Supplementary Appendix

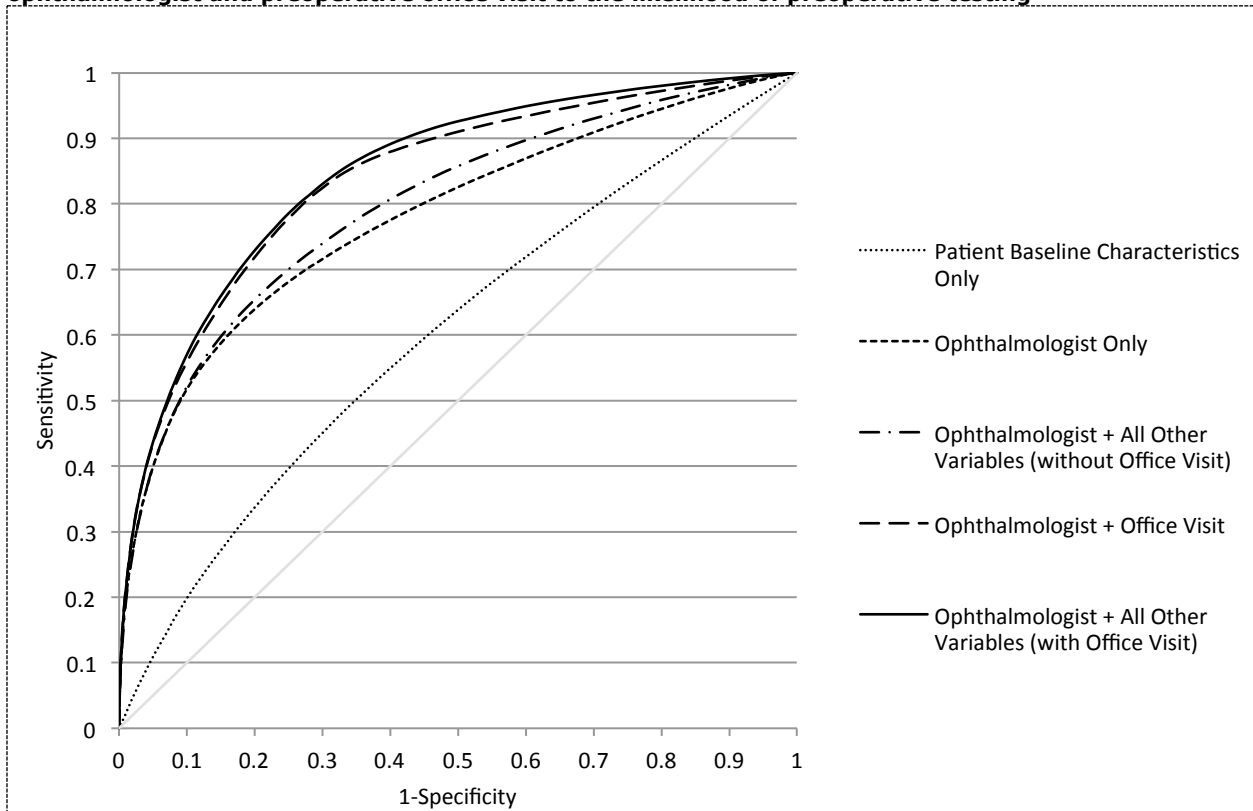This appendix has been provided by the authors to give readers additional information about their work.

Preoperative Medical Testing Prior to Cataract Surgery in Medicare Patients

SUPPLEMENTARY MATERIALS

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Figure S1a. Receiver operating curves depicting differential contributions of patient characteristics, ophthalmologist and preoperative office visit to the likelihood of preoperative testing[1]

1) C-statistics for each model: patient baseline characteristics: 0.60; ophthalmologist only: 0.78; ophthalmologist plus all other variables except office visit: 0.80; ophthalmologist plus office visit: 0.84; ophthalmologist plus all other variables including office visit: 0.85
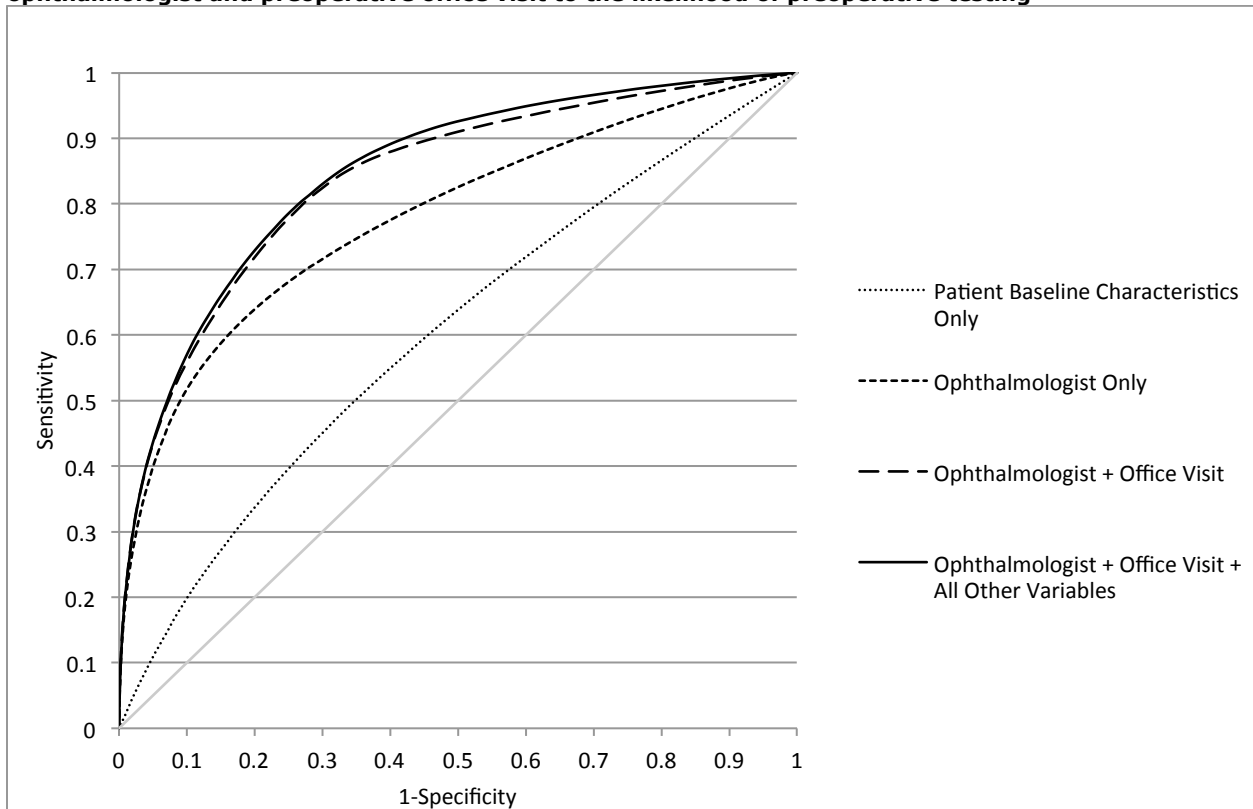
Figure S1b. Receiver operating curves depicting differential contributions of patient characteristics, ophthalmologist and preoperative office visit to the likelihood of preoperative testing[1,2]

1) C-statistics for each model: patient baseline characteristics: 0.60; ophthalmologist only: 0.78; ophthalmologist plus office visit: 0.84; ophthalmologist plus office visit plus all other variables: 0.85

2) Figure S1b does not depict the model "*Ophthalmologist + All Other Variables (without Office Visit)* shown in Figure S1a.

Table S1: CPT codes used for specified preoperative tests

Test grouping	Preoperative Test Name	CPT Code
Chemistry panel	Basic metabolic panel (Na, K, Cl, CO2, BUN, Cr, Glucose, iCa/Ca)	80047, 80048
Chemistry panel	Electrolyte panel (Na, K, Cl, CO2)	80051
Chemistry panel	Comprehensive metabolic panel (Na, K, Cl, CO2, BUN, Cr, Glu, AST, ALT, Alk phos, Tprot, Albumin, Tbili, Ca)	80053
Chemistry panel	Renal function panel (Na, K, Cl, CO2, BUN, Cr, Glucose, Ca, PO4, Albumin)	80069
Chemistry panel	Hepatic function panel (AST, ALT, Alk phos, TProt, Albumin, TBili, DBili)	80076
Chemistry panel	Calcium, serum	82310
Chemistry panel	Calcium, ionized	82330
Chemistry panel	Bicarbonate	82374
Chemistry panel	Chloride	82435
Chemistry panel	Glucose	82947
Chemistry panel	Magnesium	83735
Chemistry panel	Phosphorus	84100
Chemistry panel	Potassium	84132
Chemistry panel	Sodium	84295
Chemistry panel	Creatinine	82565
Chemistry panel	BUN	84520
Chemistry panel	Albumin	82040
Chemistry panel	Bilirubin, total	82247
Chemistry panel	Bilirubin, direct	82248
Chemistry panel	Alkaline phosphatase	84075
Chemistry panel	Total protein	84155
Chemistry panel	AST	84450
Chemistry panel	ALT	84460
Complete blood count	CBC	85025, 85027
Complete blood count	Hematocrit	85014
Complete blood count	Hemoglobin	85018
Complete blood count	WBC	85048
Complete blood count	Platelet count	85049
Coagulation panel	PT w/INR	85610
Coagulation panel	PTT	85730
Urinalysis	Urinalysis	81000, 81001, 81002, 81003, 81005
Electrocardiography	12-lead EKG	93000, 93005, 93010
Echocardiography	TTE	93306, 93307
Cardiac stress test	Stress EKG	93015, 93016, 93017, 93018
Cardiac stress test	Stress echo	93350, 93351, +/- 93352
Cardiac stress test	Stress MRI	75561, 75563
Cardiac stress test	Myocardial Perfusion Imaging, SPECT	78451, 78452
Cardiac stress test	Myocardial Perfusion Imaging, planar	78453, 78454
Chest radiograph	CXR	71010, 71020
Pulmonary function tests	Spirometry	94010
Pulmonary function tests	Bronchodilation responsiveness, spirometry pre- and post-bronchodilator administration	94060
Pulmonary function tests	Plethysmography	93720, 93721, 93722
Pulmonary function tests	Functional residual capacity or residual volume: helium, nitrogen	94240
Pulmonary function tests	Thoracic gas volume	94260
Pulmonary function tests	Determination of maldistribution of inspired gas: helium, nitrogen	94350
Pulmonary function tests	Airway closing volume	94370
Pulmonary function tests	Resistance to airflow	94360
Pulmonary function tests	CO diffusing capacity	94720
Pulmonary function tests	Membrane diffusion capacity	94725

Table S2. Characteristics of cataract surgery patients who did and did not undergo preoperative testing in the 30 days before index cataract surgery (includes all health system variables)[1,2]

Patient Characteristics	Preoperative testing (N= 232,889)	No preoperative testing (N= 207,968)
Age, mean in years (SD)	76.5 (6.3)	75.7 (6.2)
Sex		
Male	40	40
Female	60	60
Race		
White	87	90
Black	7	6
Other	6	5
Charlson Comorbidity Index		
0-1	54	69
2	17	14
3+	29	17
Health System Characteristics		
US region		
Northeast	23	10
Midwest	23	25
South	37	46
Mountain West	4	8
Pacific West	13	10
Population density		
Urban	84	81
Rural	16	19
Primary care physicians per 100,000 residents[3]		
Q1 (43.9-63.3)	22	29
Q2 (63.5-69.0)	23	28
Q3 (69.1-77.9)	26	24
Q4 (78.4-117)	30	19
Ophthalmologists per 100,000 residents[3]		
Q1 (1.6-4.2)	24	30
Q2 (4.3-4.7)	22	29
Q3 (4.8-5.6)	24	24
Q4 (5.7-10.6)	31	17
Ophthalmologist annual cataract surgery volume[4]		
Q1 (1-39)	29	20
Q2 (40-68)	26	24
Q3 (69-120)	24	27
Q4 (121-662)	20	30
Medicare expenditures per beneficiary in HRR (2010 USD)		
Q1 ($6,911-$8,689)	25	25
Q2 ($8,691-$9,674)	24	26
Q3 ($9,693-$10,311)	27	24
Q4 ($10,341-$13,824)	24	25
Surgical Setting		
Ambulatory surgery center	64	71
Hospital outpatient department	34	28
Unknown	2	1
Preoperative Office Visit		
Yes	73	28
No	27	72

1) All numbers shown as column percent unless otherwise specified.
2) P-values for all variables were less than 0.001.
3) HRR variables current as of 2006.
4) Ophthalmologist annual cataract surgery volume was calculated for the year 2011 using Medicare billing data.

Table S3. Characteristics of cataract surgery patients who did and did not have a preoperative office visit in the 30 days before index cataract surgery[1,2]

Patient Characteristics	Preoperative office visit (N=229,832)	No preoperative office visit (N=211,025)
Age, mean in years (SD)	76.4 (6.3)	75.8 (6.2)
Sex		
Male	40	41
Female	60	59
Race		
White	88	89
Black	6	6
Other	6	5
Charlson Comorbidity Index		
0-1	57	66
2	16	14
3+	27	20
Health System Characteristics		
US region		
Northeast	23	10
Midwest	24	24
South	37	46
Mountain West	4	8
Pacific West	12	11
Population density		
Urban	86	79
Rural	14	21
Primary care physicians per 100,000 residents[3]		
Q1 (43.9-63.3)	21	30
Q2 (63.5-69.0)	22	28
Q3 (69.1-77.9)	27	22
Q4 (78.4-117)	29	20
Ophthalmologists per 100,000 residents[3]		
Q1 (1.6-4.2)	23	31
Q2 (4.3-4.7)	21	29
Q3 (4.8-5.6)	24	23
Q4 (5.7-10.6)	32	17
Ophthalmologist annual cataract surgery volume[4]		
Q1 (1-39)	28	21
Q2 (40-68)	27	23
Q3 (69-120)	24	27
Q4 (121-662)	21	29
Medicare expenditures per beneficiary in HRR (2010 USD)		
Q1 ($6,911-$8,689)	25	26
Q2 ($8,691-$9,674)	25	25
Q3 ($9,693-$10,311)	26	24
Q4 ($10,341-$13,824)	24	25
Surgical Setting		
Ambulatory surgery center	67	68
Hospital outpatient department	32	31
Unknown	1	2

1) All numbers shown as column percent unless otherwise specified.
2) P-values for all variables were less than 0.001.
3) HRR variables current as of 2006.
4) Ophthalmologist annual cataract surgery volume was calculated for the year 2011 using Medicare billing data.

Table S4. Prevalence and cost of medical services provided in the 30 days before index cataract surgery

Type of medical service	Number of beneficiaries receiving medical service[1] (%)	Number of medical services performed[1]	Annual cost USD	Change in number of services over baseline period[2] (%)	Change in cost over baseline period[2] USD (%)
Chemistry panel	160,518 (36.4)	257,280	2,899,982	91,737 (55.4)	1,068,376 (58.3)
Complete blood count	131,776 (29.9)	154,523	1,562,794	68,782 (80.2)	681,006 (77.2)
Electrocardiography	123,081 (27.9)	163,519	2,507,544	113,067 (224.1)	1,832,568 (271.5)
Urinalysis	49,897 (11.3)	57,073	226,028	17,820 (45.4)	70,715 (45.5)
Coagulation panel (PT, PTT)	46,967 (10.7)	85,453	520,598	23,671 (38.3)	162,078 (45.2)
Chest radiograph	23,819 (5.4)	40,406	1,218,825	-1,190 (-2.9)	43,317 (3.7)
Echocardiography	9,034 (2.0)	11,981	2,775,937	498 (4.3)	117,798 (4.4)
Cardiac stress test	6,379 (1.4)	17,559	3,964,011	3,486 (24.8)	808,873 (25.6)
Pulmonary function tests	4,393 (1.0)	10,356	473,704	496 (5.0)	19,732 (4.3)
All preoperative tests	**232,889 (52.8)**	**798,150**	**16,149,424**	**318,366 (66.4)**	**4,804,462 (42.3)**
Preoperative office visit	229,832 (52.1)	308,397	28,347,459	118,902 (62.7)	12,435,908 (78.2)
All medical services combined	**292,139 (66.3)**	**1,106,547**	**44,496,882**	**437,269 (65.3)**	**17,240,370 (63.3)**

1) The sum of beneficiaries undergoing each medical service and the number of services performed may exceed the total number of beneficiaries because some patients may have had more than one type of test or office visit during the preoperative period.

2) Total services and costs during the baseline period were calculated by first averaging the totals for each month separately, then calculating the monthly mean for the 11-month baseline period. The baseline mean number of services and costs were then subtracted from the number of services and costs, respectively, that occurred during the preoperative month to calculate the change over baseline.

Table S5. Characteristics associated with preoperative testing prior to cataract surgery (models include office visits as a predictor)

Characteristic	Baseline patient characteristics only AOR (95% CI)	Ophthalmologist only AOR (95% CI)	Ophthalmologist plus office visit AOR (95% CI)	Ophthalmologist plus office visit plus all other variables AOR (95% CI)
Age[1]	1.19 (1.18-1.20)	-	-	1.08 (1.07-1.10)
Sex				
Male	Ref	-	-	Ref
Female	1.04 (1.03-1.05)	-	-	0.97 (0.95-0.98)
Race				
White	Ref	-	-	Ref
Black	1.04 (1.01-1.06)	-	-	1.03 (0.99-1.06)
Other	1.31 (1.28-1.35)	-	-	0.94 (0.91-0.98)
Charlson Comorbidity Index				
0-1	Ref	-	-	Ref
2	1.51 (1.49-1.54)	-	-	1.49 (1.46-1.52)
3+	2.20 (2.16-2.23)	-	-	2.18 (2.14-2.22)
US region				
Pacific West	-	-	-	Ref
Northeast	-	-	-	1.38 (1.27-1.50)
Midwest	-	-	-	0.74 (0.69-0.81)
South	-	-	-	0.76 (0.71-0.82)
Mountain West	-	-	-	0.59 (0.53-0.66)
Population density				
Urban	-	-	-	Ref
Rural	-	-	-	0.95 (0.90-1.00)
Primary care physicians per 100,000 residents[1,2]	-	-	-	1.05 (1.02-1.08)
Ophthalmologists per 100,000 residents[2]	-	-	-	1.17 (1.14-1.20)
Ophthalmologist annual cataract surgery volume[1]	-	-	-	0.98 (0.97-0.98)
Medicare expenditures per beneficiary in HRR (2010 USD)				
Q1 ($6,911-$8,689)	-	-	-	Ref
Q2 ($8,691-$9,674)	-	-	-	1.06 (0.99-1.13)
Q3 ($9,693-$10,311)	-	-	-	1.06 (0.99-1.13)
Q4 ($10,341-$13,824)	-	-	-	1.20 (1.11-1.29)
Surgical setting				
Ambulatory surgery center	-	-	-	Ref
Hospital outpatient department	-	-	-	1.42 (1.38-1.47)
Ophthalmologist[3]	-	3.40 (3.33-3.47)	2.90 (2.84-2.96)	2.63 (2.58-2.68)
Had preoperative office visit	-	-	6.12 (6.02-6.22)	5.94 (5.84-6.03)
C-statistic for area under ROC[5]	**0.60**	**0.78**	**0.84**	**0.85**

1) Age, surgery volume, and primary care physicians per 100,000 residents were divided by 10 to allow for more meaningful odds ratios.
2) HRR variables current as of 2006.
3) The influence of the ophthalmologist was summarized by the median odds ratio (MOR), which is the median ratio of the odds of preoperative testing between equivalent patients of two randomly selected ophthalmologists (n=10,507).

Table S6. Characteristics associated with having a preoperative office visit prior to cataract surgery

Characteristic	Baseline patient characteristics only AOR (95% CI)	Ophthalmologist only AOR (95% CI)	Ophthalmologist plus all other variables AOR (95% CI)
Age[1]	1.15 (1.14-1.16)	-	1.05 (1.04-1.06)
Sex			
Male	Ref	-	Ref
Female	1.10 (1.09-1.11)	-	1.08 (1.06-1.09)
Race			
White	Ref	-	Ref
Black	0.91 (0.88-0.93)	-	0.86 (0.84-0.89)
Other	1.29 (1.26-1.33)	-	0.97 (0.94-1.01)
Charlson Comorbidity Index			
0-1	Ref	-	Ref
2	1.32 (1.29-1.34)	-	1.31 (1.29-1.34)
3+	1.60 (1.57-1.62)	-	1.60 (1.57-1.63)
US region			
Pacific West	-	-	Ref
Northeast	-	-	2.04 (1.87-2.23)
Midwest	-	-	1.19 (1.10-1.30)
South	-	-	0.94 (0.86-1.01)
Mountain West	-	-	0.62 (0.55-0.69)
Population density			
Urban	-	-	Ref
Rural	-	-	0.75 (0.72-0.79)
Primary care physicians per 100,000 residents[1,2]	-	-	1.05 (1.02-1.08)
Ophthalmologists per 100,000 residents[2]	-	-	1.17 (1.14-1.20)
Ophthalmologist annual cataract surgery volume[1]	-	-	0.98 (0.97-0.98)
Medicare expenditures per beneficiary in HRR (2010 USD)			
Q1 ($6,911-$8,689)	-	-	Ref
Q2 ($8,691-$9,674)	-	-	1.00 (1.94-1.07)
Q3 ($9,693-$10,311)	-	-	0.91 (0.85-0.98)
Q4 ($10,341-$13,824)	-	-	1.15 (1.07-1.23)
Surgical setting			
Ambulatory surgery center	-	-	Ref
Hospital outpatient department	-	-	0.86 (0.84-0.89)
Ophthalmologist[3]	-	3.13 (3.07-3.20)	2.77 (2.72-2.82)
C-statistic for area under ROC	**0.57**	**0.79**	**0.79**

1) Age, surgery volume, and primary care physicians per 100,000 residents were divided by 10 to allow for more meaningful odds ratios.
2) HRR variables current as of 2006.
3) The influence of the ophthalmologist was summarized by the median odds ratio (MOR), which is the median ratio of the odds of preoperative testing between equivalent patients of two randomly selected ophthalmologists (n=10,507).