Published in final edited form as: *Br J Ophthalmol.* 2012 October ; 96(10): 1357–1358. doi:10.1136/bjophthalmol-2012-302088.

The Global Inverse Care Law: A Distorted Map of Blindness

Mr Andrew Bastawrous, BSc (Hons) MBChB HFEA MRCOphth^{*} and

MRC Clinical Research Fellow in International Eye Health, International Centre for Eye Health, Clinical Research Department, London School of Hygiene & Tropical Medicine, Keppel Street, London, WC1E 7HT, UK

Benjamin D. Hennig, PhD

Research Associate, Department of Geography, University of Sheffield, Sheffield, S10 2TN, b.hennig@sheffield.ac.uk

Keywords

Blindness; visual impairment; maps; cartogram; number of ophthalmologists

The Global Inverse Care Law: A Distorted Map of Blindness

Statistical analysis can be used to interpret and give meaning to data, however, the ability to interpret large quantities of data and it's resulting statistical reporting is not always straightforward. Graphical representations such as graphs and maps are a way of translating or converting data in to a visual interpretation.

Commonly used world maps are imperfect and contain distortions to allow a spherical reality to be represented in 2-dimensions. This distortion can be manipulated to produce a world map that gives each defined area (country or region) a size proportional to its population.[1]

Cartograms are used to effectively map socio-economic data and can be effective means of mapping disease. In keeping with the phrase "a picture equals a thousand words" cartograms can be used to analyse spatial data in an easily comprehensible style.

In 1971, Hart[2] described the, "Inverse Care Law" as the availability of good medical care varying inversely with the need for it in the population served. Hart was describing the situation in the National Health Service in Great Britain at the time in which he practiced as both a General Practitioner and an epidemiologist.

Two recently published articles demonstrate the "Inverse Care Law" on a global level. The prevalence of blindness worldwide in 2010[3] was reported by the World Health Organisation and verified that low- and middle-income countries, as expected, have the highest prevalence of blindness and visual impairment. In stark contrast to this, a more recent report describes the, "Number of ophthalmologists in training and practice worldwide"[4] providing global data for the number of ophthalmologists per county and

^{*}Corresponding author: andrew.bastawrous@lshtm.ac.uk. Phone: 0207 958 8333 .

Competing Interests Statement:

No competing interests

Contributorship Statement:

The authors both fulfill ICMJE recommendations.

demonstrates that despite a growing number in practice the gap between need and supply is widening.

The situation is also magnified within individual countries of high, middle and low-income. For example, in France, an inverse correlation was found between the number of ophthalmologists and the prevalence of low vision for subjects of similar age and socioprofessional category[5] and another example is in Kenya where of the 86 practicing ophthalmologists, 43 are based in Nairobi [personal correspondence]. That equates to 50% of the countries ophthalmologists serving 8% of an already underserved population.

We have developed two cartograms to depict the data from these two papers [3 4] using ESRI's ArcGIS 10 software with the Cartogram Creator. These tools apply the Gastner & Newman diffusion-based method [6]. This allowed us to create density-equalised maps based on the absolute values provided in the papers. In the maps, each of the reference areas (WHO regions and countries) is resized according to these values. Larger areas represent higher numbers and smaller areas proportionally smaller data values (see figures 1 and 2).

We believe these maps can be used to share masses of data in a visual, intuitive and comprehensible way, which will be understood by policy makers and can be used by advocates for global health.

Acknowledgments

Funding statement:

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

AB is in receipt of a joint MRC and Fight for Sight Clinical Research Fellowship and funding from the International Glaucoma Association (IGA) and the British Council for the Prevention of Blindness (BCPB).

References

- Dorling D, Barford A, Newman M. WORLDMAPPER: the world as you've never seen it before. IEEE Trans Vis Comput Graph. 2006; 12(5):757–64. doi: 10.1109/TVCG.2006.202[published Online First: Epub Date]]. [PubMed: 17080797]
- 2. Hart JT. The inverse care law. Lancet. 1971; 1(7696):405-12. [PubMed: 4100731]
- Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. The British journal of ophthalmology. 2011 doi: 10.1136/bjophthalmol-2011-300539[published Online First: Epub Date]|.
- Resnikoff S, Felch W, Gauthier TM, et al. The number of ophthalmologists in practice and training worldwide: a growing gap despite more than 200 000 practitioners. The British journal of ophthalmology. 2012 doi: 10.1136/bjophthalmol-2011-301378[published Online First: Epub Date]|.
- Lafuma AJ, Brezin AP, Fagnani FL, et al. Prevalence of visual impairment in relation to the number of ophthalmologists in a given area: a nationwide approach. Health Qual Life Outcomes. 2006; 4:34. doi: 10.1186/1477-7525-4-34[published Online First: Epub Date]. [PubMed: 16756661]
- Gastner MT, Newman ME. From The Cover: Diffusion-based method for producing densityequalizing maps. Proceedings of the National Academy of Sciences of the United States of America. 2004; 101(20):7499–504. doi: 10.1073/pnas.0400280101[published Online First: Epub Date]|. [PubMed: 15136719]

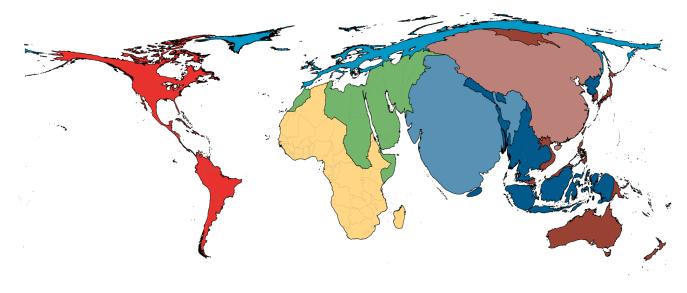


Figure 1.

A Cartogram showing the prevalence of blindness by WHO region (using WHO region colours).

Br J Ophthalmol. Author manuscript; available in PMC 2013 April 01.

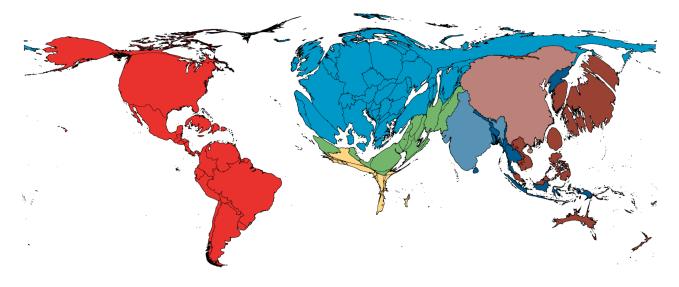


Figure 2. A Cartogram showing the number of practicing ophthalmologists worldwide by country.

Br J Ophthalmol. Author manuscript; available in PMC 2013 April 01.