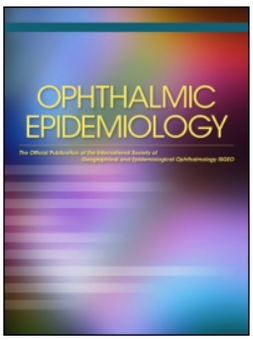

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Pediatric Case Finding in Madagascar: A Controlled, Prospective Population-based Assessment of Key Informant Productivity and Cost

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ABSTRACT

Purpose: The Key Informant (KI) case finding method, which trains community members to screen children for eye problems and refer them to eye services, is a common strategy to identify and refer children with blindness and visual impairment. However, studies to date have not determined the benefit and cost of adding KIs to routine outreach activities.

Methods: Four eye programs in Madagascar with established outreach camps added KIs to a portion of their camps distributed equally throughout their service region over a one year period. KIs recorded children screened and their attendance at an outreach camp. Outreach personnel used standardized registration forms to gather age, sex, visual acuity, diagnosis and treatment data. Costs were gathered for the KI program and outreach camps.

Results: In one year, the 4 eye programs held 138 outreach camps, 43 with KIs. The KI camps were more productive than regular camps seeing an average of 61 and 24 children and 50 and 19 children with an eye problem, for KI and regular camps, respectively. The KI camps also saw more children with moderate or severe visual impairment or blindness with 21 and 8 children (per 10 camps) for KI and regular camps, respectively. A KI camp cost $463 ($642 vs. $179) more than a regular camp and $3 ($8 vs. $11) more per child seen.

Conclusion: The KI method significantly increased the number of children attending outreach camps, at all levels of visual impairment and blindness, at a modest increase in costs.

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Case Finding; Key Informant; Community Outreach; Madagascar; Childhood Blindness

Introduction

The World Health Organization estimates that about one-half of the estimated 1.4 million cases of blindness in children below the age of 15 could be avoided.[1] While no population-based evidence is available for childhood blindness in Madagascar, based on current childhood blindness estimates in Africa and a total population of 21.3 million in 2010, the prevalence of non-traumatic cataract, the most treatable blinding condition, is estimated at 2,000 with an incidence of 600.[2]

Finding and treating children early in life is a top priority for child eye health programs and most have developed strategies to identify and refer children in need of care. One common method involves training local community members as 'Key Informants' to screen children for eye problems in their community in a one-time campaign mode and to refer them to eye health professionals, most often to outreach camps (scheduled visits to a community health facility by an ophthalmic team to offer screening and diagnostic services) in their area.

A population-based prevalence study in Bangladesh[3] first reported that KIs are an effective strategy to identify children with blindness and severe visual impairment. However, few studies have compared the effectiveness and cost of outreach camps with and without a KI program.

In 2016–17, 4 eye programs in Madagascar began collaborating on a new externally funded pediatric project that involved KIs as case finders. The eye programs evaluated the effectiveness and cost of the KI activities over a one year period.

Materials and methods

Setting

Three rural and one urban hospital (in the capital city Antananarivo) were included in the project in

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2016–2017. Two rural regions (Vakinankaratra, Sava) and the capital city program (Analamanga) involved eye departments within general hospitals operated by the Malagasy Lutheran Church (Sampan'asa Loterana Momba Ny Fahasalamana). The Atsinanana program, also a rural region, is located within a tertiary level government hospital. The 4 regions are home to an estimated 2,951,811 children below the age of 15, with Sava and Atsinanana the least densely populated (38 and 58 people per sq. km, respectively) compared to Vakinankaratra and Analamanga (109 and 198 people per sq. km, respectively).

All 4 institutions have Vision 2020 Programs (programs aimed at eliminating avoidable blindness, typically through eye health promotion, eye disease prevention, curative interventions and rehabilitation, at the district level for a population of 0.5 to 2 million over a 1 to 3 year period) which included an eye care program manager and regular community outreach. Each hospital was equipped to treat pediatric eye conditions. However, most surgical cases were referred to a Child Eye Health Tertiary Facility in the capital city of Antananarivo, with the exception of Vakinankaratra and Atsinanana who were equipped to manage uncomplicated cataract and glaucoma operations. All eye programs provided funds to reimburse transportation and surgery costs for those unable to pay.

The outreach programs operated in coordination with primary health centers, known as Centre de Santé de Base. These centers are located at the commune level with an average population of 20,000 to 50,000. Each commune was comprised of several villages with at least 2 community volunteers (known as 'Agents Communautaire'). Agents Communautaire worked for the Centre de Santé de Base with a variety of public health programs of the Ministry of Health, such as immunization, distribution of vitamin A and sensitization about hand washing and nutrition. Agents Communautaire were commonly farmers or those who staff the dispensary of the Centre de Santé de Base.

Prior to a scheduled outreach camp, the head of the Centre de Santé de Base instructed the Agents Communautaire to inform their communities of the upcoming outreach day and the opportunity to receive free eye examinations. Normally, Agents Communautaire work to mobilize people was part of their duty as a volunteer, therefore no incentives or allowances were expected or provided.

Intervention

In 2016, the 4 eye programs added the Key Informant (KI) case finding method to approximately 1/3 of their outreach camps distributed regularly through the year and throughout all areas served by the eye programs.

For KI camps, the head of the Centre de Santé de Base selected approximately 12 to 15 Agents Communautaire (covering an estimated population of 1,500 to 2,500 each), 73% of whom were women (ranging from 56%F in Vakinankaratra to 89% F in Analamanga). They received a half-day of basic eye care training at the hospital, in the case of Sava and Atsinanana, or in the village, in the case of Vakinankaratra and Analamanga, by the community coordinator or the ophthalmologist. The Agents Communautaire were selected based on reputation, dynamism, ability to read and write and availability.

During the training sessions, the Agents Communautaire were shown pictures of eye diseases, learned behavioural cues that could indicate a vision problem and were instructed to refer any child believed to have a visual problem to the upcoming outreach camp. The training sessions also focussed on identifying the barriers faced by parents in bringing their children in for care and helping the KIs to develop effective arguments to overcome those barriers. The program paid all transportation costs, helped to organize community support for the afflicted families and whenever possible KIs escorted the children to the camp. KIs were reimbursed for transportation, given a certificate and a small allowance to cover their meals and incidentals.

In the two to three weeks following training, KIs searched for children by visiting individual households and advertising on radio, making announcements at places of worship and contacting social groups within their communities. KIs created referral lists to record the name, age, sex and contact information of all referred children.

All outreach camps were held at a Centre de Santé de Base or other health facility and the majority were managed by an eye care team consisting of a coordinator, ophthalmologist, refractionist, counsellor, ophthalmic nurse, auxiliary staff and driver. The one exception was the Sava eye unit whose outreach team consisted of 14 team members, double that of the other sites.

The ophthalmic team examined all children. Children requiring medication or minor treatment received it at the camp, whereas children in need of further treatment or follow-up were referred to the base hospital or the Child Eye Heath Tertiary Facility in Antananarivo.

Data collection

Data from the outreach activities involving KIs were collected at two points: 1) at the time of child identification by the KIs using a standardized form for name, age, sex, contact information and eye problem identified for each child and to record the KI's own name,

age and village of origin; 2) at the outreach camp, by eye care personnel using a registration record for name, age, sex, contact information, visual acuity, diagnosis and prescribed treatment for each child.

Age was categorized as: <2 years, 2–5 years and 6–14 years. Visual acuity was categorized as: 1) normal visual acuity equal to or better than 6/18, 2) unable to measure, 3) indirect assessment (fixation, following, perception of light), 4) moderate visual impairment (MVI) visual acuity of 6/60 or better and less than 6/18, 5) severe visual impairment (SVI) visual acuity of 3/60 or better and less than 6/60 and 6) childhood blindness (CB) visual acuity in the better eye of less than 3/60.

Diagnosis comprised 24 categories, including: normal, conjunctivitis, significant refractive error (defined as: myopia more than −0.75 diopters; hyperopia greater than +2.00 diopters; astigmatism higher than 0.50 cylindric diopter), blepharitis and other.

Treatment was categorized as: 1) no treatment, 2) provided medication, 3) prescribed glasses, 4) referred for surgery, and 5) referred for other eye problem.

At the end of each outreach camp, the person responsible for registration collected the record forms from the KIs. Both forms and the registration records were brought to the hospital for cross-reference and entry into an Excel template by a data computing officer.

Data from the outreach camps without KIs were collected at the camp using the same paper records and subsequently entered into the same computer data entry system.

Each month, the data computing officer from each hospital sent the data to a project manager for compilation into a master Excel spreadsheet, creating a database for all children identified, referred and seen in outreach programs.

Costs were recorded for training and managing KIs as well as outreach activities (including allowance, supplies, transport and incidentals) and reported quarterly.

Productivity was measured at each outreach camp in terms of the average number of children 1) seen 2) diagnosed with an eye problem, 3) requiring medication, glasses or surgery, and 4) diagnosed with moderate or severe visual impairment or blindness in the best eye.

Costs were measured as the average cost per child 1) seen, 2) diagnosed with an eye problem, 3) requiring medication, glasses or surgery, and 4) diagnosed with moderate or severe visual impairment or blindness. The cost per child was calculated by dividing total costs by the number of children in each category.

Permission for publication was obtained from the individual hospitals and the Ministry of Health. All study procedures adhered to the recommendations of the Declaration of Helsinki.

Results

From July 2016 to June 2017, the 4 hospitals held a combined total of 138 outreach camps, 43 (31%) with KIs.

KI camps were distributed evenly over the year (average 3 per site per quarter) usually alternated with regular camps to allow for preparation and training. The KI and regular camps were the same distance from the base hospital.

A total of 558 KIs were trained. A total of 2,255 children (60% F) were seen in 95 regular camps, 81% between ages 6–14 years. A total of 2,604 children (59% F) were seen in 43 KI camps, 77% between ages 6–14 years (Table 1).

The regular camps saw an average of 24 children (range 9 to 31) (40% male, 60% female) whereas the KI camps saw 61 children (range 30 to 92) (41% male, 59% female) (Table 1).

The regular camps diagnosed an average of 19 children (range 7 to 25) with an eye problem requiring treatment compared to 50 children in the KI camps (range 26 to 78) (Table 2).

The proportion of children in each diagnostic category were very similar between camps, 54% and 52% conjunctivitis, 6% and 7% significant refractive error, 5% and 6% blepharitis and 4% and 6% other eye problems, in the regular and KI camps, respectively (Table 2).

Children in the regular and KI camps also had similar proportions of recommended treatments (68 to 70%), prescribed medication (both 7%), prescribed glasses (both 1%), referred for surgery (both 2%), and

Table 1. Children seen by camp type, age and sex.

	Regular Outreach Camp								KI Outreach Camp							
	Male		Female		Total		Average Per Camp		Male		Female		Total		Average Per Camp	
Age	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
<2 yrs	48	*(5%)*	57	*(4%)*	**105**	***(5%)***	***1***	***(5%)***	92	*(9%)*	98	*(6%)*	**190**	***(7%)***	***4***	***(7%)***
2–5 yrs	173	*(19%)*	152	*(11%)*	**325**	***(14%)***	***3***	***(14%)***	214	*(20%)*	183	*(12%)*	**397**	***(15%)***	***9***	***(15%)***
6–14 yrs	690	*(76%)*	1,135	*(84%)*	**1,825**	***(81%)***	***19***	***(81%)***	764	*(71%)*	1,253	*(82%)*	**2,017**	***(77%)***	***47***	***(77%)***
Total	**911**	***(100%)***	**1,344**	***(100%)***	**2,255**	***(100%)***	***24***	***(100%)***	**1,070**	***(100%)***	**1,534**	***(100%)***	**2,604**	***(100%)***	***61***	***(100%)***

Table 2. Children seen by camp type, diagnosis & sex.

	Regular Outreach Camp								KI Outreach Camp							
	Male		Female		Total		Average Per Camp		Male		Female		Total		Average Per Camp	
Diagnosis	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Normal	160	*(18%)*	346	*(26%)*	**506**	***(22%)***	***5***	***(22%)***	148	*(14%)*	342	*(22%)*	**490**	***(19%)***	***11***	***(19%)***
Conjunctivitis	526	*(58%)*	687	*(51%)*	**1,213**	***(54%)***	***13***	***(54%)***	584	*(55%)*	759	*(49%)*	**1,343**	***(52%)***	***31***	***(52%)***
Significant refractive error*	58	*(6%)*	88	*(7%)*	**146**	***(6%)***	***2***	***(6%)***	76	*(7%)*	108	*(7%)*	**184**	***(7%)***	***4***	***(7%)***
Blepharitis	55	*(6%)*	58	*(4%)*	**113**	***(5%)***	***1***	***(5%)***	71	*(7%)*	96	*(6%)*	**167**	***(6%)***	***4***	***(6%)***
Other	33	*(4%)*	56	*(4%)*	**89**	***(4%)***	***1***	***(4%)***	57	*(5%)*	88	*(6%)*	**145**	***(6%)***	***3***	***(6%)***
Lachrymal diseases	13	*(1%)*	15	*(1%)*	**28**	***(1%)***	***0***	***(1%)***	21	*(2%)*	29	*(2%)*	**50**	***(2%)***	***1***	***(2%)***
Chalazion	6	*(1%)*	21	*(2%)*	**27**	***(1%)***	***0***	***(1%)***	10	*(1%)*	25	*(2%)*	**35**	***(1%)***	***1***	***(1%)***
Corneal scar	9	*(1%)*	14	*(1%)*	**23**	***(1%)***	***0***	***(1%)***	17	*(2%)*	13	*(1%)*	**30**	***(1%)***	***1***	***(1%)***
Strabismus	5	*(1%)*	10	*(1%)*	**15**	***(1%)***	***0***	***(1%)***	12	*(1%)*	20	*(1%)*	**32**	***(1%)***	***1***	***(1%)***
Asthenopie	7	*(1%)*	12	*(1%)*	**19**	***(1%)***	***0***	***(1%)***	11	*(1%)*	13	*(1%)*	**24**	***(1%)***	***1***	***(1%)***
Ocular trauma	7	*(1%)*	7	*(1%)*	**14**	***(1%)***	***0***	***(1%)***	14	*(1%)*	9	*(1%)*	**23**	***(1%)***	***1***	***(1%)***
Congential cataract	7	*(1%)*	9	*(1%)*	**16**	***(1%)***	***0***	***(1%)***	11	*(1%)*	5	*(0%)*	**16**	***(1%)***	***0***	***(1%)***
Infectious keratitis	2	*(0%)*	6	*(0%)*	**8**	***(0%)***	***0***	***(0%)***	10	*(1%)*	7	*(0%)*	**17**	***(1%)***	***0***	***(1%)***
Ptosis	2	*(0%)*	3	*(0%)*	**5**	***(0%)***	***0***	***(0%)***	5	*(0%)*	6	*(0%)*	**11**	***(0%)***	***0***	***(0%)***
Low vision	7	*(1%)*	2	*(0%)*	**9**	***(0%)***	***0***	***(0%)***	1	*(0%)*	1	*(0%)*	**2**	***(0%)***	***0***	***(0%)***
Amblyopia	4	*(0%)*	–	*(0%)*	**4**	***(0%)***	***0***	***(0%)***	2	*(0%)*	4	*(0%)*	**6**	***(0%)***	***0***	***(0%)***
Uveitis	3	*(0%)*	4	*(0%)*	**7**	***(0%)***	***0***	***(0%)***	1	*(0%)*	2	*(0%)*	**3**	***(0%)***	***0***	***(0%)***
Hypovitaminose A	3	*(0%)*	1	*(0%)*	**4**	***(0%)***	***0***	***(0%)***	5	*(0%)*	1	*(0%)*	**6**	***(0%)***	***0***	***(0%)***
Congenital glaucoma	2	*(0%)*	1	*(0%)*	**3**	***(0%)***	***0***	***(0%)***	5	*(0%)*	1	*(0%)*	**6**	***(0%)***	***0***	***(0%)***
Traumatic cataract	1	*(0%)*	2	*(0%)*	**3**	***(0%)***	***0***	***(0%)***	2	*(0%)*	3	*(0%)*	**5**	***(0%)***	***0***	***(0%)***
Neonatal conjunctivitis	–	*(0%)*	2	*(0%)*	**2**	***(0%)***	***0***	***(0%)***	1	*(0%)*	1	*(0%)*	**2**	***(0%)***	***0***	***(0%)***
Dermoid cyst	–	*(0%)*	–	*(0%)*	**–**	***(0%)***	***0***	***(0%)***	2	*(0%)*	1	*(0%)*	**3**	***(0%)***	***0***	***(0%)***
Retinoblastoma	1	*(0%)*	–	*(0%)*	**1**	***(0%)***	***0***	***(0%)***	2	*(0%)*	–	*(0%)*	**2**	***(0%)***	***0***	***(0%)***
Orbital tumor	–	*(0%)*	–	*(0%)*	**–**	***(0%)***	***0***	***(0%)***	2	*(0%)*	–	*(0%)*	**2**	***(0%)***	***0***	***(0%)***
Total	**911**	***(100%)***	**1,344**	***(100%)***	**2,255**	***(100%)***	***24***	***(100%)***	**1,070**	***(100%)***	**1,534**	***(100%)***	**2,604**	***(100%)***	***61***	***(100%)***

*Myopia: more than −0.75 diopters; Hyperopia: greater than +2.00 diopters; Astigmatism: higher than 0.50 cylindric diopter

referred to the eye unit for further evaluation (both 3%) (Table 3).

The regular camps found an average of 5/1,000 children (range 2 to 6) with moderate visual impairment and 3/1,000 children (range 1 to 4) with severe visual impairment or blindness compared to the KI camps which found 15/1,000 children (range 13 to 21) with moderate visual impairment and 6/1,000 children (range 3 to 8) with severe visual impairment or blindness (Table 4).

The total cost for 95 regular camps was $17,047 USD (average $179 USD/camp with a range from $151 in Analamanga to $233 in Atsinanana). The total cost for 43 KI camps, which includes all costs related to training and deploying the KIs, was $27,590 USD (average $642 USD/camp range from $489 in Atsinanana to $902 in Sava) or $49 USD per KI trained (558 KIs at 43 camps at an average of $642 USD per camp) (Table 5).

The KI camps were more expensive per child than the regular camps in terms of the cost per child seen ($8, range $6 to $25, and $11, range $6 to $19, for regular and KI camps, respectively) diagnosed with an eye problem ($10, range $8 to $34, and $13, range $8 to $24) for regular and KI camps, respectively, as well as receiving medication, prescribed glasses or referred for surgery (Table 5).

Table 3. Children by camp type, treatment and sex.

	Regular Outreach Camp								KI Outreach Camp							
	Male		Female		Total		Average Per Camp		Male		Female		Total		Average Per Camp	
Treatment	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
No treatment needed	160	*(18%)*	346	*(26%)*	**506**	***(22%)***	***5***	***(22%)***	148	*(14%)*	342	*(22%)*	**490**	***(19%)***	***11***	***(19%)***
Medication	660	*(72%)*	863	*(64%)*	**1523**	***(68%)***	***16***	***(68%)***	802	*(75%)*	1033	*(67%)*	**1835**	***(70%)***	***43***	***(70%)***
Glasses	63	*(7%)*	88	*(7%)*	**151**	***(7%)***	***2***	***(7%)***	77	*(7%)*	111	*(7%)*	**188**	***(7%)***	***4***	***(7%)***
Surgery	8	*(1%)*	13	*(1%)*	**21**	***(1%)***	***0***	***(1%)***	13	*(1%)*	11	*(1%)*	**24**	***(1%)***	***1***	***(1%)***
Referred for other eye problem	20	*(2%)*	34	*(3%)*	**54**	***(2%)***	***1***	***(2%)***	30	*(3%)*	37	*(2%)*	**67**	***(3%)***	***2***	***(3%)***
Total	**911**	***(100%)***	**1344**	***(100%)***	**2255**	***(100%)***	***24***	***(100%)***	**1070**	***(100%)***	**1534**	***(100%)***	**2604**	***(100%)***	***61***	***(100%)***

Table 4. Children seen by camp type, visual acuity & sex.

	Regular Outreach Camp									KI Outreach Camp								
	Male		Female		Total		Average Per Camp		Average Per Thousand Children	Male		Female		Total		Average Per Camp		Average Per Thousand Children
Visual Acuity	N	(%)	N	(%)	N	(%)	N	(%)	N	N	(%)	N	(%)	N	(%)	N	(%)	N
Normal VA	720	*(79%)*	1,097	*(82%)*	**1,817**	***(81%)***	***19***	***(81%)***	***191***	816	*(76%)*	1,253	*(82%)*	**2,069**	***(79%)***	***48***	***(79%)***	***481***
VA measurement not available	108	*(12%)*	120	*(9%)*	**228**	***(10%)***	***2***	***(10%)***	***24***	113	*(11%)*	141	*(9%)*	**254**	***(10%)***	***6***	***(10%)***	***59***
Indirect VA assessment*	53	*(6%)*	90	*(7%)*	**143**	***(6%)***	***2***	***(6%)***	***15***	90	*(8%)*	99	*(6%)*	**189**	***(7%)***	***4***	***(7%)***	***44***
MVI seen (6/18–6/36 in best eye)	15	*(2%)*	28	*(2%)*	**43**	***(2%)***	***0***	***(2%)***	***5***	33	*(3%)*	33	*(2%)*	**66**	***(3%)***	***2***	***(3%)***	***15***
SVI seen (6/60–3/60 in best eye)	11	*(1%)*	7	*(1%)*	**18**	***(1%)***	***0***	***(1%)***	***2***	13	*(1%)*	4	*(0%)*	**17**	***(1%)***	***0***	***(1%)***	***4***
CB seen (<3/60 in best eye)	4	*(0%)*	2	*(0%)*	**6**	***(0%)***	***0***	***(0%)***	***1***	5	*(0%)*	4	*(0%)*	**9**	***(0%)***	***0***	***(0%)***	***2***
Total	**911**	***(100%)***	**1,344**	***(100%)***	**2,255**	***(100%)***	***24***	***(100%)***	***237***	**1,070**	***(100%)***	**1,534**	***(100%)***	**2,604**	***(100%)***	***61***	***(100%)***	***606***

** Used in place of standard visual acuity charts for infants and young children: fixation, following, light perception.*

Table 5. Costs by camp type, dollar difference & percent difference (USD).

Cost Category	Regular Outreach Camp	KI Outreach Camp	Difference	Percent Difference
Total outreach	95	43	−52	−55%
Total costs	$17,047	$27,590	$10,543	62%
Average cost per outreach	$179	$642	$462	258%
Cost per child seen	$8	$11	$3	40%
Cost per children diagnosed with eye problem	$10	$13	$3	34%
Cost per child with MVI seen	$396	$418	$22	5%
Cost per child with CB/SVI seen	$710	$1,061	$351	49%
Cost per child receiving medication	$11	$15	$4	34%
Cost per child prescribed glasses	$113	$147	$34	30%
Cost per child referred for surgery	$812	$1,150	$338	42%

Discussion

The KI method has been utilized in low-income settings as a survey method to determine the prevalence of childhood blindness and low vision.[3–12] The KI method is particularly useful in overcoming the challenges of identifying a rare condition, such blindness and visual impairment, among children in rural populations. The KI method of finding children was compared to a full population-based survey with enumeration and shown to find similar proportions of visual problems, including the proportion of female, pre-school age, multiply-impaired and rural-based children.[7]

The KI method has not been studied in terms of its efficacy and cost when added to a regular outreach program. One study compared KIs to health workers in Tanzania and showed the KIs were three times as productive as the health workers at less cost.[4] However, most studies simply report the number of children screened, referred, and examined by various personnel in a KI role including Anganwadi workers[13] or community health workers.[8,9]

This study compared KI and regular camps distributed throughout the 4 hospital service areas and spread over a one year period. The KI camps were not targeted for places with denser populations or greater anticipated need. In fact, the KI and regular camps were often alternated to allow time for training of KIs. The similarity of the service populations receiving a KI or regular camp is supported by the finding that the proportion of children in each diagnostic category was similar between KI and regular camps. However, due to data collection limitations in the Madagascar programs, this study could not conduct a comprehensive comparison of a KI versus regular camp using prior year outreach camp performance. A sample of outreach camps sites were selected for a manual review that had prior year data so that they could be compared in terms of number of children seen last year versus this year with and without the KI intervention. In all instances, significantly more children were found in the study year at an outreach site when KIs were used. Nevertheless, bias favouring the KI camps remains possible if the programs did in fact preferentially select camps to include the KI activities.

Our study found the KI camps were more productive than the regular camps at finding children 5 years and younger. That is, the KI camps found an average 13 children below the age of 5 per camp compared to the regular camps which found only 4. This supports an expected advantage of the KI method as a way to identify children younger than school age.[8]

Although KI camps in Madagascar found more younger children than regular camps, of those identified as severely visually impaired or blind, only 4% were below the age of 5. In a systematic review of KI studies, Du Toit et al established that the percentage of severely visually impaired or blind children below the age of 5 found by KIs ranged from 18% to 36%[8], indicating the KI camps in Madagascar performed poorly in this regard. Low performance finding young severely visually impaired or blind children in the Madagascar program could be attributed to the KI training program, which instructs KIs to refer all children with a suspected eye problem, not only those suspected of blindness or visual impairment. As a result, the proportion of children with severe visual impairment or blindness is lower because a higher number of children were referred overall. Indeed, studies with a higher number of severely visually impaired or blind children below the age of 5 describe a more intense training program which emphasizes the causes of blindness in children and their management, and emphasize the KI role to identify and list children they suspected of being blind.[9] It is also possible in our study that young severely visually impaired or blind children were correctly identified by a KI but did not present themselves at the camp. That is, of the 2,930 children directly referred by a KI, only 2,320 children (79%) attended a camp (Table 6). Of these 'no shows', 26% of children were aged 5 years or younger and some of these children may have been severely visually impaired or blind.

Table 6. Attendance of Key Informant (KI) referrals by age and sex.

	Total Referred by KI						Total Attended by KI						Attendance		
	Male		Female		Total		Male		Female		Total		Male	Female	Total
Age	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	(%)	(%)	(%)
<2 yrs	120	*(10%)*	115	*(7%)*	**235**	***(8%)***	87	*(9%)*	86	*(6%)*	**173**	***(7%)***	73%	75%	**74%**
2–5 yrs	237	*(19%)*	209	*(12%)*	**446**	***(15%)***	193	*(20%)*	158	*(12%)*	**351**	***(15%)***	81%	76%	**79%**
6–14 yrs	875	*(71%)*	1,374	*(81%)*	**2,249**	***(77%)***	691	*(71%)*	1,105	*(82%)*	**1,796**	***(77%)***	79%	80%	**80%**
Total	**1,232**	***(100%)***	**1,698**	***(100%)***	**2,930**	***(100%)***	**971**	***(100%)***	**1,349**	***(100%)***	**2,320**	***(100%)***	**79%**	**79%**	**79%**

The performance of the KIs in terms of the proportion of children referred who attended an outreach camp, was 79% in this study, around 10% lower than reported in other studies.[8] There was, however, considerable variation across sites. Sava and Atsinanana exhibited the highest proportion attending, at 93% and 91%, respectively, and Analamanga and Vakinankaratra the lowest, at 71% to 77%, respectively. The lowest attendance was for children below the age of 2, which was also where the performance across sites varied the greatest. For this age category, Sava and Atsinanana (at 97% and 90%, respectively), significantly outperformed Vakinankaratra and Analamanga (at 67% and 58%, respectively). Compared to Vakinankaratra and Analamanga, Sava and Atsinanana served smaller populations and had a smaller number of referrals, which could indicate that bringing KIs to the base hospital for training by the ophthalmologist may have a positive impact on KI performance.

The accuracy of referrals, calculated as the proportion of examined children who actually had CB/SVI or other eye conditions among those examined, has commonly been used as a performance measure of the KI method.[8] Despite finding more children requiring treatment (50 children per KI camp compared to 19 children per regular camp) the accuracy of referrals was very similar in the KI and regular camps 11/50 (22%) and 5/24 (21%) for the KI and regular camps, respectively. In terms of the average number of children seen per diagnosis or treatment, the KI and regular camps were very similar in all settings.

The similarity in overall and disease specific accuracy is likely the result of using Agents Communautaire for both the regular and KI camps. Many of the Agents Communautaire had been long-term volunteers for the health posts and may have previously received eye care training in earlier iterations of the KI program. This finding could also indicate that while Agents Communautaire in a KI role are much more productive at finding children, they are not more accurate in only finding children with eye diseases. Therefore, in this setting the campaign-mode style where the Agents Communautaire have dedicated time and incentives for case finding simply allows for more of the same village level activities and raises the question of the value of the additional eye care training for the Agents Communautaire to act as KIs.

The similarity in overall and disease specific accuracy in the KI and regular camps could also indicate that case finding, particularly for younger children is dependent more on the parents, than the person in the case finding role. In this sense, the KI or Agents Communautaire becomes far less of a disease screener and far more of a person providing bridging strategies between a home and eye care services.

Surgical data from the program over this same time period indicates the sex-ratio for children undergoing surgery favoured boys 2:1. Therefore, regardless of which camps performed better in terms of referrals for girls, the proportion of girls actually accepting surgical care is likely much lower, which is consistent with findings from several African and Asian settings.[14] The eye programs are aware of the inequity and have developed strategies to increase service utilization by girls.

The total cost of the KI camps was skewed by higher costs in 11 camps held by the Sava eye unit. Because of their preferred outreach practice model, their KI camps had double the number of staff compared to the other programs. Had the costs of the Sava eye unit KI camps been comparable to the other sites, the KI camps would average $371 USD more expensive than the regular camps. As a result, the difference in terms of cost per child seen, diagnosed with an eye problem, or diagnosed as severely visually impaired or blind would have been far less pronounced. In fact, other than in the Sava program, the cost per child with moderate visual impairment seen in the KI camps would actually be less than the regular camps.

From the beginning to the end of this year long KI intervention, the number of children accessing eye care services per quarter at the hospitals or outreach increased from 1,211 to 2,034. Even more promising was the number of children who came directly to the hospitals for care during the study period: 4,537 children came directly to the hospital for care, 85% to the more central and established eye units in

Vakinankaratra and Analamanga and 15% at the less easily accessible and less established eye units in Sava and Atsinanana. This would suggest, as Muhit et al hoped,[3] that the KIs are increasing awareness and health-seeking behaviour among community members.

In summary, this study demonstrates that in addition to being an effective method for identifying blind children, the KI method can be successfully used as part of a community ophthalmology program to increase the uptake of screening services at a modest increase in costs.

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