

Uncorrected refractive errors

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Global estimates indicate that more than 2.3 billion people in the world suffer from poor vision due to refractive error; of which 670 million people are considered visually impaired because they do not have access to corrective treatment. Refractive errors, if uncorrected, results in an impaired quality of life for millions of people worldwide, irrespective of their age, sex and ethnicity. Over the past decade, a series of studies using a survey methodology, referred to as Refractive Error Study in Children (RESC), were performed in populations with different ethnic origins and cultural settings. These studies confirmed that the prevalence of uncorrected refractive errors is considerably high for children in low-and-middle-income countries. Furthermore, uncorrected refractive error has been noted to have extensive social and economic impacts, such as limiting educational and employment opportunities of economically active persons, healthy individuals and communities. The key public health challenges presented by uncorrected refractive errors, the leading cause of vision impairment across the world, require urgent attention. To address these issues, it is critical to focus on the development of human resources and sustainable methods of service delivery. This paper discusses three core pillars to addressing the challenges posed by uncorrected refractive errors: Human Resource (HR) Development, Service Development and Social Entrepreneurship.

Key words: Human resource development, service delivery, social entrepreneurship, uncorrected refractive error

Global estimates indicate that more than 2.3 billion people in the world suffer from poor vision due to refractive error (RE).^[1] REs are the most common forms of eye disorders that result in poor vision and have severe social and economic implications if uncorrected.^[2] A RE can simply be diagnosed, measured, and corrected with the aid of optical corrective approaches and devices such as spectacles and contact lenses or by refractive surgical procedures.^[3] Despite this, an estimated 670 million people worldwide do not have spectacles or have inadequate correction; 517 million have near vision impairment and 153 million have distance vision impairment.^[4,5] Of the 517 million people without spectacles for near vision correction, 410 million are prevented from performing near vision tasks and activities.^[5] Current data suggests that more than 90% of people with uncorrected RE, worldwide, reside in rural and low-income countries.^[6]

The global initiative to eliminate avoidable blindness by the year 2020 (VISION 2020: the Right to Sight) has included RE as one of its five priority eye diseases, following epidemiological studies that have highlighted the escalating estimates of RE prevalence.^[7] Previous World Health Organization (WHO) categories of visual impairment refer to best corrected visual acuity in the better eye rather than presenting visual acuity.^[8] However, the establishment of the WHO Refractive Error Working Group, the inclusion on the task force of VISION 2020 of national and international NonGovernmental Development Organizations (NGDOs) and professional bodies focusing

on REs, and a series of population-based studies on RE in children, has catapulted RE interventions to the center stage of blindness prevention. Resnikoff *et al.* in 2004 reviewed a series of published and unpublished surveys on uncorrected REs.^[4] While in the past the emphasis in the presentation of RE data was on best corrected vision, Resnikoff *et al.* addressed the category of presenting vision. The latter has been found to be a more accurate indicator of the relevance and challenge of RE as a global public health problem and can thus accurately quantify the need for services.

Despite an array of RE studies conducted, the lack of consistency in defining and measuring REs has often made comparison across populations difficult. The prevalence of RE exhibits significant variation across geographic, racial, age, and ethnic boundaries, which has an enormous impact on the strategies utilized in addressing uncorrected RE.^[4,9,10] This is especially so in low- and middle-income countries where there are limited resources to target specific groups, which are most affected, including specifically, the poor living in areas that are under-served and have inadequate primary eye care services and facilities. Moreover, socio-economic status influences the ability to acquire RE correction.^[11]

REs, if uncorrected, result in an impaired or decreased quality of life for millions of people worldwide, irrespective of their age, sex, and ethnicity.^[12] Over the past decade, a series of studies using a survey methodology, referred to as Refractive Error Study in Children (RESC), were performed in populations with different ethnic origins and cultural settings: a rural district in eastern Nepal;^[13] a semi-rural county outside of Beijing, China;^[9] an urban area of Santiago, Chile;^[14] an urban and a semi-rural area of KwaZulu-Natal, South Africa;^[15] a rural district near Hyderabad, India;^[16] and an urban area of New Delhi, India.^[17] These studies have confirmed that the need for RE correction is higher for children. Results shown in the studies indicate that RE in children causes up to 77% of

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blindness and severe visual impairment (<6/60 in the better eye) in India, 75% in China, and 62.5% in Chile. RE is the cause of visual impairment (<6/12 in the better eye) in 83% children in urban India,^[17] 70% in rural India,^[16] 93% in China,^[9] 55.1% in Nepal,^[13] 55% in Chile,^[14] and 63.6% in South Africa.^[15] Of these cases, 86% of children in rural India presented without correction for RE, 92% in Nepal, 58% in China, 46% in Chile, and 71% in South Africa.

Numerous studies worldwide have affirmed that the prevalence of uncorrected RE is influenced by strong socio-economic factors.^[11,18] Moreover, uncorrected RE, now a public health problem in India and other low- and middle-income countries, may impact the learning abilities of children.^[4,10,19] The impact of uncorrected REs are 2-fold, as not only do strong socio-economic factors such as poverty and the inability to access treatment influence the correction of a RE, but uncorrected RE can also contribute to the individuals and their families' socio-economic status. Visually impairing REs have been observed to have extensive social and economic impact, for example, limiting educational and employment opportunities of economically active persons, healthy individuals, and communities.^[2] Smith *et al.* indicated in their article on the global burden of uncorrected RE, that the global economy loses \$269 billion annually as a result of lost productivity due to uncorrected RE.^[20] To overcome this problem, they suggest that prescribed spectacles should be provided to those with correctable refractive conditions which in turn may result in a net economic gain.

Public Health Challenges

The key public health challenges that are presented by uncorrected REs require urgent attention. To address these issues, it is critical to focus on the development of human resources and sustainable approaches of service delivery. The challenges of eliminating avoidable blindness and correcting poor vision can thus be solved if there is advocacy with governments, international organizations, professional bodies, and the optical industry. The three core pillars to addressing the challenges posed by uncorrected REs relate to Human Resource (HR) Development, Service Development and Social Entrepreneurship.

Human resource development

HR Development remains the major challenge to the successful expansion of RE services.^[21] It is essential to develop and strengthen refractive services at the primary (community), secondary (district level, vision centers, and mid-level refractive care), and tertiary level (specialists), in order to adequately manage uncorrected RE in target populations.^[22] Services can be strengthened and sustained by recruiting and training new personnel and/or building the skills of existing personnel. In low- and middle-income countries, many effective non-government organization (NGO) approaches to the expansion of RE services have been difficult to scale up due to the lack of ophthalmologists, optometrists, or other personnel who conduct refraction. One of the major limitations has been the lack of dedicated personnel to train ophthalmic nurses, ophthalmic clinical officers and other ophthalmic personnel. It is therefore necessary to consider the development of dedicated personnel for refraction and to conduct eye health screening.

In many countries, the term 'refractionist' is used for those who have the skills necessary for refraction, with limited ocular disease screening. Optometrists are trained to conduct refractions and are also able to provide contact lenses, as well as low vision, binocular vision and ocular diagnostic or therapeutic care. Additionally, ophthalmologists who primarily conduct refractions are present in some countries, such as in Brazil.

In addressing the need for appropriate HRs, it is necessary to adopt a systems approach. In resource limited settings, where it is not possible to have refraction personnel at the primary level, the appropriate HRs (nurses, community health workers, primary health care workers) should be identified and trained to conduct screening and make the appropriate distinction and referral for either an ocular disease or a refractive condition. At the secondary level, depending on the HRs available, the optometric technician, optometrists, ophthalmic nurse, ophthalmic clinical officer, and other eye health personnel should be able to then conduct refractions. At the tertiary level, refraction services should only be provided as pre- and postoperative support. From experience, the authors are of the view that having dedicated personnel remains the best strategy. Training optometric technicians or optometrists provides a specific focus on RE services and should be pursued. The authors further suggest that RE training programs be developed in optometry and optometric training facilities at both national and regional level. In addition, refresher training courses should be available to all eye care personnel in the areas of refraction, spectacle dispensing, spectacle manufacture, spectacle supply and distribution, ocular disease screening, health promotion, and program management. In addition, the authors suggest that attrition rate and factors such as resignations, death, dismissal, relocation, and pursuit of better career opportunities should be considered for HR projections and planning for eye care personnel. In this regard, it is further suggested that succession plans be incorporated into planning strategies to substitute the absence of key personnel and incentives be provided to avoid losing personnel who are rapidly developing skills and seeking better opportunities. The institutionalization of training programs (whereby training programs become part of the local institutions career offerings) is paramount. Many NGO training programs often provide HRs for a particular need but do not take into account the attrition rate, thus adversely affecting the programs.

The challenges presented in Table 1 should be considered at each stage of HR planning:

Refractive service delivery

There is an urgent need to develop and implement efficient, effective and sustainable service delivery models for the correction of visual impairment due to uncorrected REs. The lack of eye-care services, skilled personnel, training institutions, and affordable refractive correction such as spectacles in poor countries are the primary reasons for the millions of people across the globe suffering from poor vision.^[24] Furthermore, adequate provision of services is significantly constrained by the financial sustainability of eye health services and facilities, especially in rural areas.^[25] Research by Kovai *et al.* has shown that the majority of the persons with visual impairment due to REs do not seek treatment due to personal, economic, and

Table 1: Human resource planning challenges

HR Challenge	Considerations
Retention of workforce	HR planning stage should take into consideration risk management for the loss of trained health personnel due to relocation, health problems including HIV/AIDS, better career opportunities and other personal reasons.
Support	Health personnel providing a range of other health services may require additional support to effectively sustain the provision of refractive services.
Sustainability	Financial support (satisfactory remuneration) should be provided to eye health workers to serve communities which have limited economic resources to pay for services and spectacles. Government eye health care systems, however, should support services according to the community's needs.
Career opportunities	In order to recruit new staff and retain existing eye care workers, the opportunity for career development and progression should be considered for all eye health care personnel.
Eye care personnel in remote communities	Eye care personnel and their families need to be rewarded with attractive incentives in order to keep them from migrating to urban localities in search of better opportunities.
Competency standards	Appropriate work environments with well maintained, functional equipment are essential for maintaining good eye health service provision. Monitoring and evaluation systems need to be in place to assess competency standards for practitioners.
Resources, Technology and Infrastructure	Training facilities should be established in areas where access to existing institutions is limited. New and appropriate training programs should be incorporated in existing technical/ medical facilities and institutions. Furthermore, appropriate teaching materials and resources should be available and regularly updated to meeting practitioner training needs and to ensure good quality standards at training facilities.
Adaption to change	Strategies should be in place to address the resistance of eye health personnel to work in collaboration with new cadres of personnel.
Adequate Practitioner numbers	The recruitment of eye health personnel in communities and the development of training programs should target the achievement of adequate and appropriate practitioner/ population ratios.

HR: Human resource, Source: WHO Meeting Position Paper (2011)^[23]

social barriers.^[26] These barriers include the lack of awareness of RE and methods of correction, the unavailability and un-affordability of services and spectacles, and the lack of awareness among service providers of the consumers' perspective regarding quality, appearance, cost, and comfort.^[25]

Houn points out that there is a visible disconnect between eye care and refractive services.^[27] For example, with spectacle provision patients presenting at hospitals for diagnosis are handed a prescription and are forced to purchase spectacles from the private sector.^[27] This disengagement in RE diagnosis

and spectacle provision forms a barrier to poor people accessing refractive correction since much time and energy is spent in visiting multiple points of services and in obtaining the final product. Service delivery models, therefore, need to offer the comprehensive range of refractive services from refraction to dispensing of spectacles. At the planning stage of RE programs, it is important that community-based studies are conducted that investigates the consumers perspectives, awareness, and requirements from refractive services. However, these studies can be prohibitively expensive, time consuming, and require expertise in epidemiology.^[28] Marmamula *et al.* suggest that a sound methodology be developed that can estimate the need for services in an area in an efficient and cost effective manner and provide baseline data to aid monitoring and evaluation on the impact of service delivery.^[28] The Rapid Assessment of Avoidable Blindness (RAAB) model was successfully field-tested across the world to provide valid estimates in a short period of time and also reduce the overall cost of conducting a survey.^[29,30]

The Durban Declaration on Refractive Errors and Service Delivery, passed in 2007 at the inaugural World Congress on Refractive Error, resolved to prioritize solutions toward refractive service development.^[31] Priorities for refractive service development, included in the Declaration, refer to increasing awareness; influencing policies; addressing the paucity of services, eye care personnel, infrastructure, and spectacles; appropriate technology; addressing barriers to accessing services; creating collaborative partnerships to meeting the objectives of VISION 2020; investing in training; catalyzing the availability of optical appliances and devices to communities; and creating and disseminating evidence-based information on best practices in refractive service development and delivery.^[31]

Naidoo *et al.* assert that strategies for eye care service provision in the developing world should consider several priorities in planning expected outcomes, including the integration of services within existing eye and health care services, the provision of good quality services and products, ensuring the affordability of services and products, the inclusion of cost-recovery measures to ensure that services are sustainable, the creation of jobs to empower local people, and the promotion of community participation.^[31] Moreover, strategies should recognize the need for economic growth that results in greater state funded eye-care services that focus on health promotion to ensure the prevention of eye disease, the development of eye clinics in hospitals and health clinics, and the training of the appropriate HRs.

The delivery of refractive services is an essential part of eye health and is currently delivered through a variety of models [Table 2], many of which have proved successful.

Social entrepreneurship

In many high-income countries, low cost reading spectacles are readily available and sold in pharmacies and supermarkets, without a prescription from ophthalmologists and optometrists. This often creates an impression that uncorrected REs do not pose a socio-medical threat to society.^[38] However, in the low- and middle-income countries, where most of the poor live, ready-made spectacles are inaccessible and unaffordable to the majority of the people with poor vision, especially for those

Table 2: Refractive care service delivery models

Approaches	Models	Exemplifications
Public sector approaches	Delivery through district health systems (DHS)	The District Health System is part of the national public health care system. Linkages between levels and sustainability of community level clinics have been difficult to maintain in many places. Examples, <ul style="list-style-type: none"> • District Comprehensive Eye Care (DCEC) Model of Pakistan (Pakistan Ministry of Health 2006).^[32] • Giving Sight to KwaZulu-Natal (GSKZN) Model.^[33]
	Hospital-based refraction clinics	Refraction clinics at district, regional or national hospitals may provide refractive care in the developing world without the other components of the district eye care program being implemented. Trained cadres, established systems, short training time (achieved because practitioners do not have to practice independently) provides efficient development of HR.
NGO/Civil society approaches	Vision centre model	Adaptation of the LV Prasad Eye Institute (LVPEI) Model with a specific focus on primary-level care including refractive care, ^[34] and sustainability of independent primary eye care facilities. Focus is placed on primary level care that includes refractive care which ensures that these aspects are available within communities and are not lost amongst other services. Examples, <ul style="list-style-type: none"> • ICEE Vision Centre Model.^[35] Optical Centre Model of West Africa^[28] The social entrepreneurship component of Vision Centers aids sustainability and adaptability of services, and availability of spectacles.
	Multi-level pyramid models	The model recognizes the need for eye care to reach into communities and accounts for lack of private services in poor rural areas. It includes a structured method for allowing tasks to be divided amongst the available workforce. Integration between levels with better linkages is achieved in private and NGO management structures more than in government systems: Examples, <ul style="list-style-type: none"> • The LV Prasad Eye Institute Model.^[36] • The Aravind Model^[36] • District Health Models
Social entrepreneur model		Despite the benefits of the social entrepreneurship model in service expansion and poverty reduction, the model should not be expanded at the expense of comprehensive eye exams as well as referral and integration into the health system. Many of these issues have not been adequately addressed within an eye care framework and need to be considered. Examples, <ul style="list-style-type: none"> • Presbyopia and Social Entrepreneurship.^[37] • Vision Centers and Social Entrepreneurship.^[37] • Outreach Model – Domestic and International variants.^[37]

Adapted from: WHO Meeting Position Paper (2011)^[23]

residing in rural areas.^[12] In these countries with insufficient health care clinical workers that are capable of performing eye examinations, there is a lack of services that avail affordable spectacles and a lack of public health support structures that facilitate access to services and spectacles.^[39] Inaccessible refractive services and no access to spectacles leads to a lower quality of life. New and innovative approaches that are sustainable and empower the community are required. Social Entrepreneurship (combines a business and a social mission) offers the opportunity to expand services beyond the capacity of governments and NGOs through a social franchise where local people are involved in the sale of reading spectacles. In addition, it contributes to poverty alleviation through job creation and local ownership. However, the main reason would be to ensure that sales of spectacles are not conducted independently of eye examinations performed by trained professionals as refractive services need to be coupled with eye health services. Furthermore, setting up social franchises whereby vision centers are expanded through individual ownership, with oversight by a social enterprise (which does

not generate income for individual gain but for a social mission), will enable the up-scaling of services that is desperately needed. The impact of social entrepreneurship efforts, with particular focus on comprehensive eye care, integration and referral needs to be further developed and evaluated from a health systems approach to delivery.

Corporate social responsibility can support social entrepreneurship efforts by making available low cost quality products which will make social franchises viable. The current cost of spectacle frames and lenses is often prohibitive in terms of creating access. The current collaboration between LIONS International and Essilor is an example of such efforts that can stimulate the viability of more affordable optical outlets. Corporates diversifying their range of offerings either within current optical outlets or by setting up affordable optical outlets in less served areas will contribute significantly to creating access. However, groups such as Titan Eye will have to engage in such activities with more of a corporate social responsibility mentality rather than a pure profit generation ethos.

Conclusion

Addressing the key public health challenges posed by uncorrected REs on individuals, communities, NGOs, governments, practitioners, and eye health institutions requires the development or strengthening of HRs, the delivery of comprehensive refraction services and the integration of refractive services in the delivery of comprehensive eye care. Strategies to solve the problem of uncorrected RE in low- and middle-income countries should, therefore, include both refraction and dispensing of spectacles at either the primary or secondary (district) level of eye care, since it is at these levels that most access to services for communities occur. It is critical that a team approach be adopted that integrates screening for both refractive and non-refractive conditions, health promotion, and referral. Mechanisms for the delivery of comprehensive RE services require trained personnel to refract patients, counsel patients on their refractive conditions, and dispense spectacles. In addition, appropriate equipment that is functional is needed for eye screening and conducting refraction.^[24] It is also imperative that spectacles that are acceptable and affordable to poorer individuals and communities be made available. The social entrepreneur model offers the expansion of services as well as contributes to poverty alleviation by using local people that are trained to dispense spectacles within the boundaries of refraction clinics and facilities.

References

- Thulasiraj RD, Aravind S, Pradhan K. Spectacles for the Millions Addressing a priority of "VISION 2020 – The Right to Sight". *Community Ophthalmol* 2003;3:19-21.
- Bourne RA, Dineen BP, Noorul Huq DM, Ali SM, Johnson GJ. Correction of refractive error in the adult population of Bangladesh: Meeting the unmet need. *Invest Ophthalmol Vis Sci* 2004;45:410-7.
- Kempen JH, Mitchell P, Lee KE, Tielsch JM, Broman AT, Taylor HR, *et al.* The prevalence of refractive errors among adults in the United States, Western Europe and Australia. *Arch Ophthalmol* 2004;122:495-505.
- Resnikoff S, Pascolini D, Mariottia SP, Pokharel GP. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. *Bull World Health Organ* 2008;86:63-70.
- Holden BA, Fricke TR, Ho SM, Wong R, Schlenker G, Cronjé S, *et al.* Global vision impairment due to uncorrected presbyopia. *Arch Ophthalmol* 2008;126:1731-9.
- Sight test and glasses could dramatically improve the lives of 150 million people with poor vision [Internet]. Geneva: World Health Organization. c2011. Available from: <http://www.who.int/mediacentre/news/releases/2006/pr55/en/print.html>. [Last cited on 2011 Dec 12].
- World Health Organization. Vision 2020. Global initiative for the elimination of avoidable blindness. In Fact Sheet No 1213. Geneva: WHO; 2000.
- Johnson GJ, Minassian DC, Weale RA, West SK, editors. *International Statistical Classification of Diseases and Related Health Problems, 10th rev. The Epidemiology of Eye Disease*. 3rd ed. London: Chapman & Hall Medical; 1998. p. 8-30.
- Zhao J, Pan X, Sui R, Munoz SR, Sperduto RD, Ellwein LB. Refractive error study in children: Results from Shunyi District, China. *Am J Ophthalmol* 2000;129:427-35.
- Naidoo KS. Design of a blindness prevention reporting and planning tool utilizing the results of a population-based study of visual impairment in a health district in KwaZulu-Natal [dissertation]. Australia: The University of New South Wales; 2009.
- Drover JR, Kean PG, Courage ML, Adams RJ. Prevalence of amblyopia and other vision disorders in young Newfoundland and Labrador children. *Can J Ophthalmol* 2008;43:89-94.
- Naidoo KS, Ravilla D. Delivering refractive error services: Primary eye care centres and outreach. *Community Eye Health* 2007;20:42-4.
- Pokharel GP, Negrel AD, Munoz SR, Ellwein LB. Refractive error study in children: Results from Mechi Zone, Nepal. *Am J Ophthalmol* 2000;129:436-44.
- Maul E, Barroso S, Munoz SR, Sperduto R, Ellwein LB. Refractive error study in children: Results from La Florida, Chile. *Am J Ophthalmol* 2000;29:445-54.
- Naidoo KS, Raghunandan A, Mashige KP, Govender P, Holden BA, Pokharel GP, *et al.* Refractive error and visual impairment in African children in South Africa. *Invest Ophthalmol Vis Sci* 2003;44:3764-70.
- Dandona R, Dandona L, Srinivas M, Sahare P, Narsaiah S, Muñoz SR, *et al.* Refractive error in children in a rural population in India. *Invest Ophthalmol Vis Sci* 2002;43:615-22.
- Murthy GV, Gupta SK, Ellwein LB, Muñoz SR, Pokharel GP, Sanga L, *et al.* Refractive error in children in an urban population in New Delhi. *Invest Ophthalmol Vis Sci* 2002;43:623-31.
- Dandona R, Dandona L, Naduvilath TJ, Srinivas M, McCarty CA, Rao GN. Refractive errors in an urban population in Southern India: The Andhra Pradesh Eye Disease Study. *Invest Ophthalmol Vis Sci* 1999;40:2810-8.
- Taylor HR. Refractive errors: Magnitude of the need. *J Community Eye Health* 2000;13:1-2.
- Smith TS, Frick KD, Holden BA, Fricke TR, Naidoo KS. Potential lost productivity resulting from the global burden of uncorrected refractive error. *Bull World Health Organ* 2009;87:431-7.
- Human Resource Working Group. *Human Resources for eye care in Africa: Report and Action Plan*. London and Wales: IAPB News; 2006.
- World Health Organization. *Elimination of avoidable visual disability due to refractive errors*. Geneva: WHO; 2000.
- World Health Organisation. *Position Paper. Uncorrected refractive error, including presbyopia. International meeting on Public Health approaches to the management of chronic eye diseases*. Geneva: 2011.
- Holden BA. Blindness and poverty: A tragic combination. *Clin Exp Optom* 2007;90:401-3.
- Huon T. Experiences with optical centres in West Africa IAPB standard list for a VISION 2020 eye care service unit 2010. *Community Eye Health* 2010;20:53.
- Kovai V, Krishnaiah S, Shamanna BR, Thomas R, Rao GN. Barriers to accessing eye care services among visually impaired populations in rural Andhra Pradesh, South India. *Indian J Ophthalmol* 2007;55:365-71.
- Huon T. Experiences with optical centres in West Africa. *Community Eye Health* 2007;20:53.
- Marmamula S, Keeffe JE, Rao GN. Uncorrected refractive errors, presbyopia and spectacle coverage: Results from a Rapid Assessment of Refractive Error Survey. *Ophthalmic Epidemiol* 2008;16:269-74.
- Wu M, Yip JL, Kuper H. Rapid assessment of avoidable blindness in Kunming, China. *Ophthalmology* 2008;115:969-74.
- Neena J, Rachel J, Praveen V, Murthy GV. Rapid Assessment of Avoidable Blindness India Study Group. Rapid Assessment of Avoidable Blindness in India. *PLoS One* 2008;3:e2867.
- Naidoo KS, Wallace DB, Holden BA, Minto H, Faal HB, Dube P. The challenge of uncorrected refractive error: Driving the agenda of the

- Durban Declaration on refractive error and service development. *Clin Exp Optom* 2010;93:131-6.
32. Ministry of Health. Situation analysis of refractive services in Pakistan. Islamabad: National Committee for the Prevention of Blindness; 2006.
33. Giving Sight to one million in South Africa [Internet]. Kensington: International Centre for Eyecare Education (ICEE); 2007. Available from: http://www.icee.org/news/news_display.asp?ID=44. [Last cited on 2012 Mar 15].
34. Rao GN. An infrastructure model for the implementation of Vision 2020: The Right to Sight. *Community Eye Health J* 2005;18:61-2.
35. Public Health Education [Internet]. Kensington: International Centre for Eyecare Education (ICEE); 2007. Available from: <http://www.icee.org/education2/index.asp>. [Last cited on 2012 Mar 15].
36. Prahalad CK, Hart SL. The fortune at the bottom of the pyramid. *Strategy Bus* 2002;26:2-14.
37. Review 2010-2011 [Internet]. Kensington: International Centre for Eyecare Education (ICEE); 2007. Available from: http://www.icee.org/publications/annual_reports/Annual_Review2011_web.pdf. [Last cited 2012 Mar 15].
38. Duarte WR, Barros AJ, Dias-da-Costa JS, Cattán JM. Prevalence of near vision deficiency and related factors: A population-based study in Brazil. *Cad Saude Publica* 2003;19:551-9.
39. Nirmalan PK, Krishnaiah S, Shamanna BR, Rao GN, Thomas R. A population-based assessment of presbyopia in the state of Andhra Pradesh, South India: The Andhra Pradesh Eye Disease Study. *Invest Ophthalmol Vis Sci* 2006;47:2324-8.

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