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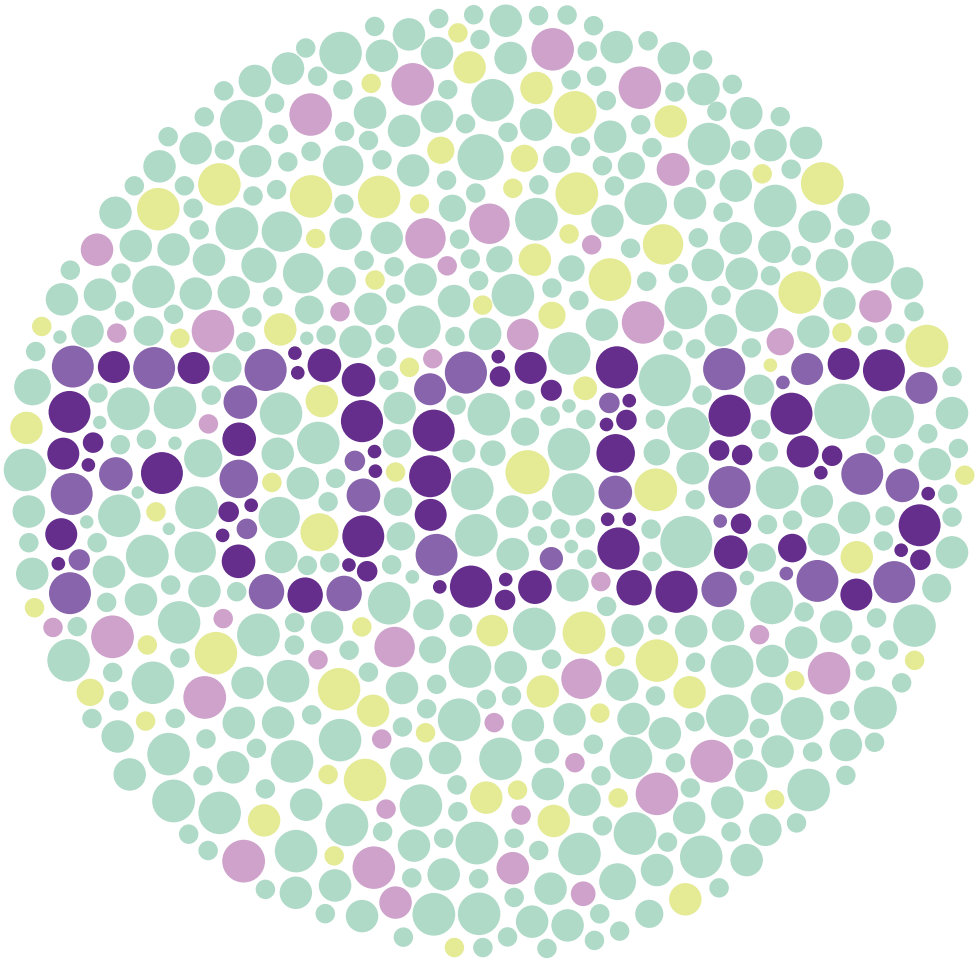

Bringing the vision care crisis into focus

By Nate Wong, Allison Winstel, and Brooke Prouty

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The vision crisis

The tape measure looks like a yellow blur. Ebrima tries to focus in on his mark and can't seem to find it. His grant from the government to obtain the tools that he needs is based on one thing: selling a quality product in a timely manner. His business is booming. Fuel-efficient cook stoves are becoming more and more popular in The Gambia, a country just south of the Sahara desert where wood to build fires is limited, and the struggle to put three meals on the table everyday isn't only about money.

However, with his failing sight, his once high-quality stoves are taking longer to make and sales are dwindling. His clientele is no longer recommending his business, he can no longer pay all of his employees, and he fears his business could fail. Unfortunately, this is a common experience for many like Ebrima, around the world.

Whether it's struggling to read notes on the classroom board that stunts educational and career opportunities or negotiating for subpar goods in the market because of inhibited quality judgment, many people struggle with vision problems that affect their very well-being—every day.

The charge: Sizing the global vision crisis

Before Deloitte began investigating this global vision impairment, understanding the scope of the crisis was far from a clear path. Existing efforts to understand how many people were affected by this global vision crisis ranged from 285 million to 2.4 billion depending on the source—a difference of 84 in magnitude.

At a time when addressing the world's largest crises is more relevant than ever, Deloitte, together with OneSight, an independent nonprofit providing access to quality vision care and glasses to underserved communities worldwide, decided it was necessary to bring this issue into clearer focus (pun intended). A more accurate picture of the crisis will help align the private, public, and social sectors around a common understanding of the pervasive problem affecting the 1.1 billion people who need, but lack access to, a simple remedy to this crisis—glasses.

Vision impairment is not a new issue facing the world, but is an intractable problem that has many ripple effects affecting health, human dignity, education, and livelihoods. Last September, the United Nations (UN) launched the Sustainable Development Goals (SDGs) setting ambitious objectives and opening pathways for collaboration to undertake some of the world's largest problems. World leaders created a new global agenda, committed to paving the way for a sustainable future world by tackling international issues including poverty, health, injustice, and climate change by 2030.[1] The seventeen SDGs will influence UN and member nation's policy and funding decisions over the next 15 years.

Sustainable Development Goal 3 turns a spotlight on addressing global public health crises, calling for the promotion of health and well-being for people of all ages.[2] Addressing global vision impairment is one step toward individuals living healthy lives and ultimately improves educational and workplace success and the economic sustainability of communities.[3,4]

With the UN's SDGs and the World Health Organization's (WHO) 2013 report, *Universal Eye Health: A global action plan* calling for cross-sector collaboration to solve these global issues, OneSight collaborated with Deloitte to lend its skills to the effort, namely to understand the extent of the problem and what regions were most adversely affected in order to adequately mobilize and prioritize efforts.

The Goldilocks problem

The first step was to understand the scale of this problem; however, there did not seem to be consensus. From the WHO to the University of Oxford, researchers attempted to size the problem, attaching magnitudes ranging from 285 million to 2.4 billion to the crisis. We found that three main discrepancies—differing vision impairment definitions and criteria, existing dataset gaps, and disparate methodologies—are driving the lack of consensus among the international community. A more tapered approach is needed to right-size the crisis.

Review of five prominent studies on the global vision crisis reveals that the estimates are based on inconsistent population criteria, as seen in figure 1. Geographical boundaries range from the entire global population to only developing countries, and there was no consistency in including or omitting already corrected vision impairment cases. Without consistent definitions, we found it difficult to compare the estimates.

Figure 1: Prior "Global Need for Glasses" studies

	Vision Spring	**World Health Organization**	**University of Oxford**	**AMD**
Type of measurement	Global, untreated vision impairment that could be corrected with glasses	Global rates of vision impairment	Global rates of refractive errors (both corrected and uncorrected)	Global, untreated vision impairment
Year of study	2014	2010	2008	2008
Number of people (lower bounds)	703 Million	285 Million	2.2 Billion	2.4 Billion

Sources:

Global Data on Visual Impairments 2010, World Health Organization, 2012. http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf

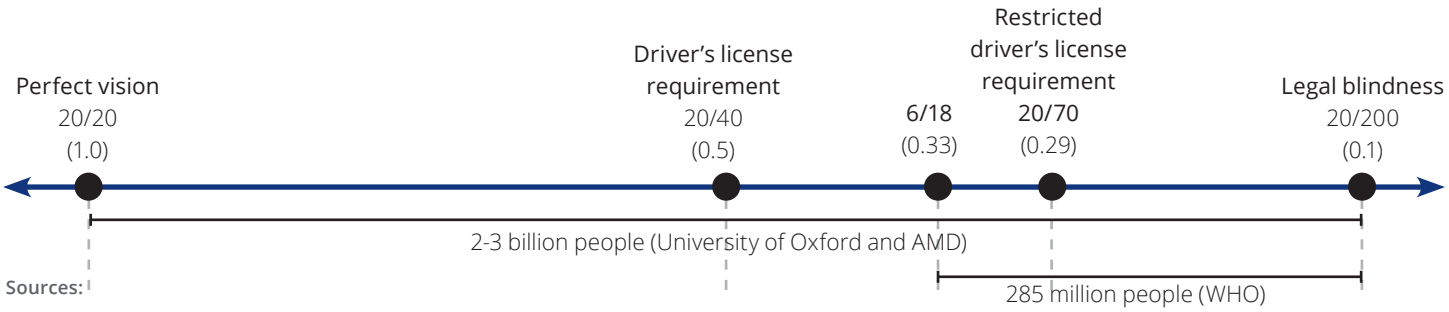
"Why Eyeglasses?" Vision Spring, 2013, http://visionspring.org/why-eyeglasses/

JD Silver, DN Crosby, MG Douali, GE MacKenzie, MD Plimmer, "The Global Need for Refractive Correction," The Centre for Vision in the Developing World, University of Oxford, http://www.vdwoxford.org/resources/IAPB_08_Poster.pdf

The Global Economic Cost of Visual Impairment, Access Economics for AMD Alliance International, 16 March 2010. http://www.icoph.org/dynamic/attachments/resources/globalcostofvi_finalreport.pdf

Even when comparing studies with similarly phrased target measurement populations (i.e., WHO and AMD), further differences exist in defining the visual acuity impairment. Per Figure 2, The University of Oxford and AMD included individuals with less than perfect vision (20/20) while the WHO included the population from 6/18 acuity to legal blindness (see figure 2).

Figure 2: Definitions of visual acuity impairment



Sources:

JD Silver, DN Crosby, MG Douali, GE MacKenzie, MD Plimmer, "The Global Need for Refractive Correction," The Centre for Vision in the Developing World, University of Oxford, http://www.vdwoxford.org/resources/IAPB_08_Poster.pdf,

The Global Economic Cost of Visual Impairment, Access Economics for AMD Alliance International, 16 March 2010. http://www.icoph.org/dynamic/attachments/resources/globalcostofvi_finalreport.pdf

Potential gaps in the dataset emerged as Deloitte looked deeper into existing research. Previous studies focused primarily on the over 50 years of age group and secondarily on the 5–15 years of age group, lacking data on a large portion of the population. Researchers had to extrapolate data across age groups, in some studies resulting in extrapolation of rates of refractive error for over 60 percent of the population. Trends were further generalized over geographies leading to inaccurate assumptions of country specific rates of refractive error.

Researchers took two differing approaches to sizing the crisis: top-down and bottom-up. The top-down approach assumed that human biology was consistent across the globe, and so used data from developed countries to determine refractive error rates and then predict the number of people worldwide with refractive error.

The bottom-up approach conducted on-the-ground studies, and then extrapolated those findings across the globe.

Given the discrepencies and lack of consensus in the international community, we could not validate or agree with existing estimates on the global vision crisis at the time of the literature review. Instead, Deloitte decided to leverage its analytical capabilities and OneSight's strategic counsel to refine the existing methodologies and define a new approach for sizing the global vision crisis. Deloitte and OneSight's methodology refines the existing top-down used by University of Oxford, capturing both the benefits of the existing top-down and bottom-up approaches while trying to minimize drawbacks (see figure 3).

Figure 3: Comparison of sizing approaches

	Bottoms-up (WHO)	Refined top-down (Deloitte/OneSight)	Top-down (University of Oxford)
Benefits			
Provides granular estimates (captures local need)	√	√	
Considers access as well as vision impairment	√	√	
Leverages reliable data sources using robust collection methodologies		√	√
Data recency		√	√
Drawbacks			
Statistical limitations of small sample sizes	X		
Gaps in available data (including age groups and geographies)	X	X	X
Requires reconciliation of individual study assumptions	X		
Requires broad-based assumptions about biology		X	X

Sources: Deloitte and OneSight research.

Solving the Goldilocks problem

Deloitte's refined top-down approach layers population estimates, visual impairment parameters, and access proxies to estimate the global need for glasses. The result is a dynamic model able to predict future crisis scale by adapting to country specific population estimates.

Defining the crisis

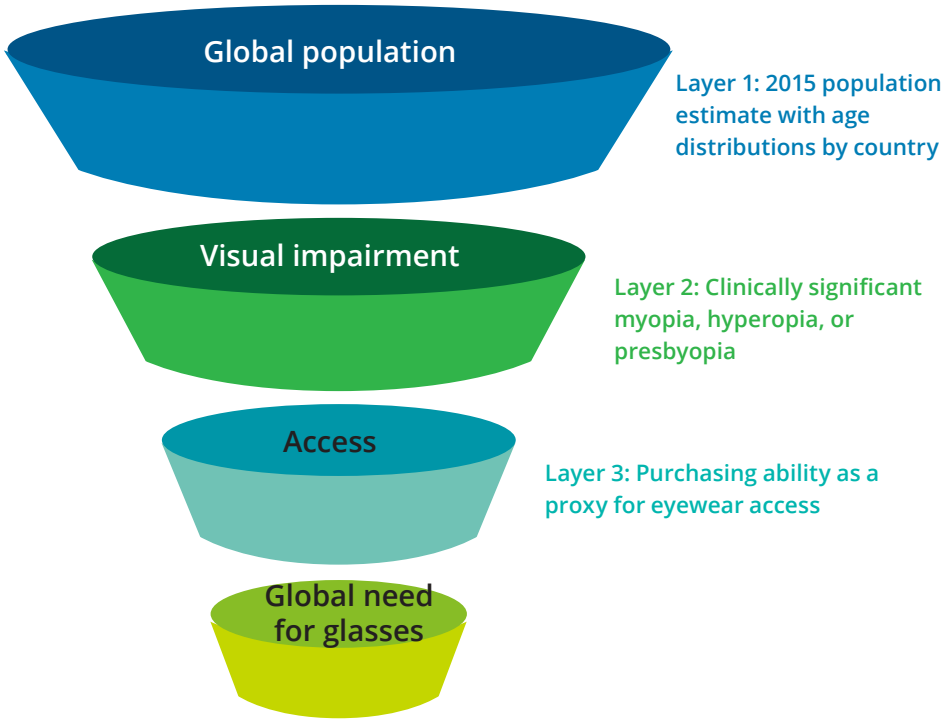
Leveraging OneSight's expertise and 28 years of experience in the space, we chose to size the vision crisis as the estimated global need for glasses, determining the scale of easily treatable vision impairment and accounting for both clinical and economic barriers to clear vision. Three refractive errors, myopia (i.e., nearsightedness), hyperopia (i.e., farsightedness), and presbyopia, a condition that occurs with age, can, in most cases, be easily treated with prescription eyewear. Nonetheless, in many developing areas, lack of healthcare infrastructure, transportation and eyewear costs, and cultural barriers prevent individuals from accessing treatment. Individuals with myopia of less than -1D (i.e., less than the driver's license requirement of 20/40 vision), hyperopia of greater than 3D, and all individuals with presbyopia were considered clinically significant for this model.

The approach

Deloitte began with UN estimates of the global population, and, as seen in figure 4, narrowed in on the measurement, layering on additional clinical, demographic, and economic parameters. Within each layer, the assumptions detailed below were made to account for dataset gaps and define vital criteria including eyewear access.

To better prepare stakeholders to address the crisis in the short- and long-term, we leveraged the model's dynamic capabilities to predict changes in scale by country between 2015 and 2020. Armed with a view of how economic factors will affect the prevalence in different geographic regions, public, private, and nonprofit organizations can better triage the solution, prioritizing those countries who will see the biggest impact from better eye health infrastructure.

Figure 4: Refined top-down approach



Source: Deloitte research.

Layer 1: Dynamic global population by age group

Assumption 1: Global population growth rates are compounded but constant from 2015-2020.

Beginning with the UN's 2015 global population estimate, we applied the United States Census Bureau's data on 2015 age distributions by country. Breaking down the population by age groups on a country-by-country basis allows for more accurate application of clinical parameters. Moreover, it enhances the model's capability to predict the future crisis size given the UN's country-specific population growth predictions.

Layer 2: Expected rates of refractive error by age group and country

Assumption 2: Limited estimates of presbyopia are available between the ages of 35-49 so 25 percent was chosen as a proxy. All adults 50 years of age and older were assumed to have presbyopia.

Assumption 3: The prevalence of myopia and hyperopia is equivalent across all countries and age groups. Deloitte used a 34 percent weighted average based on UN population estimates for 2015.

Next, we applied expected rates of refractive error across each age group and country. Figures 5 and 6 detail the rates utilized for the purposes of this model. Due to a lack of granular country data on the prevalence of myopia and hyperopia, we used a weighted average based on UN population estimates for the US, Australia, India, and China and existing data for those countries in order to get the best estimate.

Figure 5: Prevalence of presbyopia by age group

	Age (years)			
	0-14	15-34	35-49	50+
Prevalence of presbyopia	0%	0%	25%	100%^

Source:

"From Unseen to Seen: Tackling the Global Burden of Uncorrected Refractive Errors," Annual Review of Biomedical Engineering, 2014.

Figure 6: Prevalence of myopia and hyperopia

	Country			
	United States	**Australia**	**India**	**China**
Prevalence of myopia (<-1D)	25%	16%	33%	17%
Prevalence of hyperopia (>3D)	10%	6%	16%	2%
Total	35%	24%	49%	19%
Total weighted average[6]	34%			

Source:

"From Unseen to Seen: Tackling the Global Burden of Uncorrected Refractive Errors," Annual Review of Biomedical Engineering, 2014. Weighted using UN Population Estimates for 2015.

Layer 3: Purchasing ability as a proxy for eyewear access

Assumption 4: All people living on less than $2 per day or below the National Poverty Line lack access to affordable vision correction (i.e., glasses). This was mainly applied using World Bank Databank poverty headcounts focused on the developing world.

Assumption 5: The poverty rates were projected to 2015 and 2020 using the average annual percentage change in the poverty rate by country over the period from 2001-2014.

Lastly, introducing economic criteria represents the central crisis issue: the barriers preventing access to glasses. We applied the higher percentage of either the World Bank Databank poverty headcounts for people living on less than $2 per day or people below the National Poverty Line.[5]

Findings

With all criteria applied, the model reveals that 2.5 billion people in the world need glasses due to a refractive error. Of those with clinical need, 1.1 billion, or one in seven people, lack access to glasses.

No age group is untouched by the crisis (see figure 7). From school age children to working adults to the elderly, vision impairment impedes these individuals from clearly focusing on daily activities. There are over 1.2 billion untreated cases of myopia/hyperopia (750 million) and presbyopia (463 million) worldwide, with some individuals accounting for cases of each.[6]

Figure 7: Prevalence of myopia and hyperopia

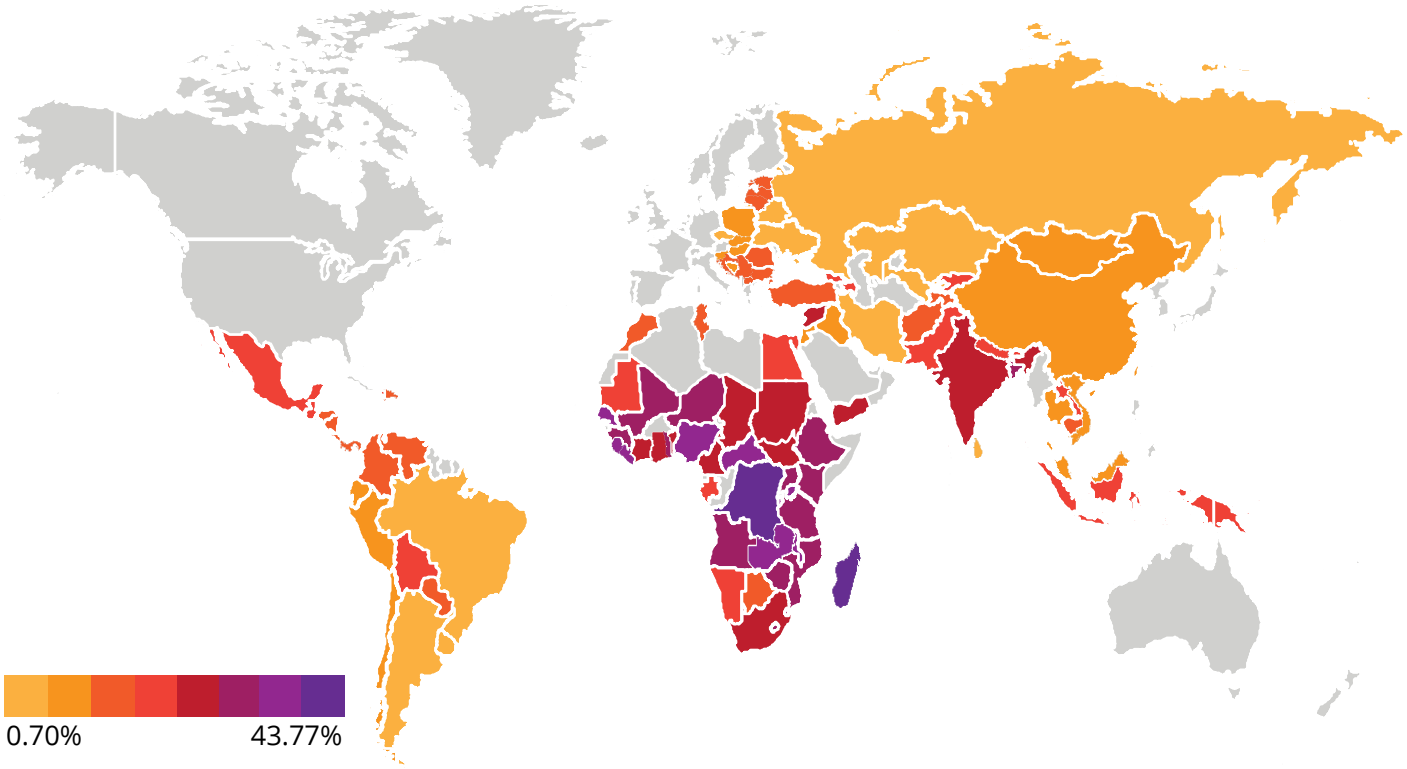
Age group	Number of individuals needing glasses
Ages 0-14	239M
Ages 15-34	256M
Ages 35-49	232M
Ages ≥=50	363M
Total	1.089B

Source:

"From Unseen to Seen: Tackling the Global Burden of Uncorrected Refractive Errors," Annual Review of Biomedical Engineering, 2014.

Taking the model a step further than sizing the crisis in its entirety, we could identify countries with the greatest need (see figure 4). With a closer look, we found the crisis to be most acute in Sub-Saharan Africa and Southeast Asia, where up to 44% of the population in certain areas has untreated vision impairment.

Figure 8: 2015 Geography of the need for glasses (percentage of the population)

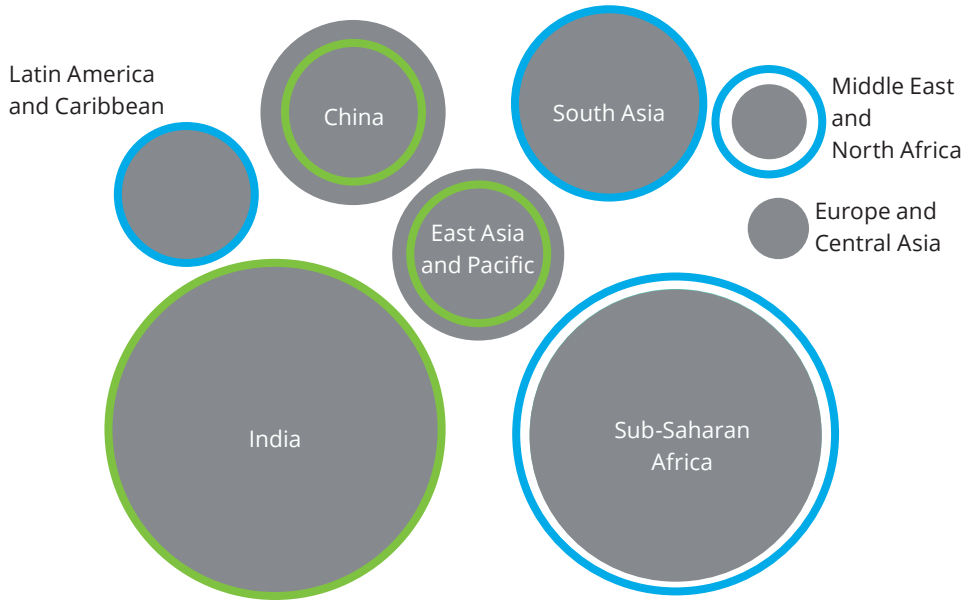


Source: Deloitte research.

Of all countries, Madagascar, Liberia, and Democratic Republic of the Congo have the most acute needs, with 44 percent, 42 percent, and 41 percent of their populations, respectively, lacking needed glasses. By total individuals, India, China, and Nigeria have the greatest need. Combined, they comprise nearly half a billion people.

Looking forward then, what can we expect? Economic factors causing declines in poverty rates will decrease the crisis size slightly to 1.07 billion by 2020. But without a global solution, one in seven will still struggle to see. The Middle East and North Africa will join Sub-Saharan Africa for the greatest acute need, while India, China, and East Asia will see decreases in total percentage lacking access (see figure 8). India, China, and Nigeria will continue to represent the largest total number of individuals, but Timor-Leste may pass Madagascar for the greatest acute need.

Figure 9: Regional changes in vision crisis 2015-2020*



Legend

- 2015 Vision crisis
- 2020 Vision crisis (decrease from 2015)
- 2020 Vision crisis (increase from 2015)

*Circle sizes are proportional to the total number of people who need but do have access to glasses.

Source: Deloitte research.

Reaching a clearer 2030

With a clear picture of the global vision crisis, what steps are next? As the UN emphasized with its seventeenth Sustainable Development Goal, it is time to "revitalize the global partnership" to solve our world's largest issues.

Deloitte's Social Impact Practice emphasizes the power of aligned action among private, public, and social sector players creating a "solution economy" where collaboration is more powerful than any individual organization's actions.[7] As the WHO addresses its global action plan's three objectives—gathering evidence for advocacy, influencing policy, and fostering collaboration—nonprofit organizations like OneSight can leverage philanthropic and private sector support, to align their on-the-ground strategies with other actions occurring in the collaborative network.

Deloitte's model gives government, businesses, and philanthropic actors a prioritization for addressing the global need for glasses in the countries with the largest and most acute needs now, over the next five years, and forward as the international community partners to tackle the UN's Sustainable Development Goals. Equipped with this dynamic model, key stakeholders can plan and pivot, always backed by the data needed to bring the world into clearer focus.

Acknowledgements

The authors would like to thank Richard Gradone, Madison Gilbert, and others of Deloitte Consulting LLP for their contributions to this study. Special thanks go to Mony Iyer and others of OneSight for their thought leadership throughout the study and additional help in reviewing the draft paper.

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Endnotes

1. "Sustainable Development Knowledge Platform," United Nations Department of Economic and Social Affairs, accessed July 14, 2016. https://sustainabledevelopment.un.org/

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5. The World Bank Databank of Poverty Headcount Ratio at $2 a day (PPP) (%) 2000-2015 and Poverty Headcount Ratio at the National Poverty Line. The poverty rates were projected to 2015 and 2020 using the average annual percent change in the poverty rate by country over the period from 2001-2014.

6. Because a 100 percent prevalence rate for Presbyopia was assumed after age 50, the total estimates for Myopia/Hyperopia and Presbyopia are not mutually exclusive.

7. "Goal 17: Revitalize the global partnership for sustainable development," United Nations Sustainable Development Goals, accessed July 14, 2016. http://www.un.org/sustainabledevelopment/globalpartnerships/