FISCAL IMPACT OF AB 175: ANALYSIS OF THE COST EFFECTIVENESS OF STORE AND FORWARD TELEOPHTHALMOLOGY

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INTRODUCTION AND RESULTS

Store and forward teleophthalmology is a screening method that has the potential to both reduce costs for the state of California and improve access to health care services, thereby preserving sight for many with diabetic retinopathy, a leading cause of blindness. This technology provides a substitute for dilated retinal exam, and relies on remote location review of digital photographs of the retina to detect patients with sight-threatening diabetic retinopathy. Using a special digital camera, minimally trained technicians and health care providers can take digital images of the affected retina and "store and forward" the images to remote locations for review by ophthalmologists or optometrists.

Current law allows reimbursement under Medi-Cal for review of stored and forwarded retinal images by an ophthalmologist, but not by an optometrist. Assembly Bill 175 would expand the definition of store and forward telemedicine to include optometrists, thereby increasing the number of providers available to review these images, and, ultimately, improve access to this method of retinopathy detection.

According to our analysis of the cost-effectiveness of store and forward telemedicine for retinopathy detection, the state can expect to experience substantial fiscal benefits resulting from expansion of this form of telemedicine. Specifically, our analysis indicates that, for each patient examined for retinopathy with store and forward telemedicine, state cost savings will total nearly $2,500 over the patient's lifetime.

BACKGROUND

A substantial body of previous research has established that using store and forward telemedicine to screen for diabetic retinopathy is a cost-effective approach.[1] However, no previous research has directly examined the cost implications for the State of California. The Blue Sky Consulting Group was engaged by the California Health Care Foundation to study and evaluate the cost effectiveness of store and forward telemedicine in the context of using

[1] See, for example, Javitt, et.al., 1996. or James, et.al., 2001.

digital imaging as a means of screening patients with diabetes for retinopathy. The preliminary results of our analysis are presented here.

METHODOLOGY

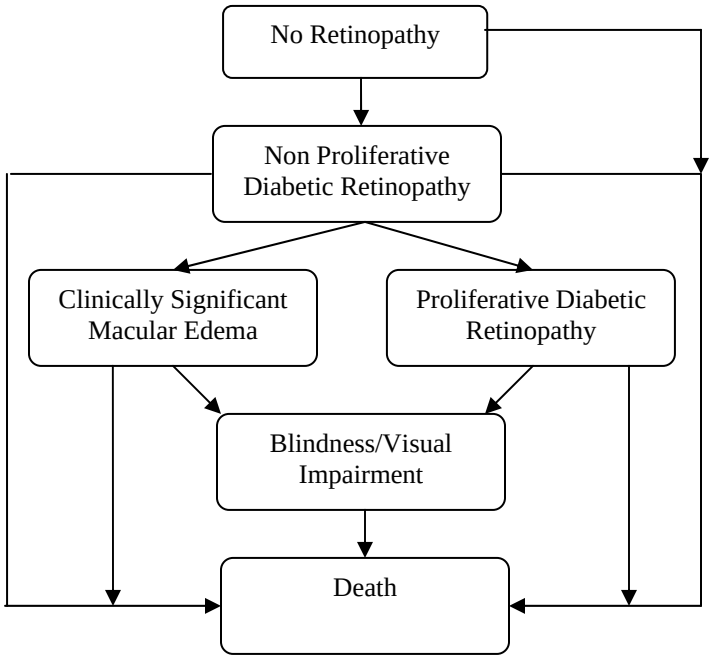
In order to assess the cost-effectiveness of this form of telemedicine, we constructed a Markov-type simulation model, which calculates the costs for a hypothetical cohort of patients in both a screening and a non-screening case, and compares the results. We estimated the characteristics of the sample cohort using data from the 2007 California Health Interview Survey (CHIS). According to the CHIS data, there are approximately 112,000 patients in the target population, defined as adult, sighted, Medi-Cal enrolled or eligible diabetics who have seen a doctor within the past 12 months, but have not had a dilated eye exam during the same period.

The choice of a "no screening" cohort as the base case reflects the assumption that the primary impact of AB 175 will be to increase access to annual screening for asymptomatic patients who otherwise would not receive any type of screening or exam. Cost savings can also be expected to the extent that store and forward screenings serve as substitutes for annual, in office exams, although the extent of the cost savings would be lower. Because the screening is the triggering event, all of the costs and benefits that follow are calculated and scored to the program. That is, the initial cost of the screening together with the resulting treatment (identified as a result of the screening) and, ultimately, blindness costs avoided are calculated as costs or benefits of the program.

In the model developed, patients are initially assigned to one of four possible health states: Asymptomatic/no retinopathy (NR), non-proliferative diabetic retinopathy (NPDR), proliferative diabetic retinopathy (PDR), or clinically significant macular edema (CSME). Patients were assigned to each health state using prevalence data collected through a pilot project funded by the California Health Care Foundation.[2] Patients then progress from one health state to the next in each cycle, according to the specific probabilities assigned. Figure 1 (next page) provides a schematic of the health states modeled. Sixty model cycles were completed, at which point all patients had progressed through various health states to death. Probabilities of moving from each health state were determined from published research. At each cycle, costs were determined and assigned to each health state, and the net present value of all costs for the screening and base cases were compared. Costs to Medi-Cal for screening, eye exams, and treatment were estimated using relevant Medi-Cal reimbursement rates. State costs for blindness include SSP, IHSS, CAPI, and rehabilitation services from the Department of Rehabilitation. Appendix A identifies the methodology used and resulting estimated cost for each health state.

[2] The CHCF funded the Diabetic Retinopathy Screening Project, which implemented remote diabetic retinopathy screening for underserved patients in California. The data from this pilot was collected in the EyePACS system, and formed the basis for the prevalence data used in this analysis. This prevalence data consisted of 15,372 cases. Patients in this pilot were similar to the kind of Medi-Cal patients that would be eligible to receive store and forward screenings under AB 175.

FIGURE 1: SCHEMATIC OF PROGRESSION OF DIABETIC RETINOPATHY AND MACULAR EDEMA[3]



RESULTS

The results of this analysis indicate that the state can expect significant cost savings due to implementation of AB 175 and the ensuing expansion of this form of telemedicine. Although each imaging session/screening results in state costs for both the screening and the needed treatment identified, the resulting increase in detection of diabetic retinopathy and, ultimately, reduction in blindness results in significant avoided state costs, particularly for SSP and IHSS.

The costs evaluated here are solely state costs for Medi-Cal, SSP, IHSS, CAPI, and blindness rehabilitation provided through the Department of Rehabilitation. Although blindness may result in significant increases in costs for the federal government (for SSI and rehabilitation, for example) and for local governments (for paratransit services), these costs are not considered here. Similarly, no savings has been assigned to the preservation of sight, although this clearly has value to the patients and, ultimately, to the state generally, to the extent that patients are able to participate in the workforce. And, no loss in tax revenues resulting from reduced work hours stemming from blindness-related disability was calculated, although some reduction is likely (including such revenues losses would serve to increase the size of the estimated fiscal benefits). In addition, no savings has been assigned in this analysis to the improvement of diabetes management that is likely to result from an increase in screenings. Experts in diabetes care anecdotally indicate that patients screened for diabetic retinopathy and warned of the risk of blindness frequently respond with improved monitoring of blood sugar levels and otherwise improved management of their illness. This

[3] Based on Sandeep, et. al. p. 891.

improvement results, in turn, in lower health care costs. However, as noted, these savings were not explicitly modeled or included in the results presented here.

According to our analysis, for each patient screened with store and forward teleophthalmology, the state can expect benefits of about $2,500 over the patient's lifetime.[4] The costs to the state stem primarily from screening and treatment costs; the benefits (cost savings) come primarily from avoided disability payments for SSP, CAPI and IHSS – which accrue for an extended period of time – as well as one-time costs for rehabilitation services provided by the department of rehabilitation.

SENSITIVITY ANALYSIS

In order to test the sensitivity of the results to variations in each of the key parameter input values, a sensitivity analysis was performed. For each model input value (e.g., prevalence of each disease state in the target population, probability of advancing from one disease state to the next, cost of screening or treatment) a low and a high value was estimated and a random value selected based on these limits. Then, a series of 1,000 Monte Carlo simulations was performed, with random values selected as noted for each parameter value. Results of the sensitivity analysis indicate that costs savings dominate, with the range of savings per patient (95% confidence interval) extending from about $500 to more than $6,000. More detailed results of the sensitivity analysis, including the distribution of outcomes can be found in Appendix B.

CONCLUSION

The results of our analysis indicate that the state can expect significant cost savings resulting from the implementation of AB 175. The type of telemedicine that would result from passage of AB 175 has been shown in previous academic work to result in substantial benefits, whether used a substitute for eye exams or as a method of increasing access to screening for patients with diabetic retinopathy (or likely to develop such). Our analysis confirms these previous studies, specifically in the context of costs to the state of California. Specifically, our analysis indicates that the state can expect to save approximately $2,500 for each patient screened (measured over the patient's life time).

[4] The net present value of the net benefits to the state, discounted at 3%.

APPENDIX A: MARKOV MODEL PARAMETERS

Variable name	Value	Low	High	Variable description	
cScreen	$53.54	$43	$64	*Cost of screening (5)*	
cExam	$57.20	$46	$69	*Cost of eye exam (5)*	
cPDR	$900.84	$721	$1,081	*Cost of Proliferative DR treatment (5)*	
cCSME	$900.84	$721	$1,081	*Cost of CSME treatment (5)*	
cBlind	$2,916	$2,333	$3,499	*Cost to state of one year of blindness (6)*	
cRehab	$1,320	$1,056	$1,584	*One-time cost to state of blindness (6)*	
cVisImpair	$2,916	$2,333	$3,499	*Cost to state of one year of visual impairment (6)*	
cImpairRehab	$1,320	$1,056	$1,584	*One-time cost to state of visual impairment (6)*	
pNPDR	6.8%	5.4%	8.1%	*Probability of NPDR Diagnosis w/ previous asymptomatic screen (2)*	
pPDR	12.9%	10.3%	15.5%	*Probability of PDR Diagnosis w/ previous NPDR diagnosis (2)*	
pCSME	10.5%	8.4%	12.6%	*Probability of CSME Diagnosis w/ previous NPDR diagnosis (2)*	
pBlind	8.8%	7.0%	10.6%	*Probability of blindness w/ previous PDR diagnosis, if untreated(2)*	
pVisImpair	5.0%	4.0%	6.0%	*Probability of visual impairment w/ prev CSME diagnosis, if untreated (2)*	
effect	81.0%	64.8%	97.2%	*Effectiveness of PDR treatment in preventing blindness (2)*	
effect_CSME	70.0%	56.0%	84.0%	*Effectiveness of CSME treatment in preventing visual impairment (2)*	
ini_age	51	46	56	*The initial/start age for the model (4)*	
aNPDR	23.5%	18.8%	28.2%	*Initial screening allocation to Non Proliferative DR (4)*	
aPDR	2.6%	2.1%	3.1%	*Initial screening allocation to PDR (4)*	
aCSME	4.5%	3.6%	5.4%	*Initial screening allocation to CSME (4)*	
aAsympt	69.5%	N/A*	N/A*	*Initial screening allocation to asymptomatic (4)***	
cycle	1	N/A	N/A	*Length in years of one cycle*	Not included in the probabilistic analysis
Base_Pct_Screen	100%	N/A	N/A	*Pct of screening case patients examined*	
Base_Pct_Exam	0%	N/A	N/A	*Pct of base case patients examined*	
cDiscount	3.0%	N/A	N/A	*Discount rate for costs*	
nD25	0.0124	N/A	N/A	*Natural death risk for over 35's (7)*	
nD45	0.0397	N/A	N/A	*Natural death risk for over 45's (7)*	
nD65	0.0897	N/A	N/A	*Natural death risk for over 65's (7)*	
nD75	0.1559	N/A	N/A	*Natural death risk for over 75's (6)*	
cohort size	1,000	N/A	N/A	*size of initial cohort starting the model*	

NOTES

1 Vijan, Sandeep, "Cost-Utility Analysis of Screening Intervals for Diabetic Retinopathy in Patients with Type 2 Diabetes Mellitus (citing DRS)

2 Aoki, Noriaki, "Cost-Effectiveness Analysis of Telemedecine to Evaluate Diabetic Retinopathy in a Prison Polulation

3 Bresnick, George, Personal Communication

4 Eyepacs/CHCF/Bob Quade

5 Medi-Cal treatment codes provided via personal communications with Jorge Cuadros and Theresa Bertero from the UCB School of Optometry/Clinic. Reimbursement rates were provided by Andrew Thompson at BKD Consulting.

6 BSCG analysis.

7 Gu, Ken, et. al., "Mortality in Adults with and Without Diabetes in a National Cohort of the US Population, 1971-1993." Diabetes Care, v.21, no 7, July 1998.

* Asymptomatic equals 1 - proportion w/ another diagnosis, and is therefore implicitly included in probabilistic analysis.

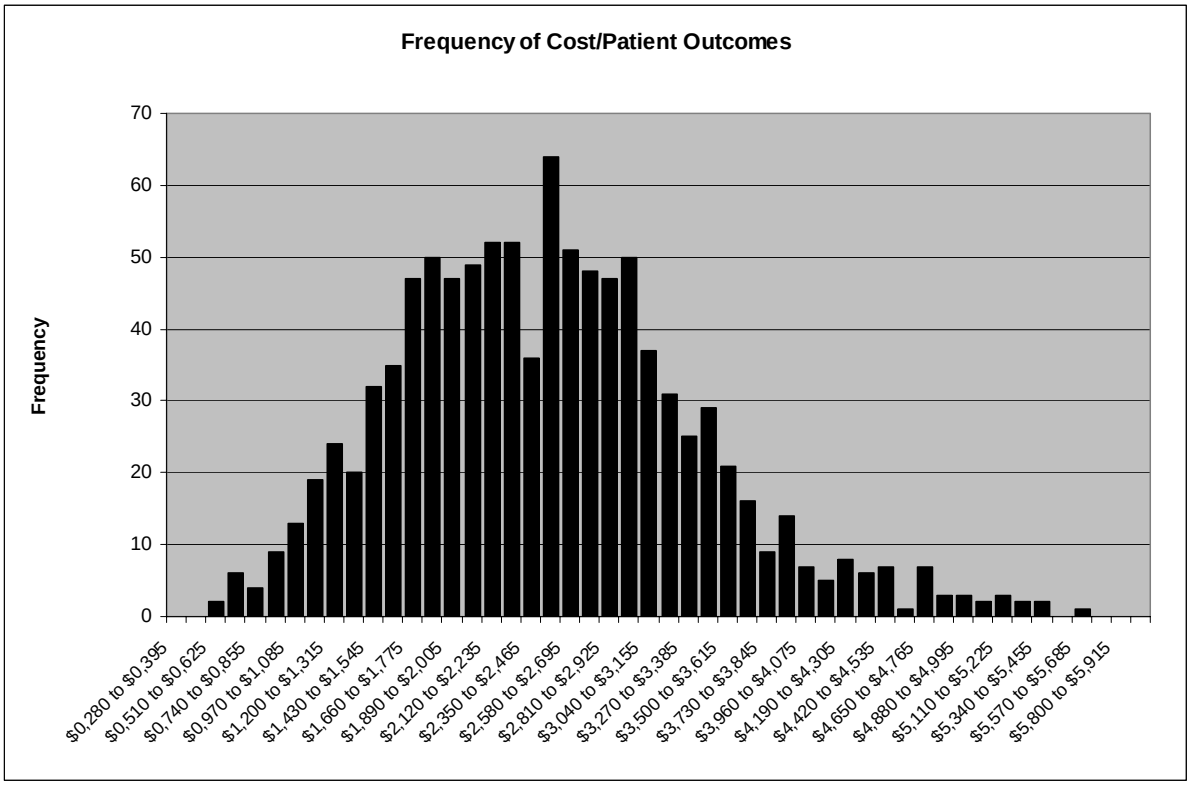
** *Those with "other" diagnosis or "cannot grade" were allocated proportionately to remaining categories.*

APPENDIX B: SENSITIVITY ANALYSIS RESULTS

In order to determine the sensitivity of the results to uncertainty and random variation in the input parameters, we conducted a sensitivity analysis in which each of the input parameters identified in Appendix A above was allowed to vary across a specified range. Specifically, each parameter was assumed to be normally distributed, with a mean equal to the initial value. High and low values were assigned, defining the limits of the 95% confidence interval. Then, a random value for each parameter was selected from within the normal distribution, and the resulting net cost/patient amount recorded. One thousand such simulations were performed. The results are presented in the table and chart below.

Probabilistic Analysis

min	$513
median	$2,467
max	$6,245
mean	$2,506
stdev	$893
95% CI lower	$991
95% CI upper	$4,600



APPENDIX C: COST DATA

Model costs as reported in Appendix A were calculated as follows:

Medi-Cal Costs for Screening and Treatment

Medi-Cal costs for screening, eye exams and treatment for PDR and CSME were estimated based on published (non-FQHC) Medi-Cal reimbursement rates, as follows:[5]

Screening/Store and Forward Imaging

CPT Code	Description	
99241	OFFICE CONSULTATION, LEVEL 1	$30.60
Q3014	TELEHEALTH FACILITY FEE	$22.94
Total		$53.54

Treatment of PDR/CSME

CPT Code	Description	
99203	OFFICE VISIT, NEW, LEVEL 3	$57.20
67210	TREATMENT OF RETINAL LESION (eye 1)	$421.82
67210	TREATMENT OF RETINAL LESION (eye 2)	$421.82
Total		$900.84

State Costs for Blindness

In order to estimate the state savings associated with blindness prevention (costs avoided), we first estimated the extent of state service utilization for the target population, and then estimated the likely change in service utilization (and corresponding costs) resulting from blindness. As previously noted, the target population consisted of Non-Blind/Non-Deaf (NB/ND) Medi-Cal enrolled or eligible patients with diabetes who have seen a doctor within the past 12 months, but have not had a dilated eye exam during the same period, as determined from CHIS.

Step 1: Defining Medi-Cal Populations and the Services They Currently Utilized

Medi-Cal eligibility is extended to those who are on CalWORKs, receive SSI/SSP, or for some other poverty or disability-related reason. Using 2007 CHIS data, we placed our target population into eligibility brackets by identifying those NB/ND Medi-Cal eligible/enrolled patients with diabetes that were Medi-Cal eligible due to CalWORKs, SSI/SSP, or some other reason. We further identified the citizenship status of each affected population sub-group within these eligibility brackets, since this affects state payments and eligibility for various services. Figure A shows the breakdown of eligibility by bucket. As indicated, 13 percent of the target population is on CalWORKs while 40 percent is already on SSI/SSP. Nearly 47 percent qualify for Medi-Cal for some other poverty or disability-related reason.

[5] Medi-Cal treatment codes provided via personal communications with Jorge Cuadros and Theresa Bertero from the UCB School of Optometry/Clinic. Reimbursement rates were provided by Andrew Thompson at BKD Consulting.

Figure A: Eligibility and Citizenship of the Affected Population

Eligibility Bracket	% of Population	% of Eligibility Bracket		
		Citizen	*Legal Immigrant*	*Total*
CalWORKs	13%	57%	43%	100%
SSI/SSP	40%	89%	11%	100%
Other	47%	73%	27%	100%
Total	100%	77%	23%	100%

Step 2: Determining Service Utilization after the Onset of Blindness

Following the onset of blindness, the target population/cohort would qualify for SSI/SSP, CAPI, and/or IHSS. The SSI/SSP and CAPI programs provide cash grants to low-income residents who are elderly, blind, or disabled. The IHSS program pays for services and assistance that helps the aged, blind, and disabled to live safely in their own homes. Only citizens qualify for SSI/SSP; immigrants with satisfactory immigration status, such as legal immigrants known as "Permanent Residence under Color of Law," or PRUCOL, qualify for CAPI. Both groups qualify for IHSS.

For the sub-population eligible for Medi-Cal due to SSI/SSP enrollment, the onset of blindness only incurs additional costs in IHSS. For all other populations, the onset of blindness results in SSI/SSP or CAPI costs, depending on citizenship, and IHSS costs. Since SSI/SSP and CAPI would have been utilized anyway, after the age of 65, we cease counting the state costs for SSI/SSP and CAPI after the age of 65.

Figure B: Program Eligibility after Blindness

Citizenship Status	Citizens			Legal Immigrant		
Eligibility Bracket	*CalWORKs*	*SSI/SSP*	*Other*	*CalWORKs*	*SSI/SSP*	*Other*
Program Eligibility	SSI/SSP, IHSS	IHSS	SSI/SSP, IHSS	CAPI, IHSS	IHSS	CAPI, IHSS

Step 3: Applying Take-Up Rates in Eligible Programs

Even though the onset of blindness makes our target population eligible for these additional services, not all of the target population will enroll. Thus, we estimated take up rates for each program. These were based on interviews with experts and our own estimates and are shown in Figure C (next page).

Figure C: Take-Up Rates for Programs

Program	Take-up Rate
SSI/SSP	80%
CAPI	50%
IHSS	33%

Step 4: Figuring the Average Cost of Increased Service Utilization

Now that we have an estimate of the fraction of our target population that would use additional state services after the onset of blindness, we need to know the average cost of these services.

For SSI/SSP, the state only incurs the cost of the state grant supplement, or SSP. According to the California Department of Social Services' Local Assistance Estimates for the 2009-10 Governor's budget, a blind SSP grant is, on average, $283 per month and a CAPI grant $628. These costs do not include administrative costs and so may understate somewhat the true state cost.

For IHSS, we estimated two different average costs, one for the SSI/SSP population that already qualifies for IHSS services and another for the other populations that would be newly qualified. For current SSI/SSP recipients, the increased cost for IHSS services was calculated as the difference between the average per month cost for a severely impaired recipient and a non-severely impaired recipient (i.e. we assumed that the addition of blindness would result in an increase in the disability classification). For the others, the cost was estimated as the average per month cost for a non-severely impaired recipient. These averages are derived from the most recent three month period for IHSS Management Statistic Summaries. Some of the "other" eligibility group may already be using IHSS services, but we are unable to estimate how many. Therefore, we used the (lower) cost of not severely impaired IHSS services for the entire "other" eligibility group. Only the state portion of IHSS costs was calculated. We then turned these monthly averages into a yearly cost as in Figure D.

Figure D: Average Program Costs

Program	Avg. State Cost/Month	Avg. State Cost/Year
SSP	$283	$3,396
CAPI	$628	$7,533
IHSS 1[6]	$245	$2,939
IHSS 2	$315	$3,781

Step 5: Calculating the Weighted Average Cost of Blindness

Finally, by multiplying the percent of the population that would qualify for services times the take-up rate times the average cost, we obtained the weighted average cost of blindness to the state for each member of the target population.

This methodology can be observed more clearly in the following diagram, which tracks the cost for a cohort of 1000 people in our target population.

[6] IHSS 1 refers to the marginal cost of going from not using IHSS to using the Non-Severely Impaired level of IHSS. IHSS 2 refers to the marginal cost of moving from the Non-Severely Impaired level of IHSS to the Severely Impaired level.

Figure E: Total Cost Calculations for 1000 Person Cohort < Age 65

Total Cost Calculations for 1000 Person Cohort < Age 65

Total Cohort			**$1,000.00**			
Elibility Bracket	CalWorks		SSI		Other	
Cohort Path	**131**		**399**		**471**	
Citizenship	Citizen	Non-Citizen	Citizen	Non-Citizen	Citizen	Non-Citizen
Cohort Path	**75**	**56**	**354**	**45**	**343**	**127**
SSP/CAPI	SSP	CAPI	SSP	CAPI	SSP	CAPI
Take-up[d]	80%	50%	0%	0%	80%	50%
Cohort Path	**60**	**28**	**0**	**0**	**275**	**64**
Avg Cost	$3,396	$7,533	$0	$7,533	$3,396	$7,533
Total Cost	$203,361	$209,912	$0	$0	$932,634	$479,494
IHSS	IHSS 1	IHSS 1	IHSS 2	IHSS 2	IHSS 1	IHSS 1
Take-up[d]	33%	33%	33%	33%	33%	33%
Cohort Path	**25**	**19**	**118**	**15**	**114**	**42**
Avg Cost	$2,939	$2,939	$3,781	$3,781	$2,939	$2,939
Total Cost	$73,259	$54,552	$445,486	$56,740	$335,974	$124,612
Total Cost	$276,620	$264,464	$445,486	$56,740	$1,268,607	$604,106
Cost / Person	$276.62	$264.46	$445.49	$56.74	$1,268.61	$604.11

Figure E follows a 1000 person cohort to show how many end up using additional state services. First, using the percentages in Figure A, the cohort is sorted into our eligibility brackets (i.e., the program they are already on while in Medi-Cal). We also use the data from Figure A to determine citizenship status. These two pieces of information then indicate which additional programs the persons will qualify for if they become blind, as in Figure B. Because not all of these residents will take up CAPI, SSI/SSP, or IHSS even though they qualify, we apply estimated take-up rates for each program. This gives us the number of newly blind Medi-Cal eligible patients with diabetes that receive additional services from the state. We then multiply the total by the average cost to the state (shown in Figure D). This total cost is then divided by the number of people in our cohort in order to get an average cost per person in the group. By taking the average cost per person for each subpopulation (shown in the last row of Figure E) and adding them together, we arrive at the weighted average cost of blindness to the state. These costs were $2,916 per year for those under 65 and $1,091 per year for those over 65.

Step 6: Estimate one-time costs of Blindness

One-time costs to the state for rehabilitation associated with blindness were estimated for vocational rehabilitation only. Because the state general fund does not directly pay for orientation and mobility, activities of daily living, and assistive technology devices, these costs were not included in the analysis. Costs for vocational rehabilitation were estimated at $30,000 per case, with a 22% state general fund match, and a 20% participation rate. Total average costs to the state for vocational rehabilitation: $1,320 ($30,000 * .22 * .20 = $1,320).[7]

[7] Conversation with department of rehabilitation staff.

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