	0.02	(0.01, 0.02)	0.824
No	370	4.0 (3.9, 4.1)	ref	ref	
Personal attitudes about vaccines					
4C score	—	—	0.54	(0.53, 0.54)	<.0001
Calculation	—	—	0.08	(0.08, 0.09)	0.003

MCO: Managed care organization, PPQ: preferred provider organization, CHC: community health center.
Some categories had missing responses and were excluded.

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PAF2: Beliefs about influencing patient demand for vaccines

Model stats
F value: 3.06
Pr>F: <.0001
N=511
R²= 0.14

Table 6. PAF2 score among National Dental PBRN dentists (draft 05/0)

Dentist characteristic	N	Mean (95%CI)	Estimate	95% CI	p-value
Age group					
27-34	57	3.4 (3.2, 3.7)	-0.09	(-0.10, -0.08)	0.525
35-44 years	124	3.4 (3.3, 3.6)	-0.09	(-0.10, -0.08)	0.447
45-54 years	112	3.5 (3.4, 3.7)	0.01	(0.00, 0.02)	0.915
55-64 years	130	3.5 (3.3, 3.6)	-0.08	(-0.09, -0.07)	0.451
≥65 years	96	3.5 (3.3, 3.7)	ref	ref	
Gender					
Female	197	3.4 (3.3, 3.6)	-0.07	(-0.08, -0.07)	0.346
Male	328	3.5 (3.4, 3.6)	ref	ref	
Race-ethnicity					
Hispanic	25	3.4 (3.1, 3.7)	0.16	(0.14, 0.17)	0.351
Asian	61	3.6 (3.3, 3.8)	0.13	(0.12, 0.14)	0.273
Black/African American	26	3.9 (3.7, 4.2)	0.46	(0.44, 0.47)	0.000
Other	40	3.5 (3.2, 3.7)	0.07	(0.06, 0.09)	0.585
White	368	3.4 (3.4, 3.5)	ref	ref	
Practice setting					
Private practice, solo	222	3.4 (3.3, 3.5)	ref	ref	
Private practice, group	186	3.5 (3.4, 3.6)	0.06	(0.05, 0.06)	0.485
MCO/PPQ/Corporate	48	3.5 (3.3, 3.7)	0.03	(0.01, 0.04)	0.848
Dental school/hospital	21	3.4 (3.1, 3.7)	-0.20	(-0.21, -0.18)	0.304
CHC/public health/federal/military	48	3.7 (3.4, 3.9)	0.16	(0.14, 0.17)	0.281
Patients include children					
Children (≤18) or all ages	260	3.4 (3.3, 3.5)	-0.15	(-0.16, -0.15)	0.796
Adult patients only	265	3.5 (3.4, 3.6)	ref	ref	
Network region					
Midwest	70	3.4 (3.2, 3.6)	-0.05	(-0.06, -0.04)	0.706
Northeast	101	3.5 (3.4, 3.6)	0.03	(0.02, 0.04)	0.800
South Atlantic	91	3.5 (3.2, 3.5)	-0.14	(-0.15, -0.13)	0.277
South Central	75	3.6 (3.4, 3.8)	0.10	(0.09, 0.11)	0.461
Southwest	101	3.5 (3.3, 3.7)	0.00	(-0.01, 0.01)	0.996
Western	87	3.5 (3.4, 3.6)	ref	ref	
Practice location					
Urban	151	3.5 (3.4, 3.7)	0.06	(0.05, 0.07)	0.482
Rural	81	3.5 (3.4, 3.7)	-0.01	(-0.02, 0.00)	0.927
Suburban	293	3.4 (3.3, 3.5)	ref	ref	
Health Professional Shortage Area					
Yes	79	3.6 (3.4, 3.8)	0.10	(0.09, 0.11)	0.422
Don't know	77	3.4 (3.2, 3.5)	-0.15	(-0.16, -0.14)	0.141
No	369	3.5 (3.4, 3.5)	ref	ref	
Personal attitudes about vaccines					
4C score	—	—	0.44	(0.43, 0.44)	<.0001
Calculation	—	—	0.02	(0.02, 0.02)	0.637

MCO: Managed care organization, PPQ: preferred provider organization, CHC: community health center.
Some categories had missing responses and were excluded.

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Conclusions

- Personal support for vaccination
- Dentists have important role in vaccine delivery
- Less support for recommending vaccines to patients
- Factor analysis useful for simplifying Reg models
- 4C scale score strongly related to professional attitudes about delivery and recommending vax
- BAA Ds higher prof support for vax vs. white Ds
- Hispanic Ds lower person support for vax vs. white Ds



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CARAD study team

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