Some Economics of Treatment Disparities in Healthcare

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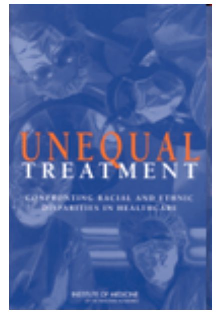
There is a massive literature in medicine and public health on treatment disparities in healthcare.

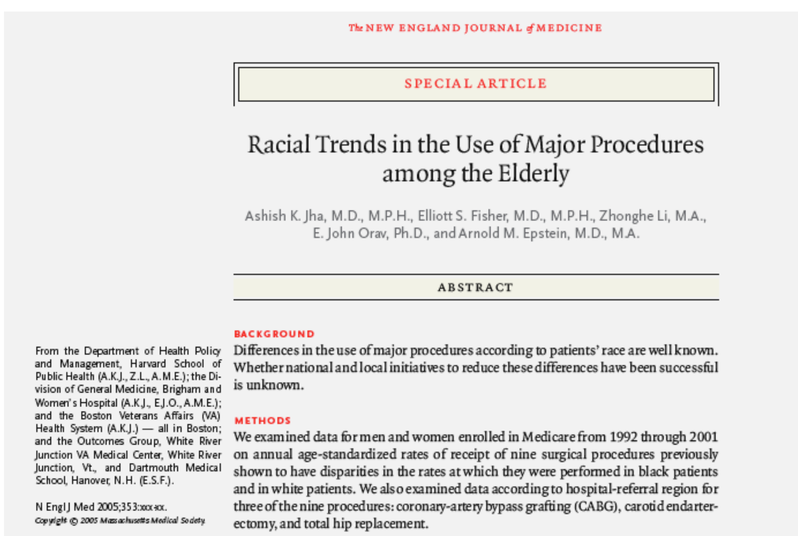
The Institute of Medicine's (IOM) report Unequal Treatment summarizes the key findings of this literature.

"Racial and ethnic minorities tend to receive a lower quality of healthcare than non-minorities, even when access-related factors, such as patients insurance status and income, are controlled. The sources of these disparities are complex, are rooted in historic and contemporary inequities, and involve many participants at several levels, including health systems, their administrative and bureaucratic processes, utilization managers, healthcare professionals, and patients. **Consistent with the charge, the study committee focused part of its analysis on the clinical encounter itself, and found evidence that stereotyping, biases, and uncertainty on the part of healthcare providers can all contribute to unequal treatment**."



Smedley, B. D., A. Y. Stith, and A. R. Nelson, eds. 2003. *Unequal treatment: Confronting racial and ethnic disparities in health care.* Washington, DC: National Academies Press.

Let's look at some examples from the literature…



The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL ARTICLE

Racial Trends in the Use of Major Procedures among the Elderly

Ashish K. Jha, M.D., M.P.H., Elliott S. Fisher, M.D., M.P.H., Zhonghe Li, M.A., E. John Orav, Ph.D., and Arnold M. Epstein, M.D., M.A.

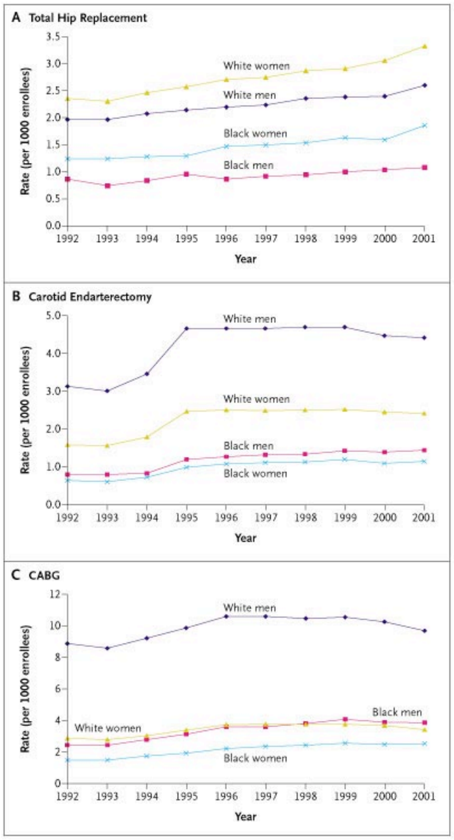
From the Department of Health Policy and Management, Harvard School of Public Health (A.K.J., Z.L., A.M.E.); the Division of General Medicine, Brigham and Women's Hospital (A.K.J., E.J.O., A.M.E.); and the Boston Veterans Affairs (VA) Health System (A.K.J.) — all in Boston; and the Outcomes Group, White River Junction VA Medical Center, White River Junction, Vt., and Dartmouth Medical School, Hanover, N.H. (E.S.F.).

N Engl J Med 2005;353:xxx-xx.

ABSTRACT

BACKGROUND
Differences in the use of major procedures according to patients' race are well known. Whether national and local initiatives to reduce these differences have been successful is unknown.

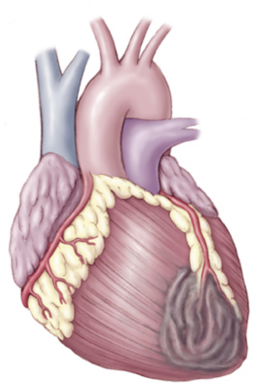
METHODS
We examined data for men and women enrolled in Medicare from 1992 through 2001 on annual age-standardized rates of receipt of nine surgical procedures previously shown to have disparities in the rates at which they were performed in black patients and in white patients. We also examined data according to hospital-referral region for three of the nine procedures: coronary-artery bypass grafting (CABG), carotid endarterectomy, and total hip replacement.



The NEW ENGLAND JOURNAL of MEDICINE

Jha, A. K. et al. N Engl J Med 2005;353:683-691c

Let's look at some facts from our own tabulations of AMI Treatments

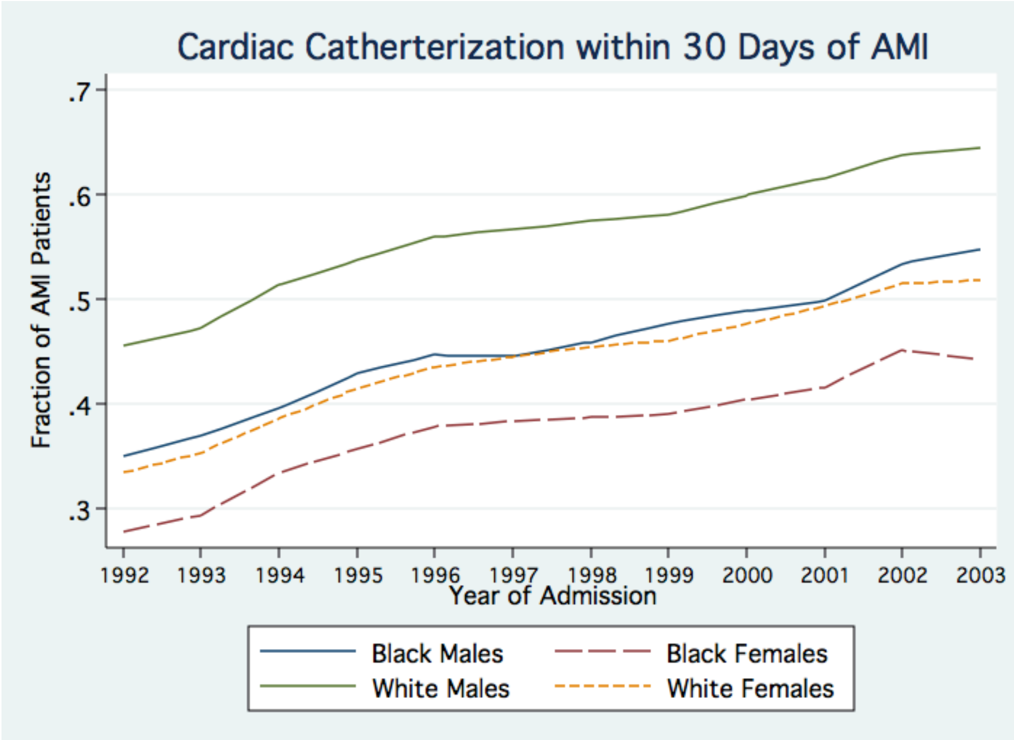


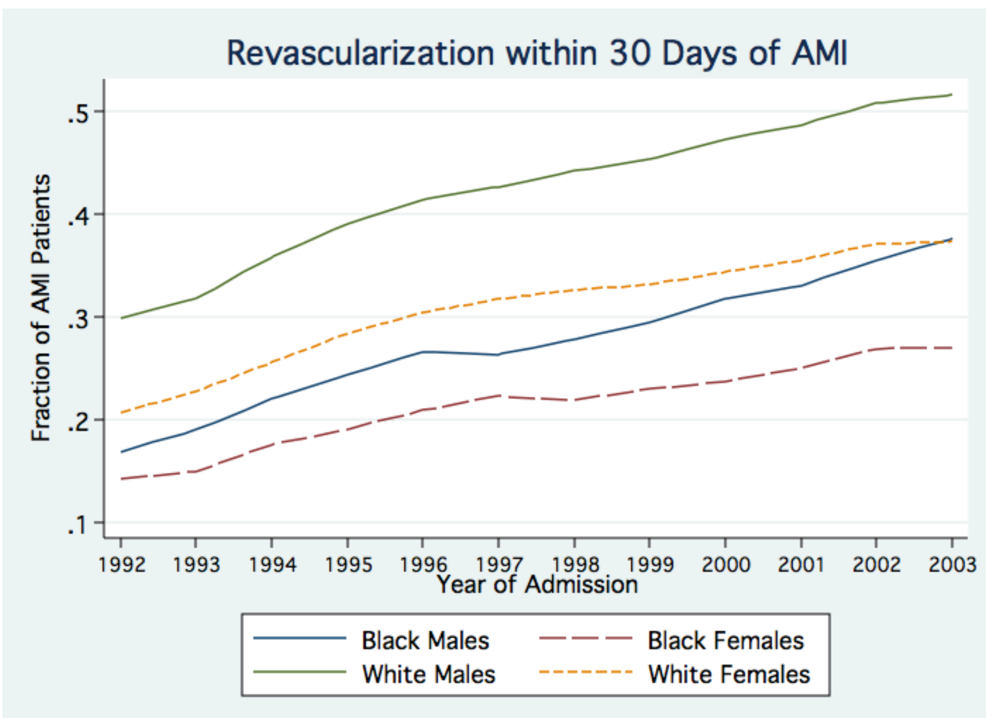
Every "first heart-attack" in Medicare since 1992.

Approximately 210,000 such patients per year.

Each AMI is matched to Part A claims data.

For a 20% random sample, we also have Part B claims.


Cardiac Catherterization within 30 Days of AMI
Fraction of AMI Patients
.3
.4
.5
.6
.7
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year of Admission
Black Males
Black Females
White Males
White Females

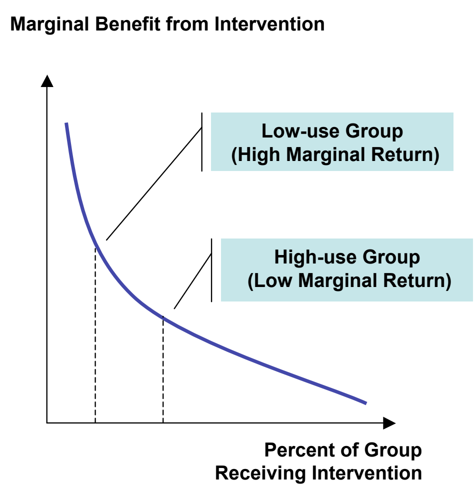

Revascularization within 30 Days of AMI
Fraction of AMI Patients
.1
.2
.3
.4
.5
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year of Admission
Black Males
Black Females
White Males
White Females

Our Enterprise

Do these disparities represent prejudice against women and minorities, or statistical discrimination?

Under statistical discrimination, physicians are trying to maximize benefit to patient, but gender/race are statistically related to the benefit (because of biology, followup, or quality of provider).

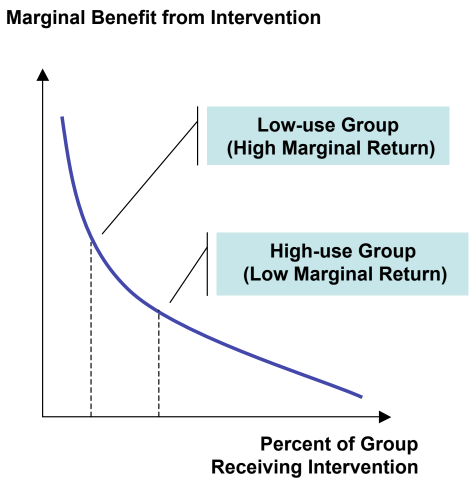
Two Different Views of the World



PREJUDICE

Patients with identical benefit treated differently.

Two Different Views of the World



PREJUDICE

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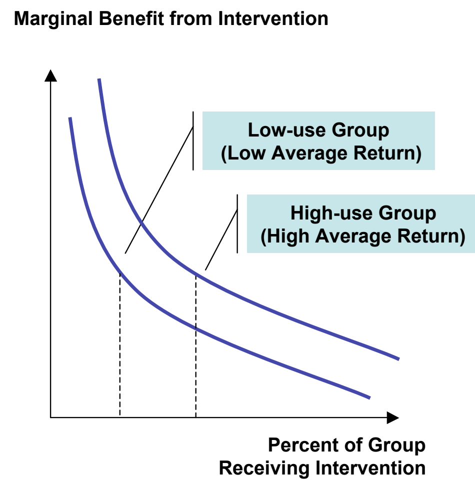


STATISTICAL DISCRIMINATION

Patients with identical benefit treated the same, but benefits higher for one group.

Model

B = Net Benefit of treatment
H= Hurdle that Benefit must exceed to receive care

(B)enefit = X^*b_0 + female$^*b_1$ + e
(H)urdle = h_0 + female$^*h_1$ + v

$h_1>0$ reflects prejudice (females must overcome larger hurdle on average to get treatment)

Pr(Treatment=1) = Pr (Benefit > Hurdle)
= Pr (X^*b_0 + female$^*b_1$ + e **>** h_0 + female$^*h_1$ + v)
= Pr (X^*b_0+female$^*(b_1$-$h_1)$–h_0 **>** v –e)
= Pr (I > v-e)

Model

B = Net Benefit of treatment
H= Hurdle that Benefit must exceed to receive care

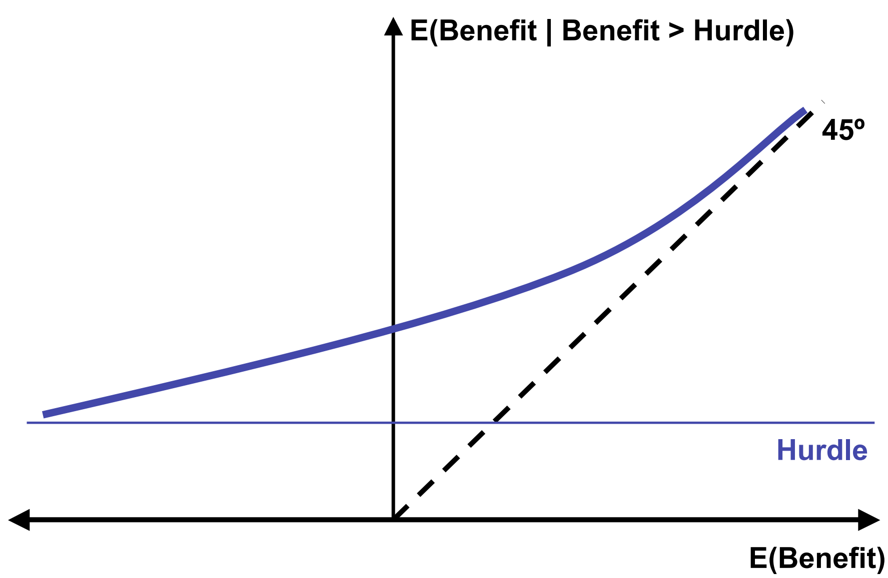
(B)enefit = X^*b_0 + female*b_1 + e
(H)urdle = h_0 + female*h_1 + v
Pr(Treatment=1) = Pr (Benefit > Hurdle)
= Pr (X^*b_0 + female*b_1 + e **>** h_0 + female*h_1 + v)
= Pr (X^*b_0+female*(b_1-h_1)–h_0 **>** v –e)
= Pr (I > v-e)

But we want treatment effect on the treated (TT):
E(Benefit | Treatment=1) = X^*b_0 + female*b_1 + E(e| I>v-e)
E(Benefit | Treatment=1) = I + h_0 + female*h_1 + E(e| I>v-e)
= g(I) + female*h_1

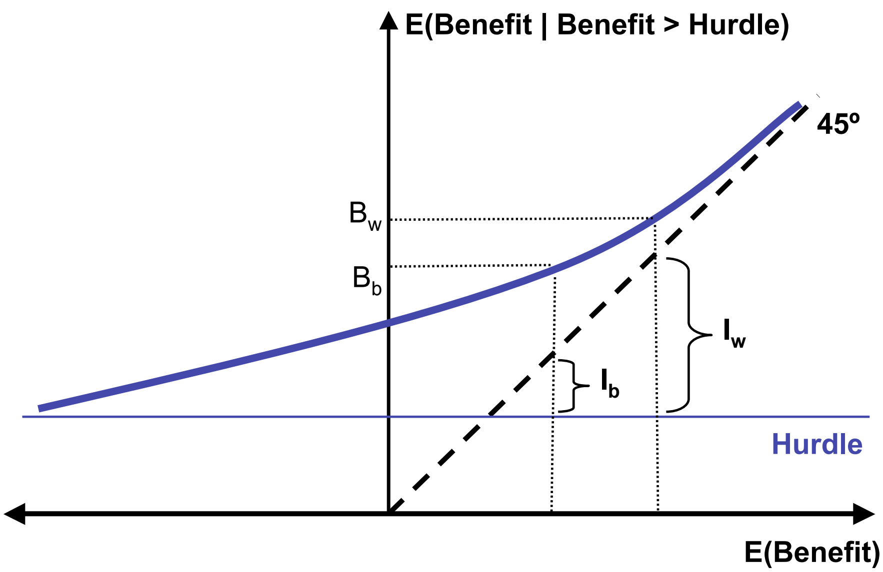
Implication 1: In the absence of prejudice (h_1=0), two people with the same propensity to get treatment (same I) will have the same expected benefit from treatment.

Implication 2: If there is prejudice (h_1>0), then we will see higher benefit (conditional on I) in discriminated group.

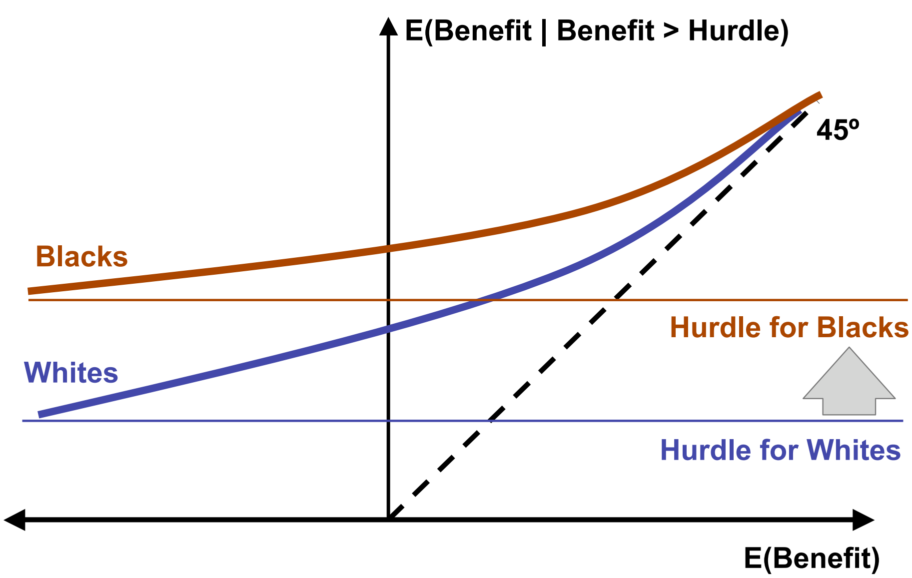
Graphical Intuition



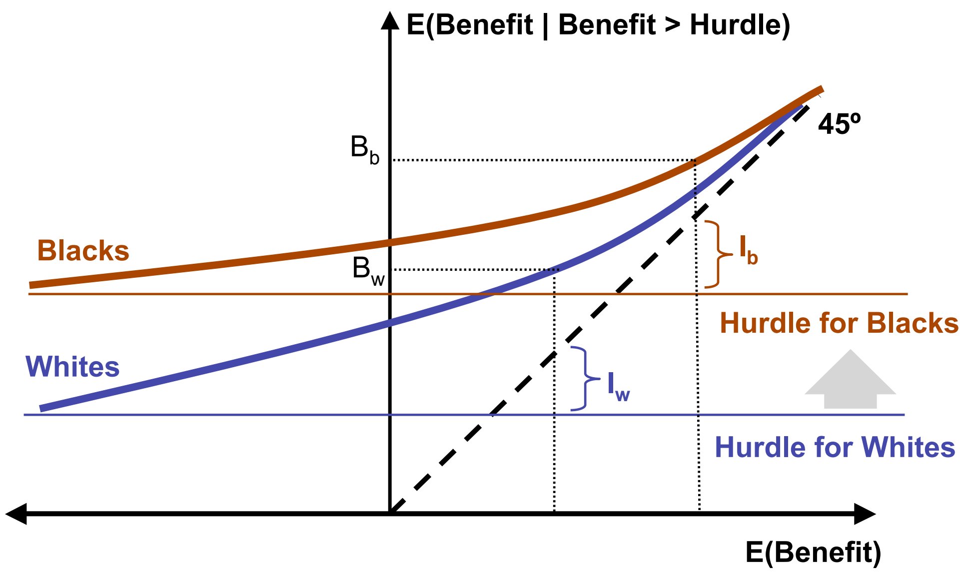
Graphical Intuition (No Prejudice)



Graphical Intuition (Prejudice)



Graphical Intuition (Prejudice)



Empirical Work

- Cooperative Cardiovascular Project (CCP)
  - Chart data on ~140,000 Medicare beneficiaries (over 65) who had heart-attacks; matched to Part B claims.
  - Sample is restricted to fresh-AMIs; we exclude transfers from another ER, or nursing home facilities.
  - Use CATH as marker for intensive treatment
  - Use DIFFERENTIAL-DISTANCE to CATH hospital as IV for Catheterization.

Construction of Clinical Appropriateness for Aggressive Treatments: Pr(CATH=1|X)

1. Age, Race, Sex
2. previous revascularization (1=y)
3. hx old mi (1=y)
4. hx chf (1=y)
5. history of dementia
6. hx diabetes (1=y)
7. hx hypertension (1=y)
8. hx leukemia (1=y)
9. hx ef <= 40 (1=y)
10. hx metastatic ca (1=y)
11. hx non-metastatic ca (1=y)
12. hx pvd (1=y)
13. hx copd (1=y)
14. hx angina (ref=no)
15. hx angina missing (ref=no)
16. hx terminal illness (1=y)
17. current smoker
18. atrial fibrillation on admission
19. cpr on presentation
20. indicator mi = anterior
21. indicator mi = inferior
22. indicator mi = other
23. heart block on admission
24. chf on presentation
25. hypotensive on admission
26. hypotensive missing
27. shock on presentation
28. peak ck missing
29. peak ck gt 1000
30. non-ambulatory (ref=independent)
31. ambulatory with assistance
32. ambulatory status missing
32. albumin low(ref>=3.0)
33. albumin missing(ref>=3.0)
34. bilirubin high(ref<1.2)
35. bilirubin missing(ref<1.2)
36. creat 1.5-<2.0(ref=<1.5)
37. creat >=2.0(ref=<1.5)
38. creat missing(ref=<1.5)
39. hematocrit low(ref=>30)
40. hematocrit missing(ref=>30)
41. ideal for CATH (ACC/AHA criteria)

Table 1: Means by sex and race, CCP data

	Total	Females	Males	Blacks	Whites
Patient Characteristics					
Age	76.7	78.1	75.3	75.6	76.7
Congestive Heart Failure	0.22	0.25	0.19	0.27	0.21
History of Dementia	0.06	0.08	0.05	0.08	0.06
Diabetes	0.30	0.33	0.28	0.42	0.30
Hypertension	0.62	0.68	0.56	0.80	0.61
Non-Ambulatory	0.03	0.04	0.02	0.06	0.03
Ambulatory With Assistance	0.16	0.20	0.12	0.20	0.16
Prediction Based on All Patient Characteristics					
Pr(Cath within 30 days)	0.46	0.42	0.50	0.43	0.46
Pr(survive to 1 year)	0.68	0.66	0.69	0.65	0.68
Patient Outcomes					
Survive to 1 year	0.67	0.65	0.70	0.67	0.67
cost in 1st year	22.5	21.4	23.7	21.7	22.6
Cath within 30 days	0.46	0.40	0.52	0.39	0.47
Revasc within 30 days	0.30	0.25	0.35	0.21	0.31

Table 2: Probit Coefficients [marginal effects] of the effect of Sex and Race on Catheterization

Dependent Variable: Cath within 30 days (mean=0.46)

	No Controls	**Full Controls**
Effect of:		
Female	-0.318	-0.165
	(0.007)	(0.008)
	[-0.126]	[-0.064]
Blacks	-0.159	-0.142
	(0.014)	(0.016)
	[-0.063]	[-0.054]
# Observations	138873	138873

Measurement

For two people with the same propensity (I):

$E(\text{Benefit} \mid \text{Cath}=1,\text{male},I) = E(\Delta S_m \mid \text{Cath}=1,\text{male},I) = g(I)$

$E(\text{Benefit} \mid \text{Cath}=1,\text{female},I) = E(\Delta S_f \mid \text{Cath}=1,\text{female},I) = g(I) + h_1$

Estimate difference in benefit, over identical distributions of I as:

$\text{Survival} = \alpha_0 + \alpha_1 \text{Cath} + h_1(\text{Cath}*\text{female}) + X\alpha_3 + e,$

where α_1 = Benefit from Cath for men

$= E_I(\Delta S_m \mid \text{Cath}=1),$

and $h_1 = E_I(\Delta S_f - \Delta S_m \mid \text{Cath}=1)$

What about Estimation?

Weighting:

- Unweighted estimation → But this produces treatment effects integrated over different distributions of treatment propensity.
- For testing our model, we need same distribution of propensity in both groups.
- Reweight men using Barsky, et al. (JASA, 2002) so that distribution of cath propensity is same as women
  - Find 1st, 2nd, …., 99th percentile of female distribution of cath propensity.
  - Reweight men by .01 over fraction of men in each range

Estimation method:

- OLS (very good X's)
- IV (using diffdist, difdist*female as IV's)
- Need to ensure that IV recovers Treatment on Treated.

Female-Male Differences in the Survival Benefit from Intensive Management

	OLS (n=138,873)				IV (n=129895)			
	Unweighted		Weighted		Unweighted		Weighted	
	cath	cath*fem	cath	cath*fem	cath	cath*fem	cath	cath*fem
1 Day Survival	0.049							
	0.002							
7 Day Survival	0.108							
	0.002							
30 Day Survival	0.123							
	0.003							
1 Year Survival	0.173							
	0.003							
2 Year Survival	0.199							
	0.003							
4 Year Survival	0.213							
	0.003							

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	Unweighted		Weighted		Unweighted		Weighted	
	cath	cath*fem	cath	cath*fem	cath	cath*fem	cath	cath*fem
1 Day Survival	0.049	0						
	0.002	0.002						
7 Day Survival	0.108	-0.005						
	0.002	0.003						
30 Day Survival	0.123	-0.011						
	0.003	0.004						
1 Year Survival	0.173	-0.027						
	0.003	0.004						
2 Year Survival	0.199	-0.025						
	0.003	0.005						
4 Year Survival	0.213	-0.017						
	0.003	0.005						

Female-Male Differences in the Survival Benefit from Intensive Management

	OLS (n=138,873)				IV (n=129895)			
	Unweighted		Weighted		Unweighted		Weighted	
	cath	cath*fem	cath	cath*fem	cath	cath*fem	cath	cath*fem
1 Day Survival	0.049	0	0.052	-0.003				
	0.002	0.002	0.002	0.002				
7 Day Survival	0.108	-0.005	0.115	-0.013				
	0.002	0.003	0.003	0.003				
30 Day Survival	0.123	-0.011	0.131	-0.019				
	0.003	0.004	0.003	0.004				
1 Year Survival	0.173	-0.027	0.184	-0.033				
	0.003	0.004	0.004	0.005				
2 Year Survival	0.199	-0.025	0.21	-0.028				
	0.003	0.005	0.004	0.005				
4 Year Survival	0.213	-0.017	0.221	-0.011				
	0.003	0.005	0.004	0.005				

Female-Male Differences in the Survival Benefit from Intensive Management

	OLS (n=138,873)				IV (n=129895)			
	Unweighted		Weighted		Unweighted		Weighted	
	cath	cath*fem	cath	cath*fem	cath	cath*fem	cath	cath*fem
1 Day Survival	0.049	0	0.052	-0.003	0.06	-0.012	0.087	-0.042
	0.002	0.002	0.002	0.002	0.023	0.031	0.028	0.035
7 Day Survival	0.108	-0.005	0.115	-0.013	0.133	-0.001	0.166	-0.035
	0.002	0.003	0.003	0.003	0.033	0.045	0.04	0.051
30 Day Survival	0.123	-0.011	0.131	-0.019	0.13	0.011	0.134	0.005
	0.003	0.004	0.003	0.004	0.039	0.053	0.047	0.059
1 Year Survival	0.173	-0.027	0.184	-0.033	0.197	-0.118	0.209	-0.132
	0.003	0.004	0.004	0.005	0.046	0.062	0.054	0.068
2 Year Survival	0.199	-0.025	0.21	-0.028	0.183	-0.077	0.198	-0.093
	0.003	0.005	0.004	0.005	0.047	0.063	0.054	0.068
4 Year Survival	0.213	-0.017	0.221	-0.011	0.164	-0.093	0.188	-0.117
	0.003	0.005	0.004	0.005	0.047	0.064	0.054	0.068

Female-Male Differences in the Survival Benefit from Intensive Management

	OLS (n=138,873)				IV (n=129895)			
	Unweighted		Weighted		Unweighted		Weighted	
	cath	cath*fem	cath	cath*fem	cath	cath*fem	cath	cath*fem
1 Day Survival			0.052	-0.003			0.087	-0.042
			0.002	0.002			0.028	0.035
7 Day Survival			0.115	-0.013			0.166	-0.035
			0.003	0.003			0.04	0.051
30 Day Survival			0.131	-0.019			0.134	0.005
			0.003	0.004			0.047	0.059
1 Year Survival			0.184	-0.033			0.209	-0.132
			0.004	0.005			0.054	0.068
2 Year Survival			0.21	-0.028			0.198	-0.093
			0.004	0.005			0.054	0.068
4 Year Survival			0.221	-0.011			0.188	-0.117
			0.004	0.005			0.054	0.068

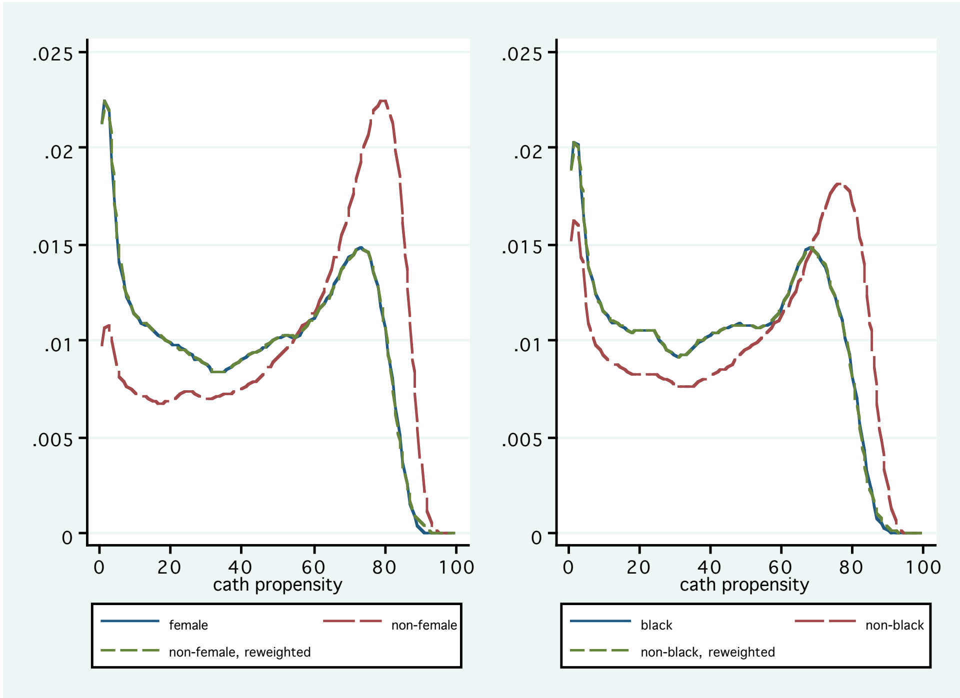
Black-White Differences in the Survival Benefit from Intensive Management

	OLS (n=138,873)			
	Unweighted		Weighted	
	cath	cath*black	cath	cath*black
1 Day Survival	0.05	-0.011	0.049	-0.012
	0.001	0.055	0.002	0.002
7 Day Survival	0.108	-0.032	0.109	-0.036
	0.002	0.007	0.002	0.003
30 Day Survival	0.12	-0.03	0.122	-0.032
	0.002	0.008	0.003	0.004
1 Year Survival	0.162	-0.036	0.166	-0.039
	0.003	0.009	0.003	0.005
2 Year Survival	0.19	-0.043	0.196	-0.045
	0.003	0.01	0.004	0.005
4 Year Survival	0.208	-0.055	0.215	-0.054
	0.003	0.01	0.004	0.005

Things you want to see

1. How well does reweighting work?
2. How good of an instrument is DD?
3. Does IV recover TT or a LATE?
4. Are physicians using the right g(I)? Is survival benefit increasing in g(I)?
5. Are physicians using the same g(I) function for men and women (blacks and whites)?
6. What if survival per dollar (instead of survival) is equalized?
7. Mechanisms: followup, hospital skill

Reweighting f(I)



Wald Estimates

Sample:	30-day CATH rate: DD Below Median	30-day CATH rate: DD Above Median	1-year Survival: DD Below Median	1-year Survival: DD Above Median	1-year Predicted Survival: DD Below Median	1-year Predicted Survival: DD Above Median
All patients (n=1 38,873)	48.9%	42.8%	67.6%	66.7%	67.6%	67.2%
By Gender						
Female (n=6 8,770)	42.5%	36.4%	65.2%	64.7%	65.9%	65.5%
Male (n= 70,103)	55.1%	49.1%	70.0%	68.8%	69.1%	68.8%
By Race						
Black (n=8,285)	41.5%	36.9%	66.7%	66.8%	64.1%	64.6%
Non-Black (n= 130,588)	49.3%	43.2%	67.7%	66.7%	67.8%	67.3%

Does the Diff-Distance IV Recover Treatment on Treated?

Concern:

When DD is small, we go deeper into the distribution of patients; DD as an IV recovers a LATE and not TT.

Test:

Compare predicted probability of receiving cath in patients *who received cath* across High and Low DD.

Ensure that patients with High DD, do not have a lower predicted probability (conditional on receiving Cath).

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	30-day predicted CATH rate for patients getting CATH	
	DD Below Median	DD Above Median
Sample:		
All patients (n=138,873)	62.7%	62.7%
By Gender		
Female (n=68,770)	60.9%	61.0%
Male (n=70,103)	64.1%	63.9%
By Race		
Black (n=8,285)	60.5%	59.6%
Non-Black (n=130,588)	62.9%	62.9%

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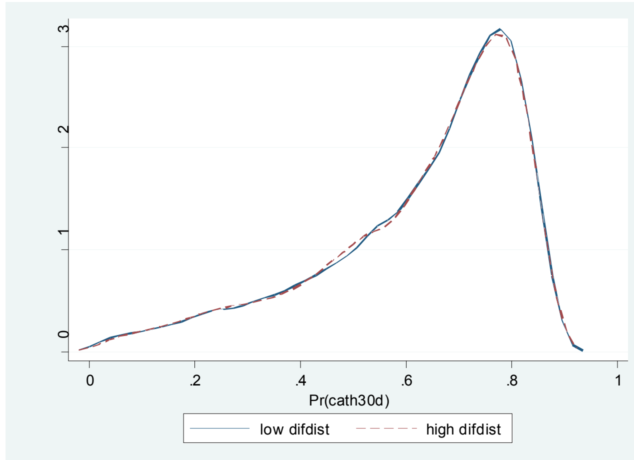


TABLE 1

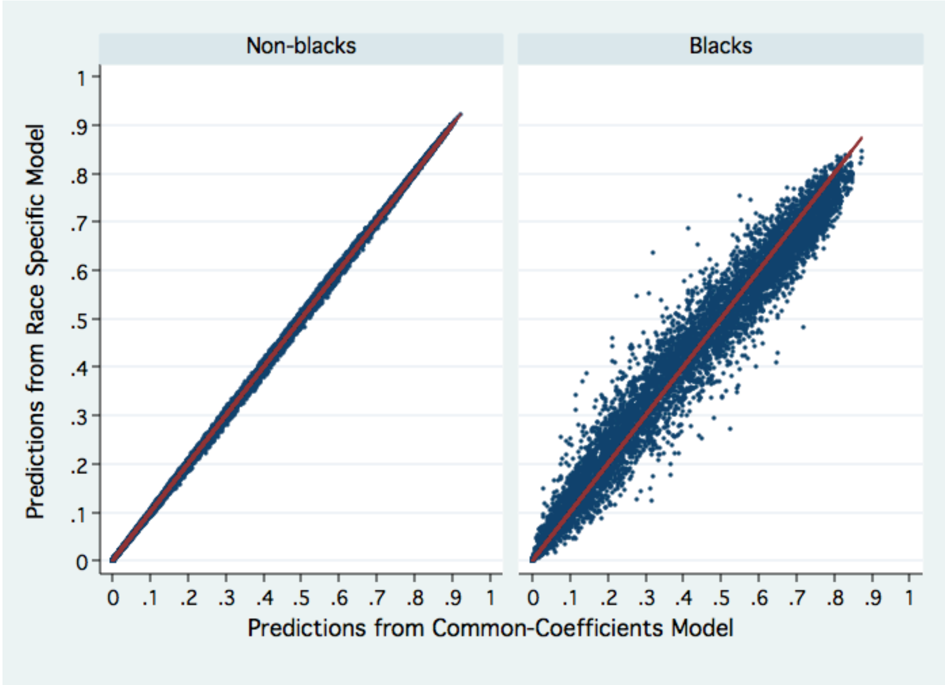
Instrumental Variable Estimates of Intensive Management and Spending on One-Year Survival by Clinical Appropriateness of Patient

Sample	Instrumental Variable Estimates of: Impact of Cath On One-Year Survival (1)	Impact of Cath On One-Year Cost ($1,000s) (2)	Impact of $1,000 on One-Year Survival (3)
A. All patients ($N=$ 129,895)	.142	9.086	.016
	(.036)	(1.810)	(.005)
B. By cath propensity:			
Above the median ($N=$ 64,799)	.184	4.793	.038
	(.034)	(1.997)	(.017)
Below the median ($N=$ 65,096)	.035	17.183	.002
	(.083)	(3.204)	(.005)
Difference	.149	−12.39	.036
	(.090)	(3.775)	(.018)
C. By age:			
65–80 ($N=$ 89,947)	.171	6.993	.024
	(.037)	(1.993)	(.009)
Over 80 ($N=$ 39,948)	.016	16.026	.001
	(.108)	(2.967)	(.007)
Difference	.155	−9.033	.023
	(.114)	(3.574)	(.011)

Note.—Cath propensity is an empirical measure of patient appropriateness for intensive treatments. We define this measure by using fitted values from a logit model of the receipt of cardiac catheterization on all the CCP risk adjusters. Differential distance (measured as the distance between the patient's zip code of residence and the nearest catheterization hospital minus the distance to the nearest hospital) is the instrument. Each model includes all the CCP risk adjusters, and the standard errors are clustered at the level of each HRR.

Do Race-Specific Models Explain Disparities in Treatments after AMI?

Jha, Lee, Staiger and Chandra (AHJ, 2007)



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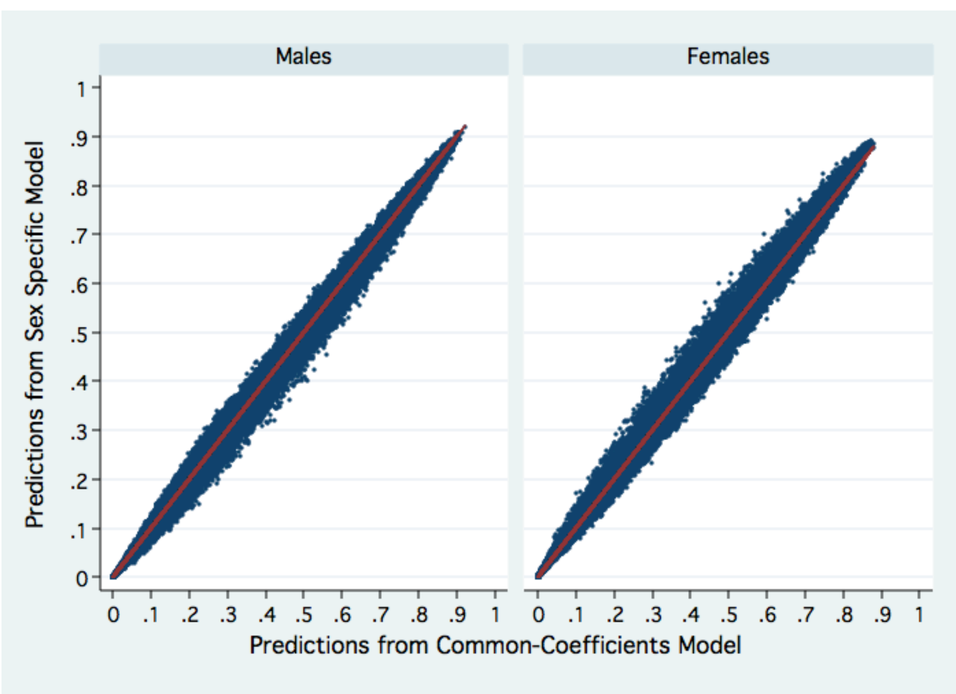

Defining Net Benefit

NB = (S)urvival – λ.(C)ost,
where λ is survival per 1000 dollars:

What are **BIG** and small values for λ?

- Some might use λ =0 (physician should ignore costs of care; infinite value of life)
- BIG value for λ implies small value of life-> Costs matter!
- One survivor at 1 year realizes about 5 years of life.
- Minimum value of life year would be $20k; λ =0.01
- More reasonable value of life year would be $100k; λ =0.002
- Our sense is that reasonable values of λ lie between 0.01 and 0.002

What about Estimation?

Estimate ΔS and ΔC from:

$$S = \alpha_0 + \alpha_1 Treat + \alpha_2(Treat{*}female) + X\alpha_3 + e,$$
$$\text{where } \alpha_1 = \overline{\Delta S_m} \text{ and } \alpha_2 = \overline{\Delta S_f} - \overline{\Delta S_m}$$
$$C = \beta_0 + \beta_1 Treat + \beta_2(Treat{*}female) + X\beta_3 + e,$$
$$\text{where } \beta_1 = \overline{\Delta C_m} \text{ and } \beta_2 = \overline{\Delta C_f} - \overline{\Delta C_m}$$

For all λ between 0.0-0.1, we test:

H0: $\alpha_2 - \lambda^*\beta_2 = 0$

- if $\alpha_2 - \lambda^*\beta_2 > 0$ → $h_1 > 0$ → prejudice against women
- if $\alpha_2 - \lambda^*\beta_2 < 0$ → $h_1 < 0$ → prejudice against men

Female-Male Differences in the Net Survival Benefit from Intensive Management

	Weighted OLS
Dependent Variable: Survival to 1 year	
Effect of Cath for Men	0.184 (0.004)
Female-Male Difference in Effect of Cath	-0.033 (0.005)
Dependent Variable: Costs in 1st year ($1000)	
Effect of Cath for Men	15.033 (0.129)
Female-Male Difference in Effect of Cath	-0.905 (0.167)
Ranges of λ between 0-0.1 that are consistent with:	
No Prejudice (a2=0)	(.025 -.060)
Prejudice against women (a2>0)	(.060 - .100)
Prejudice against men (a2<0)	(0 - 0.025)
# Observations	138873

Black-White Differences in the Net Survival Benefit from Intensive Management

	Weighted OLS
Dependent Variable: Survival to 1 year	
Effect of Cath for Whites	0.166 (0.003)
Black-White Difference in Effect of Cath	-0.039 (0.005)
Dependent Variable: Costs in 1st year ($1000)	
Effect of Cath for Whites	15.29 (0.131)
Black-White Difference in Effect of Cath	-4.251 (0.172)
Ranges of λ between 0-0.1 that are consistent with:	
No Prejudice (a2=0)	(.007 -.011)
Prejudice against blacks (a2>0)	(.011 -.100)
Prejudice against whites (a2<0)	(0 -0.007)
# Observations	138873

Conclusions

- If anything, women & blacks are getting lower returns, even after we adjust for costs.
- Our IV estimates are imprecise, but we plan to update with 1992-2003 claims data (about 20x the sample).
- Key question is why are the benefits of care different?
  - Genes? Contentious explanation for race differences
  - Geography or Hospital “expertise”? No.
  - Follow-up care? Effects grow for women, not for blacks.