estimating the

Cost of Vision Problems

The Economic Burden of Vision Loss and Eye Disorders in the United States

Presented by
John Wittenborn

NORC
at the UNIVERSITY of CHICAGO

FOCUS ON EYE HEALTH
National Summit

Prevent Blindness America
Our Vision Is Vision®

Overview

- Build on this morning's presentation
- Data
- Methods
- Detailed Results

Consensus vision burden guidelines

- Consensus guidelines for economic analyses of vision released in 2010 (Frick et al 2010)
- Defined analysis perspectives and cost categories

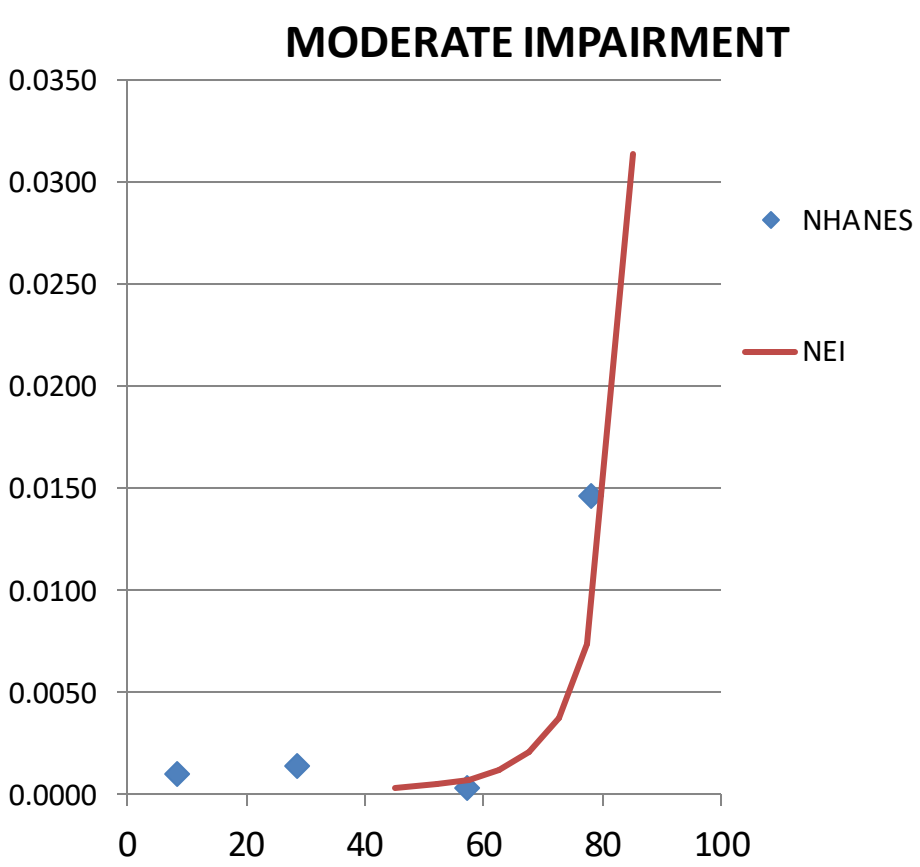
Cost Category	Perspective			
	Government	Insurance	Patient	Comprehensive
Direct Costs				
Medical costs	☑	☑	☑	☑
Other health costs	☑	☑	☑	☑
Aids/adaptations	☑		☑	☑
Indirect Costs				
Productivity loss	☑		☑	☑
Caregivers	☑		☑	☑
Deadweight loss				☑
Loss of well-being			☑	☑

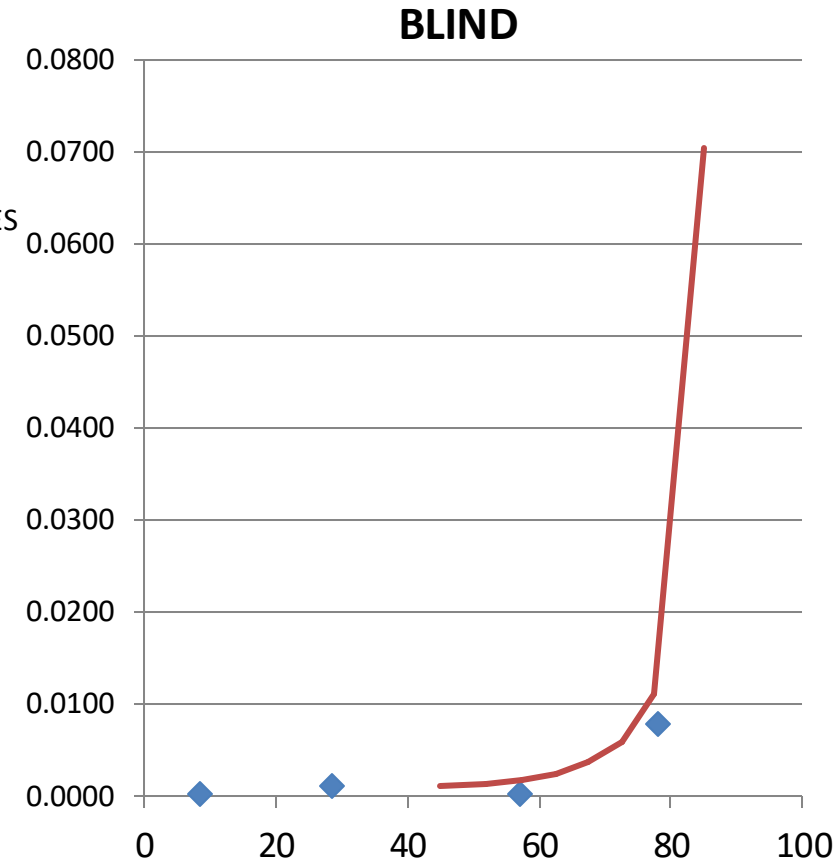
Prevalence of low vision

- Prevalence of low vision for ages 40 and older based on NEI-sponsored meta-analyses of epidemiological studies
  - Best-corrected acuity
- Prevalence of low vision ages 12-39 based on 2005-2008 National Health and Nutrition Examination Survey (NHANES) data
  - Autorefractor corrected acuity
- Prevalence for ages 0-11 imputed from incidence rates

The Eye Diseases Prevalence Research Group, Causes and prevalence of visual impairment among adults in the United States. Archives of Ophthalmology, 2004. 122: p. 477-485.

Prevalence of low vision





Medical costs – Data

- 2003-2008 Medical Expenditure Panel Survey (MEPS)
  - Panel survey of a subsample of National Health Interview Respondents
  - Respondents report medical and diagnosis history, and medical providers
  - MEPS contacts providers to verify medical events and expenditures
  - MEPS assigns diagnosis codes to respondents

Medical costs – MEPS versus claims

- 2007 estimate used claims data
  - 40-64 MarketScan commercial insurance claims
  - 65+ Medicare claims
- Disadvantages of MEPS versus claims
  - Smaller sample size
  - Wider confidence intervals
  - Difficult to get cost per diagnosis
- Advantages of MEPS versus claims
  - Includes out of pocket and vision insurance costs
  - Includes prescription drug costs
  - Includes non-ophthalmologic procedure costs

Medical costs

- "Top-down" econometric approach
  - 2-part generalized linear model, gamma distribution with log link
    - Controlling for double counting of costs for multiple conditions
  - Primary dependent variable is total medical expenditures excluding vision correction costs
  - Primary independent variables
    - Any eye/vision related diagnosis code
    - Self-reported low vision, no diagnosis code

Trogdon JG, Finkelstein EA, Hoerger TJ. Use of econometric models to estimate expenditure shares. *Health Serv Res* Jan 29 2008.

Medical costs – Diagnosed disorders

Age Group	Total			Per person		
	Mean	95% CI		Mean	95% CI	
Ages 0-17	2,455,801,946	2,192,680,309	2,769,701,443	659	585	725
Ages 18-39	4,387,668,703	3,958,364,979	4,858,517,949	1,268	1,138	1,393
Ages 40-64	12,982,975,516	11,298,073,804	14,887,145,258	1,957	1,696	2,211
Ages 65+	26,092,895,681	22,503,824,227	30,235,907,423	3,097	2,674	3,560
Total	45,919,341,846	39,952,943,320	52,751,272,073	2,470	2,139	2,820

Medical costs – Undiagnosed low vision

Age Group	Total			Per person		
	Mean	95% CI		Mean	95% CI	
Ages 0-17	47,527,024	22,042,207	80,090,533	117	50	196
Ages 18-39	474,311,372	207,727,608	810,137,672	205	88	337
Ages 40-64	1,702,212,345	424,687,555	3,866,041,598	272	68	586
Ages 65+*	798,135,633	-11,771,231	2,169,599,464	329	-5	877
Total	**3,022,186,374**	**642,686,139**	**6,925,869,268**	**274**	**51**	**618**

*Not statistically different from zero

Vision correction costs

- "Non-medical" optometry visits and medical vision aids (glasses, contacts) are captured and reported separately from other expenditures in MEPS data
  - Diagnosed disorders and low vision predicted only a tiny fraction of these costs
  - Costs are self-reported and not verified by MEPS
    - Average reported visit cost about $94
- "Bottom-up" accounting approach
  - Total of visit and medical vision aid costs

Nonmedical optometry visit costs

Age Group	Total			Per person		
	Mean	95% CI		Mean	95% CI	
Ages 0-17	387,758,202	335,826,300	440,844,146	5	5	6
Ages 18-39	679,730,896	610,488,360	748,973,432	8	7	8
Ages 40-64	1,234,825,227	1,132,115,465	1,338,689,031	13	12	14
Ages 65+*	547,016,035	489,313,922	604,718,148	15	14	17
Total	2,849,330,360	2,654,297,217	3,046,671,588	11	10	12

Medical vision aid costs

Age Group	Total			Per person		
	Mean	95% CI		Mean	95% CI	
Ages 0-17	1,479,977,160	1,386,175,790	1,573,778,529	20	19	21
Ages 18-39	3,335,159,796	3,105,867,560	3,574,874,407	38	37	39
Ages 40-64	6,222,157,495	5,867,796,767	6,576,518,223	66	64	67
Ages 65+*	2,199,120,991	2,053,207,750	2,334,611,857	61	58	63
Total	13,236,415,441	12,506,849,236	13,965,981,647	53	51	55

Long-term care

- Nursing home
  - Vision attributable long-term care utilization estimated based on data from the National Nursing Home Survey and Baltimore Eye Study
  - Cost of nursing home based on 2011 Genworth Financial Cost of Care Survey
    - $3,261 per month, or $39,132 per year
  - Cost allocation is 58% government, 34% patient, 8% insurance
- Skilled nursing facility
  - Excess SNF claims costs for Medicare patients with vision loss

Medical costs – medical vision aid costs

Nursing Home	Visually Impaired	Blind	Total
65-74	$1,151,673,904	$747,843,332	$1,899,517,235
75-84	$2,756,047,902	$2,056,147,072	$4,812,194,973
85+	$5,357,417,985	$4,752,910,393	$10,110,328,377
Total	$9,265,139,790	$7,556,900,796	$16,822,040,586

SNF	Excess Costs per Person 2013 $	# of persons with vision loss	Total Costs
Moderate	$758.35	2,069,877	$1,569,691,418
Severe	$1,165.24	479,634	$558,888,257
Blind	$1,301.29	996,730	$1,297,033,427
Total			$3,425,613,102

Informal care

- Cost of informal care attributable to low vision and blindness
  - Care hours for adults based on previous PBA estimate
    - The only parameter left-over from the original analysis
  - Care hours for children based on data from the American Time Use survey and the special census on disability in France
  - Cost of care hours based on 2013 U.S. national average wage

Frick, K., et al., *Economic impact of visual impairment and blindness in the United States.* Arch Ophthalmol, 2007. **125**: p. 544-550. Brézin A, Lafuma A, Fagnani F, Mesbah M, Berdeaux G. Prevalence and burden of self-reported blindness, low vision, and visual impairment in the French community. *Arch Ophthalmol* 2005;123:1117-1124. U.S. Bureau of Labor Statistics. American Time Use Survey—2010 Results. In: US Department of Labor, ed. Vol USDL-11-0919. Washington, DC: US Department of Labor; 2011

Productivity losses

- Median income level by self-reported vision status by age group based on Survey of Income and Program Participation data
  - assumes self-reported difficulty seeing = moderate impairment
  - assumes self-reported inability to see printed words = blindness
- Productivity losses equal to the product of:
  - The reduction in income associated with vision loss
  - the prevalence of moderate impairment and blindness

Productivity losses

- Productivity losses drop from ages 18-39 to 40-64 because of the reduction in prevalence of moderate impairment

Age Group	Moderate Impairment	Blind	Total
0-17	$0	$0	$0
18-39	$11,400,339,873	$1,577,176,319	$12,977,516,191
40-64	$6,798,546,344	$4,029,229,475	$10,827,775,819
65+	$17,701,291,441	$6,920,311,587	$24,621,603,028
Total	$35,900,177,657	$12,526,717,381	$48,426,895,038

Low vision aids, devices and dog guides

- Low vision aids are non medical personal, home, and workplace devices for low vision
  - Utilization rates identified by a special census of the disabled in France
  - Utilization rates applied to US specific blindness prevalence and unit costs
- The estimated cost of dog guides for the blind was updated for inflation

Brézin A, Lafuma A, Fagnani F, Mesbah M, Berdeaux G. Prevalence and burden of self-reported blindness, low vision, and visual impairment in the French community. *Arch Ophthalmol* 2005;123:1117-1124. Lafuma A, Brézin A, Lopatriello S, et al. Evaluation of non-medical costs associated with visual impairment in four European countries: France, Italy, Germany and the UK. *Pharmacoeconomics* 2006;24(2):193-205. Wirth KE, Rein DB. The economic costs and benefits of dog guides for the blind. *Ophthalmic Epidemiol* Mar-Apr 2008;15(2):92-98.

Special education

- Individuals with Disabilities Education Act and the Act to Promote Education of the Blind
  - requires states to provide free intervention and educational programming for children with blindness through age 21
- Number of children receiving special education due to blindness based on the American Printing House for the Blind registry
- Cost of special education for the blind based on updated value cited by the Act

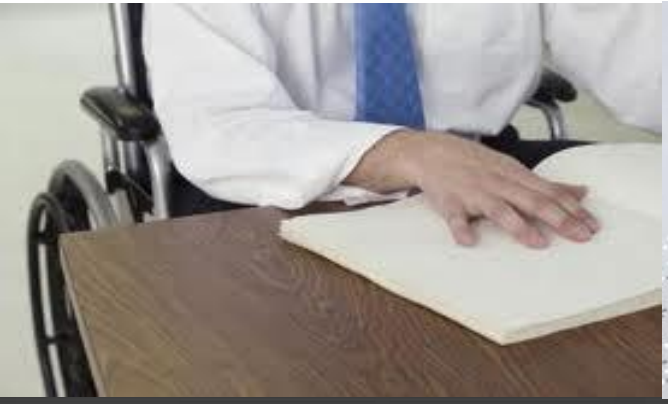
Apling RN. *Individuals with Disabilities Education Act: Full Funding of State Formula.* Washington DC: Congressional Research Service, The Library of Congress; December 27 2001. 97-433 EPW. Distribution of eligible students based on the Federal quota census of January 05, 2009. 2010. http://www.aph.org/fedquotpgm/dist10.html. Updated Last Updated Date. Accessed September 15, 2011

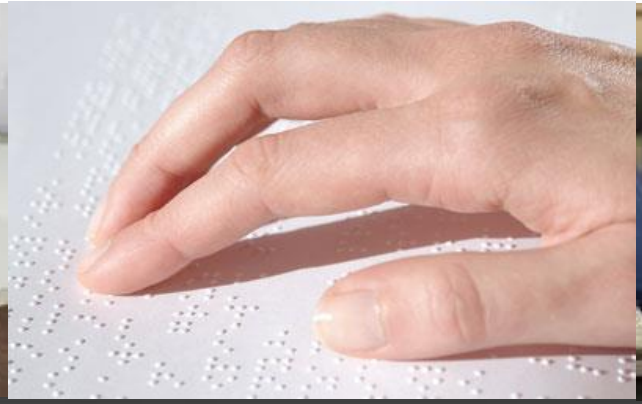
School and pre-school vision screening

- School screening is generally based on individual state law and implemented at the school district level
  - Screening ages and frequency based on a nationwide survey of school screening
- Costs and penetration rates of school and preschool screening based on our earlier evaluation of 3 PBA sponsored vision screening programs in NC, VA and GA
- We assume screening is acuity chart with stereopsis

Federal assistance programs

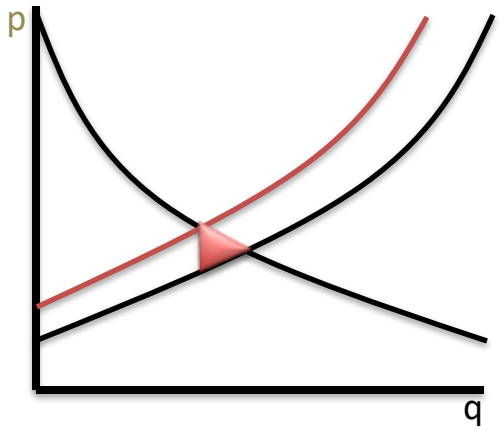
- Budgetary costs of federal supportive services
  - National Library Services for the Blind
  - American Printing House for the Blind
  - Committee for Purchase from People who are Blind or Severely Disabled





Transfers, tax losses and deadweight loss

- Transfer payments are not included in costs
  - Social Security Disability Insurance (SSDI)
  - Supplemental Security Income (SSI)
  - Supplemental Nutrition Assistance Program (food stamps)
  - Reduced tax revenue
- Deadweight loss (cost of allocative inefficiency)
  - 38% of transfer payments

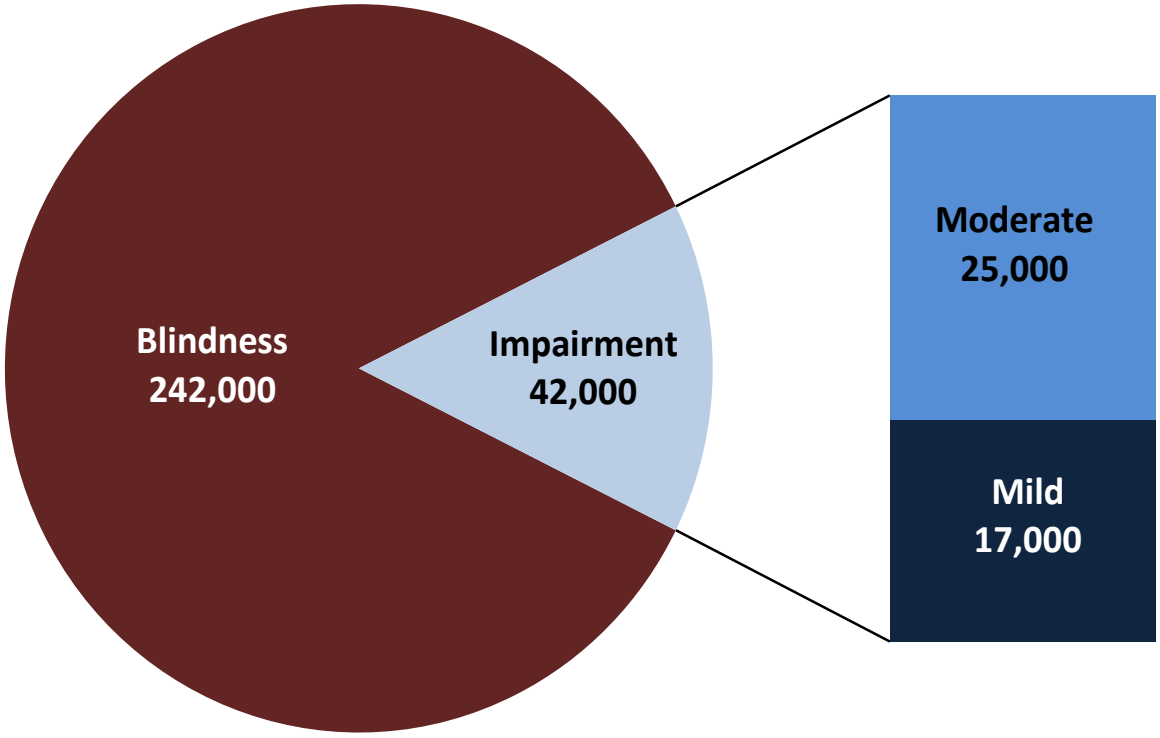


Loss of well-being and disability

- Disability adjusted life years (DALYs)
  - Disability weights from the recently released Global Burden of Disease Project
  - DALYs estimated by multiplying disability weights for impairment and blindness by the prevalent population with the condition
- We generated and alternative measure using quality adjusted life years (QALYs)
  - Utility measures in the literature

Disability adjusted life year losses

Age Group	Total DALYS	Monetized Value*
0-17	6,921	$346
18-39	26,351	$1,318
46-64	33,379	$1,669
65+	216,476	$10,824
Total	283,127	$14,156



Note: DALY = disability adjusted life years

*Valued at $50,000 per DALY, not included in total burden

Utility values in the literature

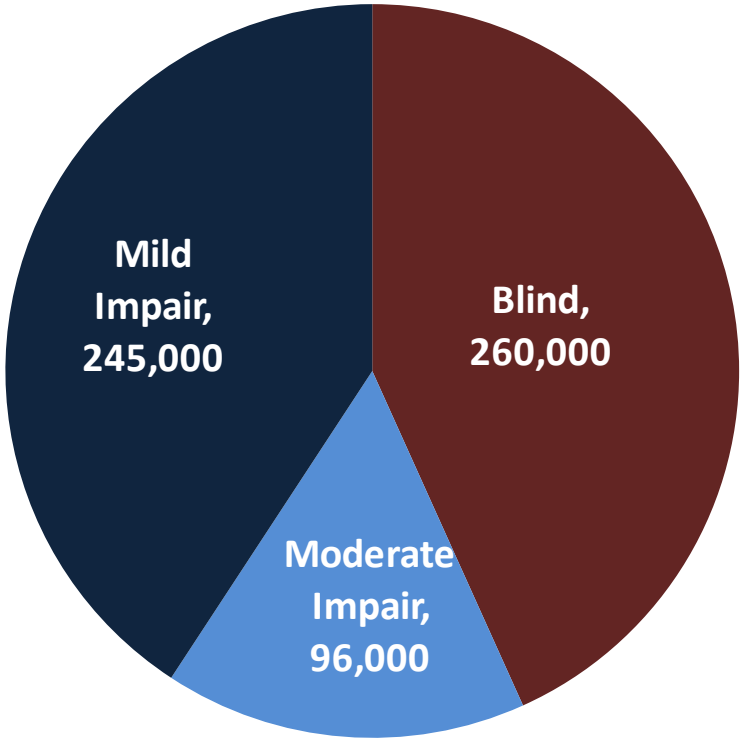
Study	Main Results		
	Normal	Impairment	Blindness
Crew et al. (2011)	1		0.79
Smith et al. (2008)	0.82	0.73	
Shah et al. (2004)	0.94	0.96	0.8
Brown et al. (2002)	0.85	0.755	0.595
Brown et al. (2001)			0.51
Brown et al. (2001)	0.93		
Clemons et al. (2003)	0.94	0.865	
Coffey et al. (2002)	0.69		0.3925
Fryback et al. (1993)	0.93	0.789	
Mittmann et al. (1999)	0.93	0.78	
Sharma et al. (2000)	0.81	0.62	0.55
Chadha, R.K. et al. (2011)	1	.65	

Utility values we used from Brown et al 2003

Acuity in Better-seeing Eye	Utility
20	0.97
20 with <=40 other eye	0.92
25	0.87
30	0.84
40	0.8
50	0.77
70	0.74
100	0.67
200	0.66
300	0.63
400	0.54
LP	0.35
NLP	0.26

Quality adjusted life year losses

Age Group	Total QALYS	Monetized Value*
0-17	64,802	$3,240
18-39	110,304	$5,515
46-64	60,682	$3,034
65+	364,732	$18,237
Total	600,520	$30,026



Note: QALY = quality adjusted life years

*Valued at $50,000 per QALY, not included in total burden

Overall Results

Age Group	Comprehensive Costs, $millions				
	0-17	18-39	40-64	65+	All Ages
Direct Costs					
Diagnosed Disorders	$2,844	$5,067	$14,218	$26,640	$48,769
Medical Vision Aids	$1,480	$3,335	$6,222	$2,199	$13,236
Undiagnosed Vision Loss	$48	$474	$1,702	$798	$3,022
Aids/Devices	$38	$77	$81	$553	$749
Education/School Screening	$651	$119	-	-	$769
Assistance Programs	$25	$13	$23	$145	$207
Total Direct Costs	**$5,086**	**$9,086**	**$22,246**	**$30,335**	**$66,752**
Indirect Costs					
Productivity Loss	-	$12,978	$10,828	$24,622	$48,427
Informal Care	$601	-	$187	$1,264	$2,052
Nursing Home	-	-	-	$20,248	$20,248
Entitlement Programs*	$0.5	$165	$279	$1,782	$2,226
Tax Deduction*	-	$6	$11	$10	$28
Transfer Deadweight Loss	$47	$98	$538	$808	$1,490
Total Indirect Costs	**$648**	**$13,075**	**$11,553**	**$46,941**	**$72,217**
Total Economic Burden	**$5,734**	**$22,161**	**$33,799**	**$77,276**	**$138,970**

Age Group	Comprehensive Costs, $millions			
Perspective	Government	Insurance	Patient	Comprehensive
Direct Costs				
Diagnosed Disorders	26,860	17,249	4,660	48,769
Medical Vision Aids	900	2,667	9,669	13,236
Undiagnosed Vision Loss	1,722	928	372	3,022
Aids/Devices	-	-	749	749
Education/School Screening	769	-	-	769
Assistance Programs	207	-	-	207
Total Direct Costs	**30,458**	**20,844**	**15,450**	**66,752**
Indirect Costs				
Productivity Loss	-	-	48,427	48,427
Informal Care	-	-	2,052	2,052
Long-term Care	13,233	1,295	5,719	20,248
Entitlement Programs*	2,226	-	-	-
Tax Deduction*	28	-	-	-
Transfer Deadweight Loss	1,490	-	-	1,490
Total Indirect Costs	**16,977**	**1,295**	**56,199**	**72,217**
Total Costs	**47,435**	**22,140**	**71,649**	**138,970**

Probabilistic sensitivity analysis results

Costs in $ millions	Median Cost	95% Credible Interval
Direct costs		
Diagnosed Disorders	$48,769	$42,468 - $55,919
Medical Vision Aids	$13,236	$11,615 - $14,892
Undiagnosed Vision Loss	$3,022	$820 - $9,090
Aids/Devices	$749	$412 - $1,110
Education	$769	$425 - $1,107
Assistance Programs	$207	$207 - $0,207
Indirect costs		
Productivity Loss	$48,427	$24,379 - $81,730
Informal Care	$2,052	$821 - $3,790
Nursing Home	$19,541	$11,946 - $25,557
Entitlement Programs*	$559	$559 - $559
Tax Deduction*	$28	$17 - $50
Transfer Deadweight Loss	$1,490	$738 - $2,224
Total costs	**$138,263**	**$111,669 - $173,692**

Limitations – Uncertainty in parameters

- Vision loss prevalence
- Impact of vision loss on wages and employment
- Self-reported eye disorders
- Nursing home placement due to vision loss
- Disability and utility weights for vision loss

Limitations – Major assumptions

- Mixing disparate sources and methodology for vision loss prevalence by age group
  - NHANES autorefractor (ages 12-39)
  - NEI ophthalmologic exams (ages 40+)
  - Imputed prevalence from incidence (ages 0-11)
- Self-reported impairment classifications for wages

Conclusions

- Guidelines are important for making economic estimates more comparable
- Burden estimates are limited by data availability and uncertainty
  - We can attempt to quantify the impact of uncertainty
- All economic analyses require assumptions
  - The impact of assumptions is hard to quantify

Thank You!

Funding provided by Prevent Blindness America and the US Centers for Disease Control and Prevention

The findings and conclusions in this paper are those of the author and do not necessarily represent the official position of NORC at the University of Chicago, Prevent Blindness America, or the Centers for Disease Control and Prevention.

For more information:
John Wittenborn
1-312-519-5718
Wittenborn-John@norc.org
JohnSWittenborn@gmail.com

Prevent Blindness America®

Our Vision Is Vision®