An Evaluation of Appointment Confirmation Techniques

Biostatistics 409

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An Evaluation of Dental Appointment Confirmation Methods

The Problem

Broken appointments are more than just a minor nuisance for a dental practice and may have serious economic consequences. When a patient fails to keep a scheduled appointment it disrupts the flow of the office as staff scramble to fill the vacant slot usually unsuccessfully. The providers, dentist and dental hygienist, delivering services to the patients, generate revenue for the dental practice. When a patient fails to keep an appointment the revenue declines yet the overhead costs are unchanged resulting in a net loss of income. There is a $50 fee for missed appointments however it is very difficult to collect and over time this loss of revenue may have a significant impact on the viability of the practice.

Many methods have been utilized over the years in an attempt to reduce the number of broken appointments including mailings, phone calls, automated messaging systems, and more recently e-mail and texting. In 2001, The University of Rochester Eastman Dental Center conducted a study to determine the effectiveness of installing an automatic confirmation system. The implementation of this system resulted in a decrease rate of broken appointments from 23.4% to 19.1% (Amolg et al, 2003). Another study by Christensen and Lupo looked at the difference in making confirmation calls one day versus two days in advance of the scheduled appointment. They found there was a 62% reduction in broken appointments among patients who received a confirmation call compared to the control group, but no significant difference between calls placed one or two days prior to the scheduled appointment (Christensen, et al 2001).

In addition to the financial impact broken appointments have on a dental practice, missed appointments prevent other patients from receiving care. Highly desirable appointment times, at the end or beginning of the day may take several weeks or months to schedule and a broken appointment is preventing others from taking advantage of these attractive time slots.

Although there are many methods available for confirming patient appointments, the system currently in place in my practice will be used to collect data.

Research Design and Hypothesis /Variables

Hypothesis

An analysis of three different scenarios will be presented each with unique hypotheses.

1.The null Hypothesis – There is no difference in the rate of broken appointments using three methods of appointment confirmation: voice confirmation, e-mail confirmation, voice message.

Alternative Hypothesis- There is a significant difference in broken appointments between three methods of appointment confirmation: voice confirmation, e-mail and voice message.

$\alpha = .05$

$Ho = \mu 1 = \mu 2 = \mu 3$

$H1 = \mu 1 \neq \mu 2 \neq \mu 3$

2. The null hypothesis- There is no difference in broken appointments related to the number of days prior to the appointment the confirmation is made.

Alternative hypothesis- There is a significant difference in broken appointments based on the number of days prior to the appointment the confirmation is made.

$\alpha = .05$

$Ho = \mu1=\mu2=\mu3$

$H1 = \mu1 \neq \mu2 \neq \mu3$

3. The null hypothesis- There is no difference in broken appointments based on the day of the week the appointment scheduled.

Alternative hypothesis- There is a significant difference in broken appointments based on the day of the week the appointment is scheduled.

$\alpha = .05$

$Ho = \mu1=\mu2=\mu3=\mu4=\mu5$

$H1 = \mu1 \neq \mu2 \neq \mu3 \neq \mu4 \neq \mu5$

Variables

Confirmation method

Independent variables

1. Voice verified confirmation method
2. E-mail verified confirmation method
3. Voice message

Dependent variable

Broken appointment

Number of days prior confirmation is made

Independent variables

Number of days (1,2,3)

Dependent variable

Broken appointment

Day of the week appointment is scheduled

Independent variables

Days of the week (M, T, W, Th, F)

Dependent variable

Broken appointment

Variable descriptions

1. A broken appointment is defined as an appointment where the patient does not arrive for treatment without 24-hour notice of cancellation.
2. Voice verification is a verbal confirmation with the patient or anyone who answers the phone at the preferred phone number.
3. E-mail verification is sent to the patient and they have the option to confirm the appointment by e-mail.
4. Voice message- a message left on voicemail at the patient's preferred contact number.
5. Number of days confirmation- the number of days prior to the scheduled appointment that it is marked confirmed.
6. Day of the week appointment is scheduled- Appointments are scheduled Monday thru Friday.

Voice verification may be problematic if it is confirmed with anyone other than the patient since the holder of the appointment may not receive the message. E-mail messages may be inconsistent, some replies go to junk mail and often email addresses are incorrect. Voice messages are unreliable since many patients rarely listen to their voicemail. The time of day that confirmation calls are made could produce a bias since calls are made between 9 am and 5-pm while many people are at work. Monday appointments are confirmed the Friday before the appointment rather than the day before since the office is closed on the weekend. Broken appointments tend to be seasonal and weather related. Patients who confirm by e-mail may be more likely to keep track of their appointments using their computer.

Design

Data collected include all scheduled appointments at the Oceanview Dental practice Monday through Friday beginning 7/30/12 through 8/6/12. A full five days of data were collected to allow for analysis regarding the day of the week in relationship to broken appointment status. Appointment schedules with confirmation method were collected daily; the following day appointment schedule with broken appointments were collected and recorded in SPSS.

The strength of the data collection is the system; the receptionist confirms the appointment and records the method directly into the appointment scheduler, thus it is fairly easy to track methods of confirmation. A potential weakness is that e-mail confirmations sometimes go to junk mail and thus are not recorded; in addition, email addresses are often inaccurate. Another weakness in the data collection process is the result of time limitations to collect adequate amounts of data. There are many factors influencing broken appointments, for example there may be seasonal fluctuations associated with last minute vacations or weather issues. There are a significant number of military families in the practice and often last minute deployment issue may affect appointment status.

Analysis

Statistical Method

SPSS software to determine descriptive statistics will provide analysis of the central tendencies with a confidence interval of 95%. The analysis of variance (ANOVA) is a technique to test for statistical significance of the differences among means of more than one group, in this case, the independent variables. The independent variables, methods of appointment confirmation, days of the week are categorical and dependent variable, number of broken appointments is continuous. Assumptions include normal distribution, independent random samples, equal variances.
A Post Hoc procedure (Scheffe test or Tukey procedure) will identity the differences in categories and help to control Type I errors.

I. Confirmation Method

Independent variables

1. Voice verified confirmation method
2. E-mail verified confirmation method
3. Voice message

Dependent variable

Broken appointment

Decision Rule	
df 1= K-1	3-1=2
df 2=N-K	60-3=57
F 2,57	≈3.16
Reject Ho if F≥ 3.16	
F= 13.317	Reject Ho
p=. 000<α< .05	

ANOVA

Appointment_satus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.737	2	1.868	13.317	.000
Within Groups	7.997	57	.140		
Total	11.733	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: Appointment_satus

	(I) Confirmation_method	(J) Confirmation_method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Voice Verified	Email verified	.107	.138	.719	-.22	.44
		Voicemail message	-.484*	.107	.000	-.74	-.23
	Email verified	Voice Verified	-.107	.138	.719	-.44	.22
		Voicemail message	-.591*	.143	.000	-.93	-.25
	Voicemail message	Voice Verified	.484*	.107	.000	.23	.74
		Email verified	.591*	.143	.000	.25	.93
Scheffe	Voice Verified	Email verified	.107	.138	.741	-.24	.45
		Voicemail message	-.484*	.107	.000	-.75	-.22
	Email verified	Voice Verified	-.107	.138	.741	-.45	.24
		Voicemail message	-.591*	.143	.001	-.95	-.23
	Voicemail message	Voice Verified	.484*	.107	.000	.22	.75
		Email verified	.591*	.143	.001	.23	.95

*. The mean difference is significant at the 0.05 level.

Frequency Table

Appointment_satus

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Kept appointment	44	73.3	73.3	73.3
	Broken Appointment	16	26.7	26.7	100.0
	Total	60	100.0	100.0	

Homogeneous Subsets

Appointment_satus

	Confirmation_method	N	Subset for alpha = 0.05	
			1	2
Tukey HSD[a,b]	Email verified	10	1.00	
	Voice Verified	28	1.11	
	Voicemail message	22		1.59
	Sig.		.690	1.000
Scheffe[a,b]	Email verified	10	1.00	
	Voice Verified	28	1.11	
	Voicemail message	22		1.59
	Sig.		.714	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.559.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

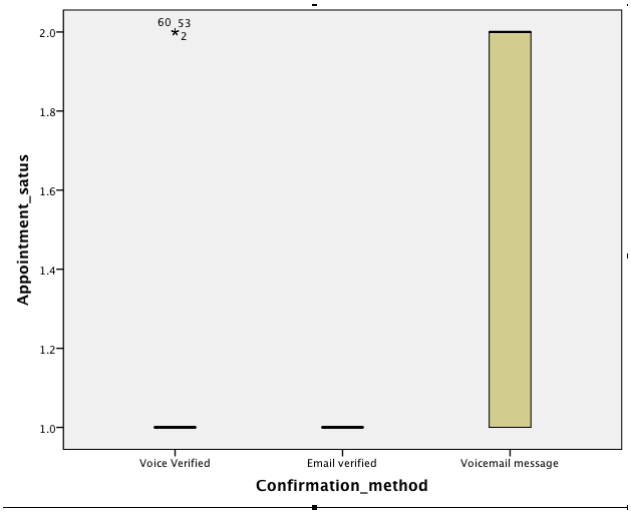
Post hoc analysis- Tukey
Voice verified and voicemail significant difference .000<. 05
E-mail verified and voicemail significant difference .001<. 05
Voice verified and e-mail sig .741> .05 No significant difference

Descriptives[a]

	Confirmation_method			Statistic	Std. Error
Appointment_satus	Voice Verified	Mean		1.11	.060
		95% Confidence Interval for Mean	Lower Bound	.99	
			Upper Bound	1.23	
		5% Trimmed Mean		1.06	
		Median		1.00	
		Variance		.099	
		Std. Deviation		.315	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		0	
		Skewness		2.686	.441
		Kurtosis		5.614	.858
	Voicemail message	Mean		1.59	.107
		95% Confidence Interval for Mean	Lower Bound	1.37	
			Upper Bound	1.81	
		5% Trimmed Mean		1.60	
		Median		2.00	
		Variance		.253	
		Std. Deviation		.503	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		1	
		Skewness		-.397	.491
		Kurtosis		-2.037	.953

Method	Mean	Standard Deviation
Voice verified	1.11	.315
Voicemail	1.59	.503

* e-mail not calculated



II. Number of days prior confirmation

Independent variables
# of days 1,2,3

Dependent variable
Broken appointment

Decision Rule	
df 1= K-1	3-1=2
df 2=N-K	60-3=57
F 2,57	3.16
Reject Ho if F≥ 3.16	
F= 3.353 therefore reject Ho	
p=. 042<α< .05	

ANOVA

Appointment_satus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.235	2	.618	3.353	.042
Within Groups	10.498	57	.184		
Total	11.733	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: Appointment_satus

	(I) Days_prior_confirming	(J) Days_prior_confirming	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	1	2	.306*	.123	.041	.01	.60
		3	.273	.158	.206	-.11	.65
	2	1	-.306*	.123	.041	-.60	-.01
		3	-.034	.154	.974	-.40	.34
	3	1	-.273	.158	.206	-.65	.11
		2	.034	.154	.974	-.34	.40
Scheffe	1	2	.306	.123	.053	.00	.62
		3	.273	.158	.236	-.13	.67
	2	1	-.306	.123	.053	-.62	.00
		3	-.034	.154	.976	-.42	.35
	3	1	-.273	.158	.236	-.67	.13
		2	.034	.154	.976	-.35	.42

Homogeneous Subsets

Appointment_satus

	Days_prior_confirming	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	2	27	1.15
	3	11	1.18
	1	22	1.45
	Sig.		.099
Scheffe[a,b]	2	27	1.15
	3	11	1.18
	1	22	1.45
	Sig.		.120

Means for groups in homogeneous subsets are displayed

Days_prior_confirming

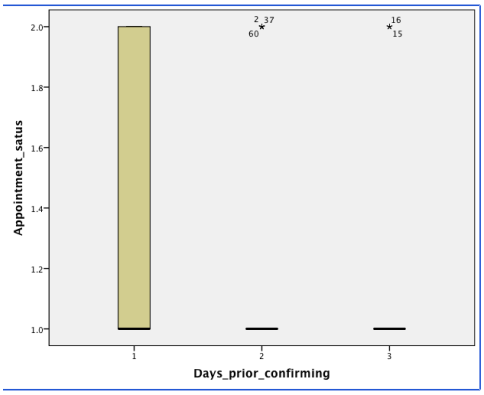
Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Days_prior_confirming	N	Percent	N	Percent	N	Percent
Appointment_satus	1	22	100.0%	0	0.0%	22	100.0%
	2	27	100.0%	0	0.0%	27	100.0%
	3	11	100.0%	0	0.0%	11	100.0%

	Days_prior_confirming			Statistic	Std. Error
Appointment_satus	1	Mean		1.45	.109
		95% Confidence Interval for Mean	Lower Bound	1.23	
			Upper Bound	1.68	
		5% Trimmed Mean		1.45	
		Median		1.00	
		Variance		.260	
		Std. Deviation		.510	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		1	
		Skewness		.196	.491
		Kurtosis		-2.168	.953
	2	Mean		1.15	.070
		95% Confidence Interval for Mean	Lower Bound	1.00	
			Upper Bound	1.29	
		5% Trimmed Mean		1.11	
		Median		1.00	
		Variance		.131	
		Std. Deviation		.362	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		0	
		Skewness		2.099	.448
		Kurtosis		2.594	.872
	3	Mean		1.18	.122
		95% Confidence Interval for Mean	Lower Bound	.91	
			Upper Bound	1.45	
		5% Trimmed Mean		1.15	
		Median		1.00	
		Variance		.164	
		Std. Deviation		.405	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		0	
		Skewness		1.923	.661
		Kurtosis		2.037	1.279

Days	Mean	Standard Deviation
1	1.45	.501
2	1.15	.362
3	1.18	.405

Post hoc analysis- Tukey
Confirmation 1 day to 2 = .041 <. 05 significant difference
Confirmation 1day to 3 =. 206 > .05 no significant difference
Confirmation 2 days to 3 =. 974 > .05 no significant difference



III. Day of the week appointment is scheduled

Independent variables
Days of the week (M, T, W, Th, F)
Dependent variable
Broken appointment

Decision Rule	
df 1= K-1	5-1=4
df 2=N-K	60-5=55
F 4,55	≅ 2.53
Reject Ho if F≥2.53	
F=1.044	Do not reject Ho
p=. 393 >α = .05	

ANOVA

Appointment_satus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.828	4	.207	1.044	.393
Within Groups	10.905	55	.198		
Total	11.733	59			

	(I) DOW_APPT	(J) DOW_APPT	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Monday	Tuesday	-.040	.200	1.000	-.60	.52
		Wednesday	.082	.195	.993	-.47	.63
		Thursday	-.091	.190	.989	-.63	.44
		Friday	-.239	.169	.619	-.72	.24
	Tuesday	Monday	.040	.200	1.000	-.52	.60
		Wednesday	.122	.205	.975	-.45	.70
		Thursday	-.051	.200	.999	-.61	.51
		Friday	-.199	.180	.804	-.71	.31
	Wednesday	Monday	-.082	.195	.993	-.63	.47
		Tuesday	-.122	.205	.975	-.70	.45
		Thursday	-.173	.195	.900	-.72	.38
		Friday	-.321	.174	.359	-.81	.17
	Thursday	Monday	.091	.190	.989	-.44	.63
		Tuesday	.051	.200	.999	-.51	.61
		Wednesday	.173	.195	.900	-.38	.72
		Friday	-.148	.169	.903	-.62	.33
	Friday	Monday	.239	.169	.619	-.24	.72
		Tuesday	.199	.180	.804	-.31	.71
		Wednesday	.321	.174	.359	-.17	.81
		Thursday	.148	.169	.903	-.33	.62
Scheffe	Monday	Tuesday	-.040	.200	1.000	-.68	.60
		Wednesday	.082	.195	.996	-.54	.70
		Thursday	-.091	.190	.994	-.70	.51
		Friday	-.239	.169	.734	-.78	.30
	Tuesday	Monday	.040	.200	1.000	-.60	.68
		Wednesday	.122	.205	.985	-.53	.77
		Thursday	-.051	.200	.999	-.69	.59
		Friday	-.199	.180	.874	-.77	.38
	Wednesday	Monday	-.082	.195	.996	-.70	.54
		Tuesday	-.122	.205	.985	-.77	.53
		Thursday	-.173	.195	.939	-.79	.45
		Friday	-.321	.174	.499	-.88	.23
	Thursday	Monday	.091	.190	.994	-.51	.70
		Tuesday	.051	.200	.999	-.59	.69
		Wednesday	.173	.195	.939	-.45	.79
		Friday	-.148	.169	.941	-.69	.39
	Friday	Monday	.239	.169	.734	-.30	.78
		Tuesday	.199	.180	.874	-.38	.77

Homogeneous Subsets

Appointment_satus

	DOW_APPT	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	Wednesday	10	1.10
	Monday	11	1.18
	Tuesday	9	1.22
	Thursday	11	1.27
	Friday	19	1.42
	Sig.		.438
Scheffe[a,b]	Wednesday	10	1.10
	Monday	11	1.18
	Tuesday	9	1.22
	Thursday	11	1.27
	Friday	19	1.42
	Sig.		.576

DOW_APPT

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	DOW_APPT	N	Percent	N	Percent	N	Percent
Appointment_satus	Monday	11	100.0%	0	0.0%	11	100.0%
	Tuesday	9	100.0%	0	0.0%	9	100.0%
	Wednesday	10	100.0%	0	0.0%	10	100.0%
	Thursday	11	100.0%	0	0.0%	11	100.0%
	Friday	19	100.0%	0	0.0%	19	100.0%

Descriptives

DOW_APPT				Statistic	Std. Error
Appointment_satus	Monday	Mean		1.18	.122
		95% Confidence Interval for Mean	Lower Bound	.91	
			Upper Bound	1.45	
		5% Trimmed Mean		1.15	
		Median		1.00	
		Variance		.164	
		Std. Deviation		.405	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		0	
		Skewness		1.923	.661
		Kurtosis		2.037	1.279
	Tuesday	Mean		1.22	.147
		95% Confidence Interval for Mean	Lower Bound	.88	
			Upper Bound	1.56	
		5% Trimmed Mean		1.19	
		Median		1.00	
		Variance		.194	
		Std. Deviation		.441	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		1	
		Skewness		1.620	.717
		Kurtosis		.735	1.400
	Wednesday	Mean		1.10	.100
		95% Confidence Interval for Mean	Lower Bound	.87	
			Upper Bound	1.33	
		5% Trimmed Mean		1.06	
		Median		1.00	
		Variance		.100	
		Std. Deviation		.316	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		0	
		Skewness		3.162	.687
		Kurtosis		10.000	1.334
	Thursday	Mean		1.27	.141
		95% Confidence Interval for Mean	Lower Bound	.96	
			Upper Bound	1.59	
		5% Trimmed Mean		1.25	
		Median		1.00	
		Variance		.218	
		Std. Deviation		.467	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		1	
		Skewness		1.189	.661
		Kurtosis		-.764	1.279
	Friday	Mean		1.42	.116
		95% Confidence Interval for Mean	Lower Bound	1.18	
			Upper Bound	1.67	
		5% Trimmed Mean		1.41	
		Median		1.00	
		Variance		.257	
		Std. Deviation		.507	
		Minimum		1	
		Maximum		2	
		Range		1	
		Interquartile Range		1	
		Skewness		.348	.524
		Kurtosis		-2.115	1.014

Days	Mean	Standard Deviation
Monday	1.18	.405
Tues	1.22	.441
Wednesday	1.10	.316
Thursday	1.27	.467
Friday	1.42	.507

Post hoc analysis- Tukey	
Monday	1.0 > .05 no significant difference
Tuesday	1.0 > .05 no significant difference
Wednesday	.993 > .05 no significant difference
Thursday	.998 > .05 no significant difference
Friday	.619 > .05 no significant difference

Summary/Discussion

1. There is significant evidence that at α =>05, the mean appointment status (kept, broken) is not equal for voice verify, e-mail verified and voicemail.
2. We have significant evidence at α =.05 ,the mean appointment status is not equal for one, two or three days prior confirmation.
3. We do not have significant evidence that at α =.05 to show that the mean appointment status for the day of the week appoints are scheduled are not equal.
4. The overall broken appointment rate for the time period of July 31 to August 6 equals 26.7%. (This data is not typically included, however the office manager requested it, therefore I included).

In this small sample e-mail confirmation was constant with no broken appointments. This may suggest patients who have access to email to confirm appointments and are more likely keep their appointments. The sample size was quite small and a very limited number of e-mail confirmations were made. We may want to analyze a larger sample over a longer period of time to compare results to this study. During the limited time the data were collected, the overall broken appointment rate was 26.7%; this will have significant long-term financial consequences for the practice due to lost revenue. The broken appointment fee is very difficult to collect and will not offset the scheduled production for the missed appointment. Anticipating the broken appointments, procedures may be implemented to modify the schedule accordingly. For example, the voicemail verification method seems less reliable than the e-mail method so double book or stagger those appointment.

Broken appointments are not only a problem for dental offices but also this issue transverse health care to various venues such as hairdressers, day spas' and just about any business that schedules appointments resulting in lost revenue. In an effort to curtail the problem different methods have been instituted to reduce broken appointments. A careful statistical analysis of one's business may provide insight into the effectiveness of the confirmation methods and provide accurate data leading to better solutions for this vast problem.

References

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