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**ReadyMade Analysis of Hospital de la Familia's  
Cataract Surgery Program in Guatemala**

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## ReadyMade Analysis of Hospital de la Familia's Cataract Surgery Program in Guatemala<sup>1</sup>

**Goal: Improve the health and daily life for people in Guatemala who do not normally have access to health care.**

Hospital de la Familia (HDLF) provides medical care to rural residents of Guatemala, who otherwise might receive little or no medical care. Medical teams from the U.S. go to Nuevo Progreso, Guatemala to provide medical and surgical care three or four times each year for eight to ten days each trip. Medical groups include specialties in Optometry, Plastic Surgery, Ob-Gyn, General Surgery, Pediatrics, Ear-Nose-Throat, and Nutrition. When medical teams are not at the hospital, it is maintained by Nuns and Guatemalan residents, who have limited training. HDLF also runs some educational programs, including a school for girls and boys for grades 1 through 6, a sewing school, and a nursing school.

Patients who come to Hospital de la Familia have a range of serious health problems, especially poor vision from cataracts and facial disfiguration from cleft lips and palates. HDLF tracks the number of patient consultations and the number of surgeries performed each year. The medical staff provided 3,982 patient consultations in 2008, which reflects a steady rise from 2,890 in 2004 (up 38%). The staff performed 1,321 surgeries in 2008, an increase of 26% from 2004. These numbers, impressive by themselves, don't begin to demonstrate the impact that improved eyesight or normal appearance and use of mouth has on the people treated. Yet they provide us with a jumping off point for assessing the benefits and costs of this program. There are many stories but few statistics. These memorable stories and experiences keep medical teams returning—the teenage girl with a cleft lip who arrives hiding her face, and after surgery leaves with a beautiful smile that has dramatically changed her life because she has a chance to lead a normal life that includes marriage and children. Or the grandmother who can no longer help care for grandchildren, or even herself, because her vision is so poor from cataracts. She leaves the hospital with the ability to return to her normal activities of caring for the home and grandchildren because her vision has returned.

Here we focus on the optometry/ophthalmology program in order to provide a pilot assessment that provides data on cataract patients before and after the procedure. The goal of the pilot is to provide information on the impact of HDLF's cataract program, and also to provide an example of how HDLF can collect basic data to assess the impact of its programs on improving people's lives in rural Guatemala. For optometry/ophthalmology, teams performed 894 surgeries (mostly cataract) in 2008, up 71% from the 524 surgeries performed in 2004. Dr. Larry Thal (Assistant Dean and Clinical Professor of the Optometry School at UC Berkeley and a member of the HDLF Hospital Board of Directors), who has participated for 25 years on medical missions to Guatemala, worked with Dr. Clair Brown, Professor of Economics and Director of the Center for Work, Technology, and Society, UC Berkeley, to

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<sup>1</sup> This ReadyMade study was undertaken with the HDLF staff who run the HDLF Eye Clinic in Guatemala. They collected the data and provided the cost data. We thank the HDLF patients for completing the surveys. This research was supported by a grant from the Institute for Research on Labor and Employment.

design a survey and collect and analyze the data on cataract patients. Dr. Thal and the HDLF team<sup>2</sup> collected the data in August 2010.

We want to know if the cataract surgeries allowed patients to return home with visual acuities satisfactory to contribute to the family's functioning. Specifically, we ask: What is the benefit of cataract surgery to the patients and their families of improved eyesight in terms of the patient's capability to function independently and to contribute to family care and household resources as well as engage in community activities such as Church?

Although we can measure the improvement in visual acuity after the first day, and estimate the continued improvement in the patient's visual acuity over time, we don't know the full range of benefits the improved eyesight provides the person, their families, and their community. With a short survey on key activities of most patients during the August clinics, along with a few in-depth interviews, we explored how the cataract surgery and improved vision resulted in more hours of regular daily activities for patients.

One challenge that HDLF continually faces is letting Guatemalans know the benefit of early diagnosis and treatment for many of the conditions treated at HDLF, including cataracts. Many patients are already suffering unnecessary blindness by the time they arrive at HDLF for cataract surgery. As part of this process we developed a flyer that patients take home with them informing others in their communities about the services provided. These flyers are being distributed not only by HDLF patients but by the Sisters and Nuns as they visit churches throughout Guatemala. We will use our data collection to provide evidence to support our requests (insistence) that the local Padre and Sisters go on radio, in addition to visiting nearby communities, advertising the services provided at Hospital de la Familia.

Here our focus is on benefits, because the value to the patients of regaining sight is hard to quantify. Using simple assumptions about how patients' mobility and daily activities impact their lives, we estimate the benefits from cataract surgery. These estimates are based upon data collected from patients and files combined with structured interviews during five days of cataract surgeries in August 2010. Together these data document how people's lives have been transformed.

HDLF believes that a combination of data collection on key basic variables along with structured interviews can provide an important basis for estimating the impact of their program and for making improvements in internal decision making and management of the program.

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<sup>2</sup> We are grateful to Juan Artiaga, a volunteer who lives in Nuevo Progreso, Guatemala, and Gene de Juan of California, for their invaluable help in collecting the data.

## ReadyMade Impact Assessment for Cataract Surgery: Functionality Approach

An individual's capability to engage in daily life requires mobility, and so *the ability to walk unassisted* ("Walk") was chosen as the *key outcome of cataract surgery*, based upon the key output of improved visual acuity.<sup>3</sup> We investigate to what extent the mobility variable indicates the improved daily functionality of patients who have had cataract surgery, and then we explore how the improved mobility has provided the patients with more hours of regular daily activities.

The following survey was used for data collection from patients who visited the Eye Clinic in August 2010 and who had undergone cataract surgery on a prior visit. We identified four key activities that adults perform in providing normal daily life for themselves and families: assist with household tasks ("Tasks"); care for self ("Self"); assist with care of others ("Assist"); and work for pay ("Job"). Patients' capability to undertake these activities was recorded both before ("—Pre") and after ("—Post") cataract surgery as follows:

1. Yes
2. Sometimes
3. No

Data were collected from 59 patients visiting the Eye Clinic on days 5-7 (one case was dropped because of incomplete data) and using the survey form (below in English). Patients were asked about their functionality before their previous cataract surgery (i.e., recall data) and after surgery (i.e., at the present time). In addition, extensive interviews were conducted by Juan Artiaga of 13 of these patients in order to guide our understanding of their daily activities. As a consistency check, Dr. Thal also collected data from 39 files of the patients visiting the Eye Clinic on days 3-4. Based upon the observations of Dr. Thal and other eye clinic staff members, Dr. Thal used the following guidelines to map visual acuity to capability to walk unassisted by the following rules:

- acuity of 20/400 or better: nearly always walked by themselves
- acuity of 20/800 or worse: almost never walked unassisted
- acuity of between 20/400 and 20/800: "sometimes" walked unassisted

Altogether we have mobility data for 97 patients with daily activity capability data for 58 of them, supplemented by interview data for 13 of the 58 patients.

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<sup>3</sup> We note that WalkPre and WalkPost are not highly correlated (0.077), and WalkPre is correlated with TaskPre (0.605), JobPre (0.174), CarePre (0.413), and AssistPre (0.439); WalkPost is correlated with TaskPost (0.542), JobPost (0.198), CarePost (0.247), and AssistPost (0.321); and WalkImprovement is correlated with TaskImprovement (0.480), JobImprovement (0.159), CareImprovement (0.429), and AssistImprovement (0.467).

Pt. No. _____	BEFORE SURGERY			AFTER SURGERY		
Female ___ Male ___ Age ___						
	Yes	Sometimes	No	Yes	Sometimes	No
Can walk unassisted (Walk)						
Can assist with household tasks (Tasks)						
Can work for pay outside the home (Job)						
Can work for pay inside the home*						
Can provide majority of self care (Self)						
Can assist with care of other household members (Assist)						

\* Because so few patients reported working for pay at home, we combined the two work-for-pay activities into the one variable called “job”.

### Description of Survey Data on Cataract Patients

Of our 97 patients, 55% are female and 45% male; 34% are over 80 years old and 18% are under 60 years old, with 26% in their 60s and 23% in their 70s. The full sample<sup>4</sup> is almost evenly divided in their abilities to walk unassisted before cataract surgery (30% usually walk unassisted and 32% never walk unassisted), and their mobility improves dramatically after cataract surgery (75% usually walk unassisted; those who do not typically report other health problems that cause mobility problems). WalkPre and WalkPost are not highly correlated (0.077), which suggests that many patients’ mobility changed after their cataract surgery.<sup>5</sup>

To look at improvement in functionality of patients in mobility and daily activities, we created an *improvement variable* with suffix “—Improvement”, where the functionality is as follows (recall that a lower number is “better”):

1. Decreased: —Post > —Pre
2. Stayed the same: —Post = —Pre
3. Increased: —Post < —Pre

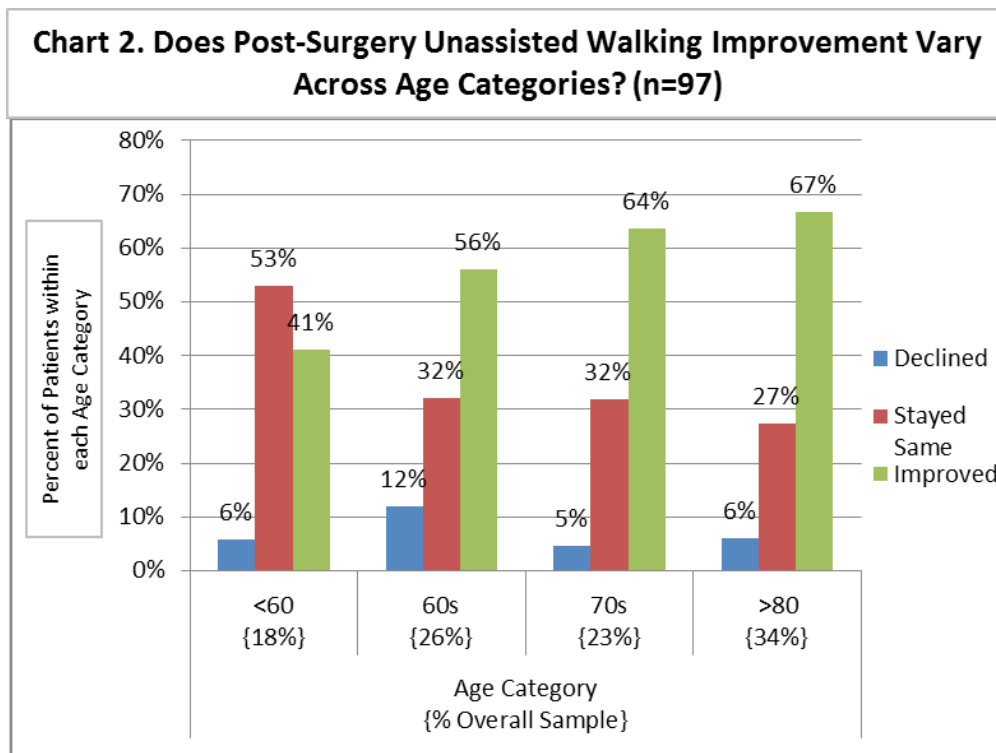
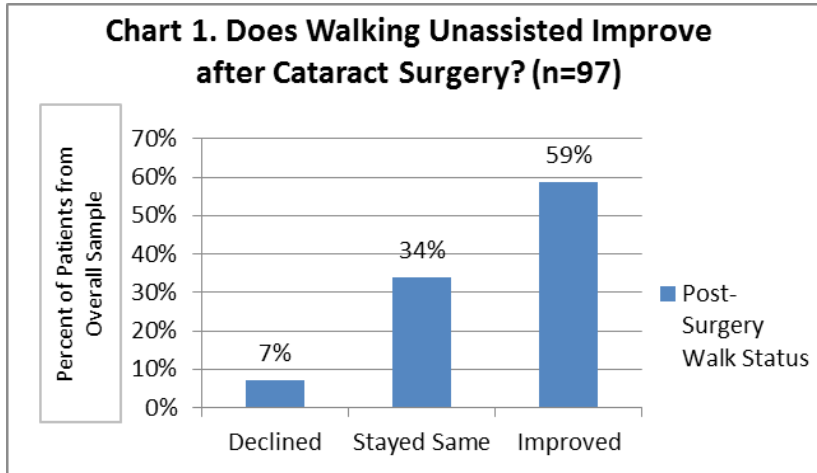
for the activities Walk, Tasks, Job, Self, and Assist. Note that we coded the –Improvement so that a higher number is “better”.

WalkImprovement indicates that mobility of 59% of patients improved after cataract surgery, and 7% of patients had a decrease in mobility (see Chart 1). WalkImprovement is significantly and positively correlated to WalkPre, and a patient who already walks unassisted

<sup>4</sup> The full sample includes the patient sample using self-reported mobility data and the file sample using the assumed link between visual acuity and mobility.

<sup>5</sup> WalkImprovement is not significantly different between the survey patient group and the file patient group, once age and gender are controlled using linear regressions.

pre-surgery cannot have improved mobility post-surgery (by definition). Patients under 60 are more likely to be able to walk unassisted pre-surgery because they usually have an operable cataract in only one eye. Older patients often have bilateral operable cataracts, and therefore are less likely to walk unassisted pre-surgery. We see that the majority of patients over 60 had improved mobility after surgery, while the majority of patients under 60 years old reported their mobility stayed the same (i.e., they already walked unassisted) (see Chart 2). These data indicate that improved mobility is a good indicator of the impact of cataract surgery on older patients' lives, but is not as good an indicator for patients under 60 years old.



Using improvement in mobility provides a conservative indicator of the improvement in the patient's functioning and quality of life as a result of cataract surgery, because even when mobility stayed the same, primarily for patients who could walk unassisted before cataract surgery, their improved vision improves their capabilities and their daily lives independent of their mobility. Also improvement in mobility is a conservative indicator because we did not include the impact of the patient's vision impairment on her family members, who often spend several hours each day providing care and who miss having normal interactions with the patient. We heard examples about how the patient's improved vision allowed other family members to return to their own activities and allowed better family interactions in our interview surveys.

To look at the relationship between improved functionality of patients and their improved mobility, we calculated correlations and ran simple linear regressions in order to control for age and gender. Here we summarize the important relationships. WalkPre, WalkPost, and WalkImprovement are all correlated with the corresponding four daily activities, which implies that mobility is a good indicator of patient's capability in daily activities. This means that the ReadyMade approach of identifying a key variable that serves as a proxy for impact of a program on participant's lives is a valid approach for HDLF.

Now let us see how patients functioned before and after cataract surgery.

Tables 1-3 show that improvements in three daily activity variables (Tasks, Self, and Assist) are significantly and positively related to WalkImprovement, given controls for age and sex.<sup>6</sup> These results indicate that WalkImprovement is a good proxy for the patient's improved capability in assisting with household tasks, providing care for self, and assisting with care of others. The controls for age and sex are not significant in any of the three regressions, which mean that the statistical relationships do not vary for men and women or by age (or at least such variation cannot be detected in our sample).

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<sup>6</sup> Robustness checks were conducted to ensure that walk improvement was still significant if the variable for pre-surgery capability of performing the given activity was also included in the regression. Both walk improvement and pre-surgery capability of given task were both significant and positive RHS variables for the three activities (task, self, and assist). Note that these regressions have only 58 observations because data on the capability variables were collected only from the patients and were not available from the files.



Table 1. Linear Regression of TasksImprovement on WalkImprovement

\*\*\* Significant at the 1% level

Tasks Improvement	Coef.	Std. Err.	T
Walk Improvement	0.482***	0.122	3.96
Age	-0.002	0.006	-.29
Sex	-0.163	0.163	-1.00
Constant	1.362***	0.466	2.92
# Observations	56		
Prob > F	0.002		
Adj R <sup>2</sup>	0.202		

\*\*Significant at the 5% level  
\*Significant at the 10% level

Table 2. Linear Regression of SelfImprovement on WalkImprovement

Self Improvement	Coef.	Std. Err.	T
Walk Improvement	0.307***	0.088	3.49
Age	-0.0003	0.004	-0.08
Sex	0.063	0.117	0.53
Constant	1.435***	0.334	4.30
# Observations	58		
Prob > F	0.010		
Adj R <sup>2</sup>	0.143		

\*\*\* Significant at the 1% level  
\*\*Significant at the 5% level  
\*Significant at the 10% level

Table 3. Linear Regression of AssistImprovement on WalkImprovement

Assist Improvement	Coef.	Std. Err.	T
Walk Improvement	0.422***	0.108	3.92
Age	-0.002	0.005	-0.34
Sex	-0.217	0.144	-1.51
Constant	1.387***	0.408	3.40
# Observations	58		
Prob > F	0.001		
Adj R <sup>2</sup>	0.210		

\*\*\* Significant at the 1% level  
\*\*Significant at the 5% level  
\*Significant at the 10% level

JobImprovement does not seem to be an important outcome for these cataract patients, primarily because few women have jobs<sup>7</sup> and because of age, which is negatively related to having a job both before and after surgery. As expected, JobImprovement is not significantly related to WalkImprovement(see Table 4). If we analyze the small sample of 14 patients who are under 60 years old, we observe that JobImprovement has a significantly positive relationship with WalkImprovement (see Table 5). The promising outcome for this small group indicates that further analysis of the relationship between improvement in mobility and working capability should be undertaken for younger cataract patients.

Overall we think that working for pay, and the improvement in family income that earnings bring, is not a good indicator of the increase in quality of life for HDLF’s older cataract patients. For this reason, we focus on measuring quality of life improvements that are related to improved functionality in caring for self, assisting in household tasks, and care for others.

Table 4. Linear Regression of JobImprovement on WalkImprovement

Job Improvement	Coef.	Std. Err.	T
Walk Improvement	0.136	0.096	1.42
Age	-0.008	0.005	-1.66
Sex	-0.207	0.128	-1.62
Constant	2.295***	0.364	6.31
# Observations	58		
Prob > F	0.086		
Adj R <sup>2</sup>	0.065		

\*\*\* Significant at the 1% level  
 \*\*Significant at the 5% level  
 \*Significant at the 10% level

Table 5. Linear Regression of JobImprovement (Under Age 60)

Job Improvement Under Age 60	Coef.	Std. Err.	T
Walk Improvement	0.365**	0.154	2.37
Sex	0.072	0.174	0.42
Constant	1.303***	0.364	3.57
# Observations	14		
Prob > F	0.101		
Adj R <sup>2</sup>	0.221		

\*\*\* Significant at the 1% level  
 \*\*Significant at the 5% level  
 \*Significant at the 10% level

We ran validity checks on the data collected from patients to check the accuracy of the self-reported data. The patients came into the clinic for an appointment after obtaining

<sup>7</sup> Fourteen men and 4 women reported “usually working” pre-surgery, and 4 men and 1 woman reported “sometimes working” pre-surgery.

cataract surgery during a previous visit, and they were asked about their mobility and daily activities before the surgery and at the present time. Data on visual acuity tests were collected from patient files on three other days and the visual acuity was linked to the mobility variable (as described above). We found that the 39 patients from the file survey were older (8% under 60 years and 51% over 80 years) than the 59 patients from the self-reported survey (24% under 60 years and 24% over 80 years). The patients' reporting of mobility and the patients' implied mobility using visual acuity were statistically the same for the two samples, controlling for age and sex. HDLF medical staff are interested in the relationship between visual acuity and mobility and intend to collect more data on this next year to analyze the relationship.

Overall HDLF is very pleased with the results from this pilot survey and assessment. We think that the survey results provide two important outcomes:

1. Cataract surgery improves the functionality of patients in their caring for themselves and others, and in assisting in household tasks.
2. Mobility and its improvement is a good proxy for patients' functionality pre- and post-surgery (especially for those over 60 years old), and this variable is easy to collect to provide an impact assessment on an on-going basis.

We now use our structured interviews to make assumptions about patients' daily activities in order to map the survey data to quantitative estimates of improvements in functionality as a measure of the benefits of cataract surgery. Our interviews indicated how women and men tend to use their time if they are able to walk unassisted or not able to walk unassisted (see Table 6). Although some differences are observed by age, these differences mainly reflect the patient's health, which is reflected in the mobility variable. For this reason, we separate out activities for women and men by mobility status. We learned that post-surgery female patients who are mobile are actively involved with housework tasks (including care for others) and with interactions with family and Church and can care for themselves; post-surgery male patients who are mobile are actively involved with their jobs (both for pay and at home), and spend some time on taking care of themselves, housework tasks, and interactions with family and Church.

Our structured interviews verified that the daily activities for patients who cannot walk unassisted are greatly circumscribed; these patients have a difficult time doing more than minimal self care. Men cannot work for pay, and women cannot do much for themselves or others at home. They need assistance to get to Church or visit family members, and to be fed and cared for. To be conservative in our estimation of the increased quality time available with improved mobility, we do not include the time of other family members in these calculations. We allow 2 hours for women to participate in family and Church activities, once they have made it to Church, because Church was reported as being very important by the women. Overall we see that the gain in quality hours each day from becoming mobile with improved vision is 13 for women and 15 for men. Men gain more quality hours because they spend fewer hours being with their families or at church than women do, and these more social hours are easier for women with poor vision to do.

Table 6. Daily Activities for Women and Men (by mobility)

	Able To Walk Unassisted		Cannot Walk Unassisted		Quality Hours Gained	
	Women	Men	Women	Men	Women	Men
Housework Tasks (includes care for others)	10 hrs	2 hrs	0 hrs	0 hrs	10 hrs	2 hrs
Job	0 hrs	10 hrs	0 hrs	0 hrs	0 hrs	10 hrs
Care of Self	1 hr	3 hrs	1 hr	1 hrs	0 hrs	2 hrs
Family & Church	5 hrs	1 hr	2 hrs	0 hrs	3 hrs	1 hr
Total Quality Hours	16 hrs	16 hrs	3 hrs	1 hr	13 hrs	15 hrs
Sleep	8 hrs	8 hrs	8 hrs	8 hrs		
Inactive	0 hrs	0 hrs	13 hrs	15 hrs		
Total hours in day	24 hrs	24 hrs	24 hrs	24 hrs		

We assume that each person has 16 hours of possible quality hours per day, and the proportional gain in daily quality hours is 0.81 for women and 0.94 for men (or average of 0.9) for patients who cannot walk unassisted before surgery and can walk unassisted after surgery. Our calculation of the gain in daily quality hours is a simple version of quality adjusted life years (QALY), which is used in cost-effectiveness analyses as a measure of improvement in quality-adjusted life expectancy of a specific health intervention relative to no intervention over the relevant period of improvement in quality of life.<sup>8</sup> Here we use the patient’s assessment of their own functionality by activity with and without the ability to walk unassisted. We assume that the quality of life improvement is constant over the remaining life expectancy, which does not change with the surgery, and we ignore other health-related problems. Our measurement of improved quality of life years (proportional improvement times the number of additional years of life) provides a first approximation of the impact of the cataract surgery on the patients’ lives. Over time this measurement can be improved.

In order to apply the improvement to all patients who receive cataract surgery, we divide the patients into categories that reflect their mobility before and after surgery. We use survey data to create three categories of improvement (0, 1, 2) based on the following assumptions:

- Ability to walk unassisted, if not able to do so before surgery, provides maximum benefits (category 2);
- Ability to walk unassisted remains the same, both before and after cataract surgery, provides benefits from improved vision (without benefits related to mobility) (category 1; this is the diagonal of the matrix below);
- Ability to walk unassisted sometimes after surgery and not able to walk unassisted before surgery, provides benefits from improved vision and mobility (category 1);

<sup>8</sup> For an overview of QALY, see Franco Sassi, “Calculating QALYs, comparing QALY and DALY calculations”, *Health Policy and Planning*, 21: 402-408.

<http://heapol.oxfordjournals.org/content/21/5/402.short?rss=1&ssource=mfc>

- Decreases in ability to walk unassisted after surgery (category 0) are ignored in the few cases where this occurs, because in interviews we learned that patients' inability to walk unassisted was related to another health problem, such as a leg injury.

Table 7. Three Categories of Improvement (given patient's before and after mobility)

PreWalk/PostWalk	Yes	Sometimes	No
Yes	1	0	0
Sometimes	2	1	0
No	2	1	1

Table 7 summarizes these categories. For the patients who become mobile because of their improved vision after cataract surgery, their improved ability to see and walk allows them to begin living again (Category 2). For each year post cataract surgery, we assign them an improved quality life year proportion of 0.9, i.e., the average cataract patient who was not able to walk unassisted pre-surgery and is able to walk unassisted post-surgery gains back 90% of their quality hours in each day (and year).

We do not have data for assigning improved quality life year proportion for patients who have improved vision after cataract surgery but whose mobility remains the same (Category 1), and so we arbitrarily assign them a range of possible improved quality life year proportion of 0.3 to 0.7 (midpoint 0.5), which provides us with upper and lower estimates and allows us to see how sensitive the results are to the assumed improvement in quality life year proportion.

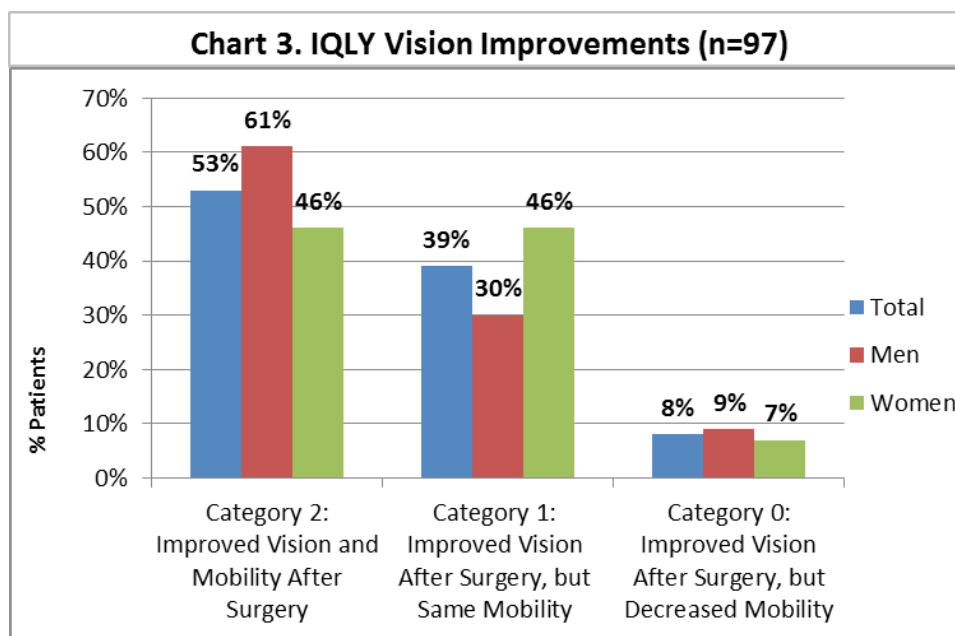
In summary, we assign the following improved quality life year proportions related to improved mobility to patients by category:

Category 2: 0.9

Category 1: 0.3 to 0.7

Category 0: 0.0.

The distribution of the 97 post-cataract patients in our survey by their Category of Improvement is shown in Chart 3.



Using this distribution of patients by mobility category and our estimated improved quality life year proportion for categories 1 and 2, we calculate the average improved quality life year for the cataract patients in 2010:

**Increase in Improved Quality Life Year Proportion for average patient: 0.67<sup>9</sup>**  
(range 0.59 to 0.75, depending upon improved quality proportion for Category 1)<sup>10</sup>

What does this number .67 (with a range of .59 to .75) mean? For the average patient who had cataract surgery at HDLF in 2010, that patient’s improvement in quality hours per day (or per year) was .67—her or his quality hours after cataract surgery were two-thirds higher than before surgery. The average patient has almost 11 more quality hours to enjoy each day. Even if we assume a low score of improved quality life proportion for the patients whose mobility remained the same (or improved only slightly), the average patient’s improvement in quality hours per day was almost 60%, or over 9 more quality hours to enjoy each day.

We can then apply this improved quality life year proportion to the life expectancy of the cataract patients to estimate the average patient’s improvement in quality life years. In 2010 the average age of the HDLF cataract patients in our sample was 72 (median 71), and we compare this to the Guatemala life expectancy,<sup>11</sup> which is 86 years old for our sample.

<sup>9</sup> Although we can calculate the improved quality life year proportion by gender, here we calculate an average based upon the female/male distribution of our sample, because we think it represents the distribution of patients in the future.

<sup>10</sup> We see that the average improved quality life year proportion is not overly sensitive to our assumption about the gain in daily quality hours for patients in Category 1: when the gain goes from 0.3 to 0.7 (more than doubles), the average patient improvement only increases by a quarter.

<sup>11</sup> This is the conditional life expectancy calculated from Guatemala life expectancy at age 70 (85.7 for male, 86.7 for female) and at age 75 (87.4 male, 88.3 female). WHO data <http://www.worldlifeexpectancy.com/country-health-profile/guatemala>

**The average cataract patient can expect to live for an additional 14 years with an improvement in quality life years of .67, or 9.4 additional years of quality life (QALY).**

Even for this relatively elderly population, the improvement in quality life years is impressive, and important to them and their families. An indication of the importance of the cataract surgery to these patients is demonstrated by the onerous journey many of these elderly patients, with family members, undertook to arrive at the HDLF clinic to receive treatment. For the thirteen patients who were interviewed in depth, all but two came by bus. One patient who came by car traveled for 21 hours, and the other lived a half hour away. Most of the patients traveling by bus had to take three to four different buses to arrive at the HDLF clinic in Nuevo Progreso. The average travel time to the clinic was 4.3 hours each way. The trip was costly and difficult to make, and most of the cataract patients needed a family member to help them travel to the clinic.

### **Cost Analysis**

Next we look at HDLF's costs<sup>12</sup> to run the Eye Clinics in order to compare the average QALY benefit to the cost of providing cataract surgeries. Here we examine out-of-pocket costs that can be attributed to the Eye Clinics, and then also consider the value of donated time and materials.

The out-of-pocket costs<sup>13</sup> for all clinics incurred by the U.S. medical teams for the year ending 2009 include the following:

Medical supplies purchased	\$24,960
Travel costs for medical teams	193,568
Team coordination	24,000
Warehouse rent	48,000
Postage	579
Office supplies	1,217
Telephone	1,365
D & O insurance	3,461
Miscellaneous <sup>14</sup>	11,842
Total for all clinics	\$308,992
½ attributed to Eye Clinic	\$154,496
Eye clinic construction	\$40,000

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<sup>12</sup> These costs are the costs borne by the U.S group, which pays for the U.S. medical teams and the hospital expenses while running the clinics, and for construction and maintenance costs of the hospital buildings. It excludes costs borne by the hospital for the treatment of patients during the rest of the year, primarily by Nuns. There are four clinics per year with approximately 50 medical staff per clinic.

<sup>13</sup> We assume that the Eye Clinic accounts for one-half of all medical and overhead costs because cataract surgeries were one-half of all surgeries in 2009. It excludes the costs (\$8,700) associated with supporting a school.

<sup>14</sup> Miscellaneous expenses includes equipment repair (sending things back to the U.S. for repair), shipping expenses for supplies and equipment, and quarterly board meetings.

Depreciated over 20 years <sup>15</sup>	3,200
Total annual Eye Clinic costs	\$157,696
Cost per Eye Surgery	\$302

The medical supplies purchased, typically medications and intraocular lens implants, are the one item that varies from year to year because it depends on how many supplies are donated. The medical supply expense for 2009 is fairly typical. In contrast, the medical supply expenses of \$108,619 in 2008 were high because donations were unusually low. Until we have better data on donations of medications and intraocular lens implants, we assume that the difference between the 2009 and 2008 medical expenses represents the average value of donated supplies. We estimated the medical expenses per eye surgery to be \$24 in 2009 and \$82 in 2008,<sup>16</sup> and the difference is \$58 per eye surgery.

The cost of cataract procedures in the U.S. provides an interesting comparison to the costs at HDLF. The average reimbursed cost per procedure for cataract surgery in the U.S. is \$973. A surgeon receives \$606 and the attending staff receives \$121 per procedure. In addition, the surgery center receives \$246 for costs of material, medications, anesthetics, and lens implant.<sup>17</sup> We can use these figures to calculate the cost associated with the medical personnel at HDLF is \$208 per surgery, which compares to \$727 per surgery in the U.S. However six surgeries are performed daily per surgeon at HDLF and 3.3 surgeries are performed daily per surgeon in the U.S. If the U.S. daily medical personnel costs are spread out over 6 surgeries instead of 3.3, the medical staff costs per surgery are \$400. We assume that the difference between out-of-pocket costs for medical personnel (\$208) and U.S. medical staff costs (\$400) is the value of the donated time (\$192). If we add this value of donated time and of donated materials (\$58, above) to the out-of-pocket costs, the total cost per cataract surgery is  $\$302 + \$192 + \$58 = \$552$ .

Comparing the QALY lifetime benefits per patient and the costs per surgery, we see that the average 9.4 additional years of quality life costs HDLF only \$32 per additional year of quality of life (out-of-pocket costs), or \$59 per additional year of quality life if we include donated time and materials. This appears to be an excellent social investment for the rural poor of Guatemala.

## Summary

The simple ReadyMade analysis provides a first approximation of how cataract surgery improves the mobility and daily functioning of the elderly patients at Hospital de la Familia's Eye Clinic. The statistical correlations and linear regressions indicate that mobility is a good proxy for three of the patients' major daily activities (taking care of self, assisting with household tasks, assisting with care of others). Detailed interviews indicate how the

<sup>15</sup> A carrying cost of foregone interest of 3% per year is included.

<sup>16</sup> We multiplied total medical purchases by proportion of surgeries that are by Eye Clinic (0.68 in 2008 and 0.50 in 2009), and divided this expense by number of eye surgeries (894 in 2008 and 522 in 2009).

<sup>17</sup> Medicare Certified Ambulatory Surgical Centers, Cataract Surgery Costs and Related Issues, Department of Health & Human Services. The surgeon receives an average of \$2,000 per day, or performs 3.3 cataract operations.



patient's mobility before and after cataract surgery translates into the hours they can spend in these activities and in social activities, such as going to Church. Together the survey data and the interview data provide evidence that mobility before and after surgery is a good proxy for patient's functionality before and after surgery. Patient data on mobility before and after cataract surgery can be collected by the staff when the patient checks in at the HDLF Eye Clinic, and the patient does not have to be surveyed, and so this key variable can be easily collected for patients whenever they come to the clinic.

The estimated functionality improvements associated with improved mobility were translated into increased quality of life years for the average remaining life expectancy. These calculations provided us with the benefits of cataract surgery:

**The average cataract patient can expect to live for an additional 14 years with an improvement in quality life years of .67, or 9.4 additional years of quality life (QALY).**

The 2009 costs of running the Eye Clinic were calculated for HDLF out-of-pocket costs (\$302 per surgery) and for total costs including donated time and materials (\$552 per surgery). Even using the high costs of U.S. medical staff's time, we see that the average 9.4 additional years of quality life costs HDLF only \$59 per additional year of quality life, or only \$32 per additional year of quality of life (out-of-pocket costs).

We note that the cataract costs per patient at HDLF are high compared to some developing countries, such as India, where many local doctors have been trained to do these procedures. The need to send medical teams to Guatemala to provide health care to the rural population, as opposed to developing sufficient local capability as in India, reflects a different approach to health care and a difference in socio-political norms. In Guatemala local specialists are insistent that the U.S. medical teams do not train local doctors to do these procedures. In contrast, in India the U.S. medical teams have taught thousands of local doctors to do these procedures and to teach others as well. In India, the U.S. medical teams also helped create a new industry to fabricate low-cost intraocular lenses locally, and now these lenses are sold worldwide.

The simple ReadyMade approach used here can be criticized in many ways (too few interviews, no specific data mapping vision improvement to mobility, simplistic application of QALY)<sup>18</sup>, and over time it can be improved in a variety of ways. Experts in the field can use the data available to do alternative calculations of QALY, costs, daily functioning, and so forth. For the time and money invested in the collection and analysis of data, HDLF is pleased with what they learned, and will continue to collect ReadyMade data for periodic analyses. HDLF will use the results for internal discussions and improvements and for external fundraising.

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<sup>18</sup> See Van C. Lansingh, Marissa J. Carter, Marion Martens, "Global Cost Effectiveness of Cataract Surgery", *Ophthalmology* 114:1670-1678, 2007 for a meta-analysis of cataract surgery studies in a variety of countries. They apply their own estimation of QALY, assuming 12-year life expectancy and a utility gain of 0.148, which is much lower than the gain in hours of functioning that we use. Cataract benefits to patients in developed countries, where vision impairment is minor prior to surgery, are not nearly as great as the benefits to patients in developing countries, where vision is often badly impaired before surgery.