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A Predictive Model for Decreasing Clinical No-Show Rates in a Primary Care Setting

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Background

A challenging obstacles to primary care delivery in the United States (US) is patient no-shows or missed appointments.

- No-show rate in can vary from 5.5% to 50%¹⁻⁶
- Loss to revenue from a no show rate of 5.5% was salary of three nursing staff¹
- Requires tailored prediction tool to target reduction strategies efficiently⁵
- Solutions: phone reminders⁷, automated phone reminders⁸, text messages^{8,9}, exit interviews¹⁰, fees¹¹, overbooking¹²⁻¹⁴, predictive modeling¹⁵⁻²⁰, and predictive modeling with overbooking²¹⁻³⁰

Problem Statement

The clinical no-show rate is a cause of lost productivity in primary care, predictive models may help reduce the rate.

Methods

An IRB approved study was conducted to retrospectively develop a predictive model and prospectively test the model.

- Staff interviews and process mapping defined the problem.
- Patient visits from 2014-2015 were analyzed with regression using STATA 13
- Variables included month, day, age, gender, race, ethnicity, insurance type, visit type, and number of previous no shows
- A threshold for classifying no shows was determined using a histogram
- The model was tested on patient visits in 2016 with sensitivity, specificity, and receiver operating characteristic (ROC) curve calculated
- The model was used to simulate overbooking by visit day on the prospective sample

Results

6,758 patient visits were analyzed with probit regression.

- Significant variables included: 18 to 25 years of age, 36 to 39 years of age, check up visits, no insurance, and two previous no-show visits.

3,571 patient visits were used to test the model

- Model performed at 47% sensitivity and 79% specificity
- Simulated predictive overbooking resulted in 3.67 vs. 6.87 unused appointments, $p < 0.000$ (mean diff 3.2, 95% CI, 2.9 to 3.5). Visit utilization increased from 69% with normal scheduling to 82% with predictive overbooking.
- The receiver operating characteristic (ROC) curve area under curve (AUC) was 0.72 (95% CI, 0.69 to 0.76) for the model and 0.70 (95% CI, 0.65 to 0.74) for predicted visits.

Table 1: Demographics

Characteristics	Phase 1 (n = 2,946)	Phase 2 (2,209)
Age, years: mean (SD)	51.6 (18.6)	53.2 (18.9)
Sex, male: N (%)	1744 (59.2%)	1317 (59.6%)
Race, N (%)		
White	2677 (90.9%)	1989 (90.0%)
Black	165 (5.6%)	133 (6.0%)
Hispanic	48 (1.6%)	39 (1.8%)
Asian	27 (0.9%)	24 (1.1%)
Other	29 (1.0%)	24 (1.1%)
Ethnicity, Hispanic (%)	65 (2.2%)	48 (2.2%)
Insurance, N (%)		
Medicare	601 (20.4%)	499 (22.6%)
Private Insurance	2213 (75.1%)	1634 (74.0%)
Uninsured	132 (4.5%)	76 (3.4%)

Figure 1: A process flow diagram constructed with Microsoft Visio for the single physician office with typical patient flow.

Family Medicine Practice Patient Flow Diagram

CU = Check Up, INJ = Injection, OV = Office Visit, NP = New Patient, Physical = Physical Exam, * = significant at $p < 0.05$

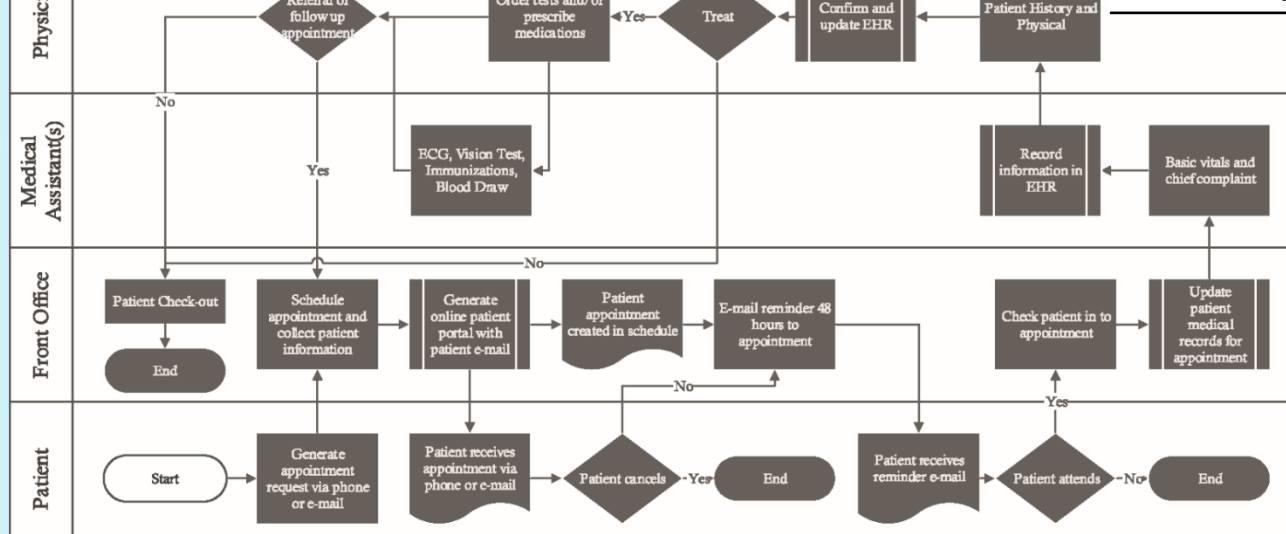
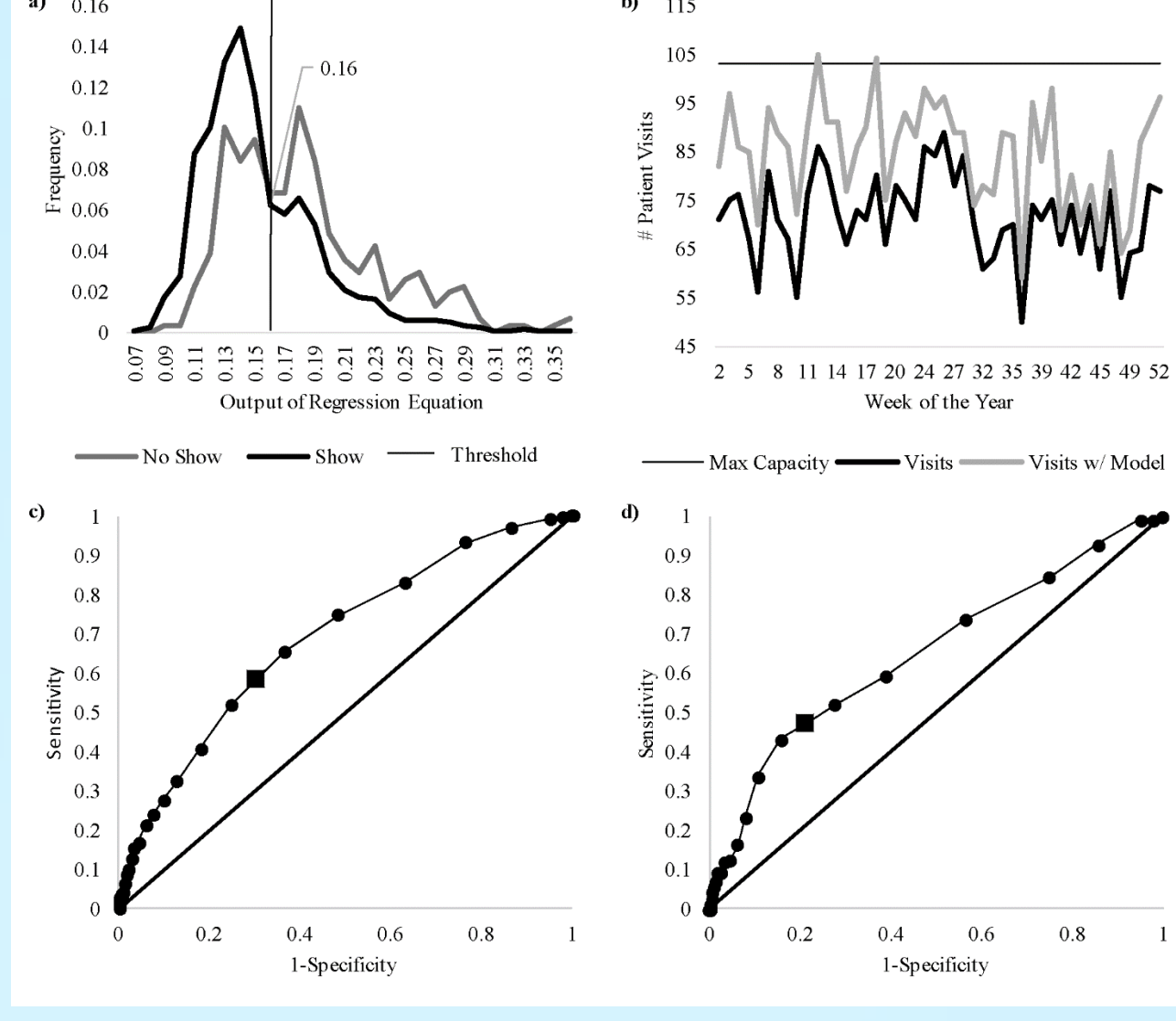


Table 2: Results of Probit Regression Analysis

Month	Beta Coefficient (95% CI)	Significance
No significance		
Day		
No significance		
Age		
18 to 25	0.31 (0.05 to 0.57)	0.019*
36 to 49	0.26 (0.06 to 0.45)	0.012*
Gender		
No significance		
Race		
No significance		
Insurance		
Medicare	-0.3 (-0.6 to -0.01)	0.046*
Private Insurance	-0.27 (-0.51 to -0.03)	0.030*
Uninsured	0 (0 to 0)	Reference
Visit Type		
CU	0.39 (0.23 to 0.56)	0.000*
Previous No Shows		
Twice	0.94 (0.3 to 1.58)	0.004*

Figure 2: a) A histogram plotted using Microsoft Excel with the output of the regression equation for 6,758 patient visits from 2014-2015. Visit status by show and no show is separated to highlight distributional differences. A threshold of 0.16 was chosen to classify a visit as a show or no show for model deployment. b) 251 visit days were analyzed with one excluded as holiday scheduling. The remaining visits, no shows, and overbooked appointments with predictive model were compared to maximum capacity for each visit day. Visit days are displayed as weeks with holiday weeks 23, 28, 29, 37, 48 and 53 excluded to simplify maximum capacity. c) The threshold value of 0.16 is marked on the receiver operating curve (ROC) for the training data in Microsoft Excel. The area under the curve is 0.72 (95% CI, 0.69 to 0.76). d) The threshold value of 0.16 is marked on the receiver operating curve (ROC) for the predicted data. The area under the curve is 0.70 (95% CI, 0.65 to 0.74) in Microsoft Excel.



Discussion

Age, visit type, insurance status, and two previous no show visits were significant in our model.

- Previous research is mixed on age and insurance status^{6,31}
- No association between no shows and race or gender which conflicts previous research^{19,20}
- Predictive modeling with overbooking has not been studied in single physician practices, but is effective²¹⁻³⁰
- Visits for chronic illness or hospital admissions have higher no show rates³²
- SELECT: Leadership and knowledge of health systems with technology can improve practice efficiency while emphasizing improved patient care as it relates to chronic illness and hospital follow ups.

Conclusions

It is possible to develop a predictive model for no shows for clinics as small as single physician practices.

- Some significant variables were similar to prior research, however, others differed.
- Predictive modeling in conjunction with overbooking may provide an opportunity to mitigate the effect of no shows.
- SELECT tools would be necessary to balance staff wellness, patient care, and revenue goals

REFERENCES

1. Moriguchi M. No-show patients in an ambulatory outpatient department. *Acta Otolaryngol.* 1994;72(5):254-260.
2. Sarinath RC, Ward VL, Malin P, et al. Missed Appointments: Factors Contributing to High No-Show Rates in an Urban Pediatric Primary Care Clinic. *Clin Pediatr (Phila).* 2015;54(10):976-982.
3. Kishor N, et al. Patient no-shows in primary care appointments: why patients do not come. *J Prim Care Community Health.* 2013;4(4):251-255.
4. Tangen L, Coughlin C, Steier M, Meyer H, Sellen SA. Risk factors for missed primary care visits among non-Hispanic whites. *J Behav Med.* 2012;35(5):549-556.
5. Laitner RE, Blumenthal L, Lambert K, Caplan B, Bor DM. Missed appointment rates in primary care: the importance of site of care. *J Health Care Poor Underserved.* 2000;16(3):475-488.
6. Davies LF, Fauce JJ, Cyrino Oliveira FL, Hamacher S, No-shows in appointment scheduling—a systematic literature review. *Health Policy (New York).* 2018;122(4):413-421.
7. Patel R, Gupta A, Natarajan C, Reddy S, et al. The effectiveness of outpatient appointment reminder systems in reducing no-show rates. *Am J Med.* 2010;123(9):543-548.
8. Jandl P, et al. Text messaging versus telephone reminders to reduce missed appointments in an academic primary care clinic: a randomized controlled trial. *BMC Health Serv Res.* 2015;15:225. doi:10.1186/s12913-015-0725-1.
9. Chiu C, Wang C, Chen H, Chen Y. The effect of SMS text messaging and phone reminders to improve attendance at a health promotion center: a randomized controlled trial. *J Zhejiang Univ Sci B.* 2008;9(1):34-38. doi:10.1007/s12030-007-1464-4.
10. Chiu C, Richardson L, Chen H, Schmidt S. The effect of text-intervent patient education on no-show rates at a family practice residency clinic. *J Am Board Fam Pract.* 1997;10(5):399-404. doi:10.3122/archfam.10.5.399.
11. Laitner R. Assessing the influence of a no-show fee on patient compliance at a CHHC. *Acad Policy Manag Health.* 1995;23(6):624-631. doi:10.1007/BF02524808.
12. LaGrange LR, Lawrence SR. Clinic Overbooking to Improve Patient Access and Increase Provider Productivity. *Health Care Manag Sci.* 2007;3(2):205-216. doi:10.1111/j.1545-5915.2007.00152.x.
13. D'Amore M, Hordeman K, Proctorson J, Fry J, A multi-method intervention to reduce no-shows in an urban residency clinic. *Fam Med.* 2015;47(8):534-541. doi:10.1093/famfam/mfv014.
14. Berg BP, Mar M, Chandra D, et al. Estimating the cost of no-shows and evaluating the effects of mitigation strategies. *Med Decis Making.* 2013;33(3):376-385. doi:10.1177/0272882813478194.
15. Laitner R, Torres E. Improving clinic utilization using decision analysis-based patient scheduling. *Decision Support Syst.* 2014;62(2):174-178. doi:10.1016/j.dss.2014.01.002.
16. Goffman RM, Harris S, May J, et al. Modeling Patient No-Show History and Predicting Future Outpatient Appointment Behavior in the Veterans Health Administration. *Med Care.* 2017;55(12):e1708-e1714. doi:10.1097/MLR.0000000000000430.
17. Alsharif A, Yang K, Reddy C, Yu S. A probabilistic model for predicting the probability of no-show in hospital appointments. *Health Care Manag Sci.* 2011;14(2):146-157. doi:10.1007/s10729-011-9148-9.
18. Torres E, Berg BP, Chiu C, Opatowicz D, Chandra J, Higgins T. Risk factor model to predict a missed clinic appointment in an urban, academic, and underserved setting. *Prim Health Manag.* 2015;18(2):131-136. doi:10.1089/phm.2014.0047.
19. Goldstein L, Finkelstein C, Cook EF, Epstein R, et al. A multivariate approach to the prediction of no-show behavior in a primary care center. *Arch Intern Med.* 1992;152(12):1633-1637. doi:10.1001/archinte.152.12.1633.
20. Cohen AS, Kasper DM, Kasper R, Brachman E, Varley DA. Nonattendance of adult outpatients for scheduled appointments. *J Laryngol Otol.* 2007;117(13):256-261. doi:10.1097/OTO.0b013e3180150003.
21. Reed MW, Cohen S, Wang H, et al. Preventing patient absenteeism: validation of a predictive overbooking model. *Am J Manag Care.* 2015;21(12):952-955. doi:10.3916/ajmc.v21n12.0004.
22. Samson M, Laitner R. Outpatient appointment scheduling given individual day-dependent no-show probabilities. *Eur J Oper Res.* 2015;240(1):245-257. doi:10.1016/j.ejor.2014.06.024.
23. Duggir J, Lawley M, Willis D, et al. Using no-show modeling to improve clinic performance. *Health Informatics J.* 2010;16(4):266-280. doi:10.1177/1474048210380201.
24. Mathuram M, Lawley M. A stochastic overbooking model for outpatient clinic scheduling with no-shows. *Int Trans.* 2008;40(6):581-593. doi:10.1080/00207179.2008.306262.
25. Huang Y, Hagan DA. Patient no-show predictive model development using multiple data sources for an effective overbooking approach. *Appl Clin Inform.* 2014;5(3):306-310. doi:10.4330/ACI.2014.04.04.004.
26. Huang Y, Hagan DA. Time-dependent patient no-show predictive modeling developed in a Health Care setting. *Health Care Manag Sci.* 2016;19(1):104-114. doi:10.1007/s10729-016-0077-7.
27. Zeng B, Turkan A, Liu J, Lawley M. Clinic scheduling models with overbooking for patients with heterogeneous no-show probabilities. *Am J Oper Res.* 2010;17(6):1121-1144. doi:10.1007/s10729-010-0069-5.
28. Cohen J, Li H. A general approach for patient scheduling. *J Med Econ.* 2017;20(7):780-798. doi:10.1080/10887692.2017.1331970.
29. Yang FP, Reed MW, Cohen S, Dickey F, Spiegel DM. Predictive overbooking and active recruitment increases uptake of endoscopy appointments among African American patients. *Gastroenterol Endosc.* 2017;69(7):750-755. doi:10.1016/j.gie.2016.10.011.
30. Reed MW, May PP, Martinez B, et al. Preventing Endoscopy Clinic No-Shows: Prospective Validation of a Predictive Overbooking Model. *Am J Gastroenterol.* 2016;111(9):1287-1293. doi:10.1039/gastro.2016.269.
31. Harris S, Kumar C, Chiu C, Malhotra H, Shih S, Willis D. An empirical investigation into factors affecting patient cancellations and no-shows at outpatient clinics. *Decis Support Syst.* 2014;57:428-443.
32. Zahraoui AH, Gu NJ, Nak-Shama H. Why do patients with chronic illnesses fail to keep their appointments? A telephone interview. *Asia Pacific J Public Health.* 2006;18(1):10-15.

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