# Cataract surgery for the developing world

Geoffrey Tabin[a], Michael Chen[b] and Ladan Espandar[a]

[a]John A. Moran Eye Center, University of Utah, Salt Lake City, Utah and [b]David Geffen School of Medicine at UCLA, Los Angeles, California, USA

Correspondence to Geoffrey Tabin, MD, John A. Moran Eye Center, 65 North Medical Dr, Salt Lake City, UT 84132, USA
Tel: +1 435 729 9610; fax: +1 801 5813357;
e-mail: Geoffrey.Tabin@hsc.utah.edu

**Current Opinion in Ophthalmology** 2008, 19:55–59

**Purpose of review**

To review surveys published within the last year concerning the prevalence of cataract blindness, rates of cataract surgical coverage and visual outcomes of cataract surgery in various developing countries, and to review recent studies that compare the different cataract surgical techniques used in developing countries.

**Recent findings**

Up to 75% of blindness (visual acuity below 20/400) is due to cataract. Cataract remains the most common treatable cause of blindness. Reported cataract surgical coverage is low, and visual outcomes are poor and necessitate improvement. Phacoemulsification is the preferred technique for cataract surgery in developed countries, but large-scale implementation in developing countries may prove to be a challenge. An alternative surgical technique, manual sutureless small incision extracapsular cataract surgery, has been increasing in popularity, as the technique has been shown to yield similar surgical outcomes as phacoemulsification.

**Summary**

Treating cataract blindness worldwide continues to be a formidable challenge. Significant barriers include cost, lack of population awareness, shortage of trained personnel and poor surgical outcomes. Both phacoemulsification and manual small incision extracapsular cataract surgery achieve excellent visual outcomes with low complication rates, but manual small incision extracapsular cataract surgery is significantly faster, less expensive and requires less technology. Therefore, manual small incision extracapsular cataract surgery may be the preferred technique for cataract surgery in the developing world.

**Keywords**

cataract blindness, cataract surgery, developing countries, manual sutureless small incision cataract surgery

Curr Opin Ophthalmol 19:55–59

1040-8738

## Introduction

Cataract blindness poses one of the greatest public health challenges of the 21st century. Cataract is the leading cause of blindness worldwide, accounting for nearly half (47.8%) of all cases of blindness [1]. According to the World Health Organization (WHO), an estimated 20 million people worldwide are blind from bilateral cataracts [2]. It is estimated that over 90% of the world's visually impaired live in developing countries [3]. In these countries, blindness is associated with considerable disability and excess mortality, resulting in large economic and social consequences [4].

In 2002, the WHO estimated that blindness affected 37 million people globally [1]. If efforts are not increased to treat avoidable blindness worldwide, this number is projected to increase to 76 million by the year 2020 [4]. To address this issue of increasing blindness, in 1999 the WHO and the International Agency for the Prevention of Blindness launched a global initiative called 'VISION 2020: the Right to Sight' to eliminate avoidable blindness by the year 2020.

Here, the aims of this article are to review the surveys published within the last year concerning the prevalence of cataract blindness, rates of cataract surgical coverage and visual outcomes of cataract surgery in various developing countries, and to review recent studies that compare the advantages and disadvantages of different cataract surgical techniques that are used in developing countries. Given the implications of these studies, we are convinced that it is possible to develop high-quality, high-volume, low-cost programs for relieving cataract blindness.

## Prevalence of cataract blindness

The WHO defines blindness as presenting visual acuity below 20/400 in the better eye with available correction, severe visual impairment as presenting visual acuity of 20/400 or above, but below 20/200 with available correction, and visual impairment as presenting visual acuity of

**Table 1 Prevalence of blindness (by World Health Organization standards unless otherwise noted) in underdeveloped countries as reported in national and regional surveys**

| Country | Region | Number of persons examined | Age of study population (years) | Prevalence of blindness [% (95% confidence interval)] | Blindness due to cataract (%) | Reference |
|---|---|---|---|---|---|---|
| Pakistan | National | 16507 | >30 | 3.4 (3.1–3.7) | 51.5 | [7•] |
| India | Tamil Nadu | 3924 | >40 | 3.36 (2.80–3.93) | 74.62 | [8] |
| Nepal | Gandaki Zone | 5002 | >45 | 1.2 (0.9–1.6) (VA < 20/200) | 74.2 | [9] |
| Myanmar | Meiktila District | 2076 | >40 | 5.3 (4.0–6.6) | 53 | [10] |
| Papua New Guinea | National | 1174 | >50 | 3.9 (3.4–6.1) | 73.2 | [11] |
| Philippines | Antique District | 3177 | >50 | 3.0 (2.4–3.6) | 63 | [12] |
| Philippines | Negros Island | 2774 | >50 | 2.6 (2.0–3.2) | 54 | [12] |
| Timor-Leste | Dili and Bobonaro | 1414 | >40 | 7.7 (NA) (VA < 20/200) | 76.1 | [13] |
| Botswana | National | 2127 | >50 | 3.69 (2.38–5.00) | 46.9 | [14] |
| Cameroon | Limbe Urban Area, South West Province | 2215 | >40 | 1.1 (0.7–1.5) | 21 | [15] |
| Cameroon | Muyuka, South West Province | 1787 | >40 | 1.6 (0.8–2.4) | 62.1 | [16] |
| Cape Verde Islands | National | 3374 | all ages | 0.8 (0.5–1.1) | 57.7 | [17] |
| Kenya | Nakaru district | 3503 | >50 | 2.0 (1.5–2.0) | 42.0 | [18] |
| Nairobi | Kibera slums | 1438 | NA | 0.6 (0.21–1.0) | 37.5 | [19] |
| Nigeria | Imesi-Ile, Osun State | 2201 | 8–92 | NA | 44.4 | [20] |
| Nigeria | Ozoro, Delta State | 815 | >40 | 6.3 (4.6–8) | 60 | [21] |
| Rwanda | Western Province | 2206 | >50 | 1.8 (1.2–2.4) | 65 | [22] |
| Sudan | Mankien Payam | 2499 | >5 | 4.1 (3.4–4.8) | 41.2 | [23] |

NA, not applicable; VA, visual acuity.

20/200 or above, but below 20/60 with available correction [5]. Several national and regional surveys regarding visual impairment from Asia and Africa were published within the last year. By the WHO definition of blindness, the prevalence of blindness ranged from 0.8–6.3% of the study populations. The WHO considers blindness to be a public health problem when the prevalence of blindness in the general population exceeds 1.0% [6]. In most of these surveys, cataract was the most common cause of blindness, accounting for almost 75% of cases of blindness in several surveys. See Table 1.

## Cataract surgical coverage

Given the high prevalence of treatable blindness due to cataracts in developing countries, it is important to assess the proportion of individuals with blinding cataracts who undergo cataract surgery. Cataract surgical coverage (CSC) can serve as a marker of the availability of eye care services and is defined as the percentage of individuals (or eyes) with operable cataracts that have undergone cataract surgery. Operable cataract can be defined at different visual acuity cutoffs [24] and thus the CSC can vary. As apparent from the CSC values in various developing countries reported within the past year (Table 2), the CSC is usually higher with worsening visual acuity.

Inadequate coverage may be due to various barriers to patient care. In the survey conducted in Pakistan, those who remained blind from operable cataracts were asked why they did not receive cataract surgery; 76.1% identified cost and 11.5% identified lack of awareness [25•]. Similar reasons were reported in the surveys conducted in the Philippines, Botswana, Cameroon and Kenya [12,14–16,18]. Another reason reported in the surveys conducted in Botswana and Kenya was lack of escort [14,18]. In Timor-Leste, when those who had previously undergone surgery or had at least one vision impaired eye (visual acuity below 20/60) were asked what price they were willing or able to pay for cataract surgery, 94% were unwilling and/or unable to pay more than US$10 [13].

**Table 2 Cataract surgical coverage in underdeveloped countries as reported in national and regional surveys**

| Country | Region | Visual acuity | Cataract surgical coverage (individuals) (%) | Reference |
|---|---|---|---|---|
| Pakistan | National | <20/400; <20/200; <20/60 | 77.1; 69.3; 43.7 | [25•] |
| Nepal | Gandaki Zone | <20/200 | 59.5 | [9] |
| Cameroon | Limbe Urban Area, South West Province | <20/400: <20/200 | 80; 71 | [15] |
| Cameroon | Muyuka, South West Province | <20/400; <20/200 | 55; 64.3 | [16] |
| Botswana | National | <20/400 | 66.5 | [14] |
| Kenya | Nakaru district | <20/400; <20/200 | 78; 48.3 | [18] |
| Rwanda | Western Province | <20/400; <20/200; <20/60 | 47.2; 42.6; 21.4 | [22] |
| Timor-Leste | Dili and Bobonaro | <20/200 | 20.2 | [13] |
| Philippines | Negros Island | <20/400; <20/200; <20/60 | 61.6; 57.9; 27.0 | [12] |
| Philippines | Antique District | <20/400; <20/200; <20/60 | 61.5; 50.8; 32.1 | [12] |

## Reported visual outcomes from population surveys

Relieving cataract blindness not only involves sufficient surgical coverage, but also good surgical outcomes. Growing concern exists over the outcomes of cataract surgery in developing countries. The surgical outcomes reported in recent surveys (Table 3) are noticeably suboptimal when compared to consolidated data from the US, Canada, Denmark and Spain [27]. In these four developed countries, 92% of operated eyes achieved a postoperative visual acuity of 20/60 or above, 6% 20/200 or above and below 20/60, and 2% below 20/200. Of note, with the exception of the survey conducted in Pakistan, the particular cataract surgery techniques utilized [i.e. intracapsular cataract extraction (ICCE), conventional extracapsular cataract extraction (ECCE), phacoemulsification and manual sutureless small incision cataract surgery (SICS)] were not specified, and thus these data cannot be used to evaluate and compare the efficacy of these surgical techniques. Surveys in Pakistan and in the Nakaru district, Kenya, attributed poor postoperative visual acuity to refractive error (53.4 and 33.9%), surgical complications (21.4 and 30.4%) and concurrent eye disease (23.5 and 35.7%) [18,26•]. Posterior capsular opacification was the most common postoperative complication and due to the unavailability of the Nd:YAG laser, only 0.98% of these patients received YAG capsulotomy [26•]. Good postoperative visual outcomes were associated with the use of intraocular lenses (IOLs) [12,15,18,22,26•]. Poor postoperative visual outcomes were associated with ICCE, surgery performed at an eye camp or government hospital, rural dwelling, female gender and illiteracy [26•].

The difference between uncorrected visual acuity and best corrected visual acuity in several studies brings attention to the fact that residual refractive error is a major barrier to successful outcomes and highlights the importance of adequate follow-up care. The preferred surgical technique is one that minimizes the need for postoperative refractive correction.

## Comparisons of different approaches to cataract surgery

Several studies have brought attention to the advantages and disadvantages of various surgical approaches to cataract surgery in developing countries. Throughout the first four decades of the 20th century, ICCE was the predominant form of lens removal worldwide [28]. As patients remain aphakic after ICCE, aphakic spectacles must be worn for optical correction [29]. Aphakic spectacles, if the patient receives and uses them, pose obvious disadvantages such as image magnification, restricted visual fields, poor coordination and physical discomfort. ECCE with the implantation of an IOL became the preferred method of cataract surgery in the 1980s and today most surgeons in developing countries have been trained in this technique. Despite the better visual outcomes of ECCE over ICCE, ICCE is still a technique commonly practiced in developing countries and continues to outnumber ECCE in countries such as Pakistan (61.5 vs. 33.9%) [26•,30].

Phacoemulsification is the predominant surgical technique employed in developed countries, as studies have suggested that phacoemulsification gives better visual outcomes than ECCE [31,32]. This is attributed in part to less postoperative astigmatism due to the lack of sutures and smaller size of incision (phacoemulsification around 3 mm, ECCE around 12 mm) [33]. Phacoemulsification, however, is difficult to employ in high volume in developing countries as the technology requires costly machinery and consumables, a permanent and reliable source of electricity, regular maintenance, and specially trained surgeons and support staff. Phacoemulsification can also potentially lead to more serious complications when used to remove extremely dense cataracts commonly encountered in developing countries [31].

Given these challenges, manual sutureless SICS has been the technique increasingly employed in developing countries. Manual SICS is comparable to phacoemulsification in achieving excellent visual outcomes with low

**Table 3 Postoperative visual acuities as reported in national and regional surveys**

| Country | Region | Number of eyes operated | Visual acuities | With no correction or available correction (%) | With best correction (%) | Reference |
|---|---|---|---|---|---|---|
| Pakistan | National | 1788 | ≥20/60; ≥20/200, <20/60; <20/200 | 29.5; 35.3; 34.3 | 50.1; 27.5; 22.1 | [26•] |
| Cameroon | Limbe Urban Area, South West Province | 26 | ≥20/60; ≥20/200, <20/60; <20/200 | 23; 19; 57 | NA | [15] |
| Cameroon | Muyuka, South West Province | 28 | ≥20/60; ≥20/200, <20/60; <20/200 | 25; 10.7; 64.3 | NA | [16] |
| Botswana | National | 148 | <20/200 | NA | 37 | [14] |
| Kenya | Nakaru district | 222 | ≥20/60; ≥20/200, <20/60; <20/200 | 49.5; 19.8; 30.6 | 63.5; 14.4; 22.1 | [18] |
| Rwanda | Western Province | 29 | ≥20/60; ≥20/200, <20/60; <20/200 | 24; 35; 41 | 55; 14; 31 | [22] |
| Philippines | Negros Island | 113 | ≥20/60; ≥20/200, <20/60; <20/200 | 68; 17; 23 | 70; 15; 15 | [12] |
| Philippines | Antique District | 120 | ≥20/60; ≥20/200, <20/60; <20/200 | 70; 18; 13 | 79; 13; 8 | [12] |

NA, not applicable.

complication rates, but is significantly faster, less expensive and requires less technology [33,34••,35••,36].

Gogate *et al.* [33] compared phacoemulsification with manual SICS in a randomized controlled trial of 400 eyes in India and concluded that the techniques were comparable in efficacy and safety. Uncorrected visual acuity of 20/60 or above at postoperative week 1 and postoperative week 6 was achieved by 68.2% phacoemulsification vs. 61.25% SICS, and 81.08% phacoemulsification vs. 71.1% SICS, respectively. Best corrected visual acuity of 20/60 or above at postoperative week 6 was achieved by 98.4% phacoemulsification vs. 98.4% SICS. Complications included posterior capsular opacity, iridodialysis and iritis, but were rare and rates were similar between both groups.

Ruit *et al.* [35••] compared phacoemulsification with manual SICS in a randomized controlled trial of 108 eyes in Nepal, and showed that both phacoemulsification and manual SICS achieved comparable, excellent visual outcomes. Uncorrected visual acuity of 20/60 or above at postoperative month 6 was achieved by 85% phacoemulsification vs. 89% manual SICS. Best corrected visual acuity of 20/60 or above at the same visit was achieved by 98% phacoemulsification and 98% manual SICS. Both groups had low complication rates, with only one case of posterior capsule rupture with vitreous loss in the phacoemulsification group. There were 17 cases of transient hyphema; all but one case occurred in the manual SICS group. None of these cases of hyphema required intervention and all of them spontaneously cleared by postoperative day 5.

Manual SICS was shown to be significantly faster than phacoemulsification. The average operative times plus turnover reported by Gogate *et al.* [34••] and Ruit *et al.* [35••] were 15 min 30 s and 15 min 30 s for phacoemulsification, respectively, and 8 min 35 s and 9 min for manual SICS, respectively. Venkatesh *et al.* [36] conducted a study at the Aravind Eye Hospital that showed an average operative time plus turnover of less than 4 min per case of manual SICS. Other studies have reported a similar manual SICS surgical rate of 12–16 cases per hour [37].

Manual SICS has also been shown to cost less than phacoemulsification. Muralikrishnan *et al.* [38] reported in a study in India an average cost of US$25.55 for phacoemulsification and US$17.03 for manual SICS. Gogate *et al.* [34••] reported an average cost of US$42.10 for phacoemulsification and US$15.34 for manual SICS, assuming that consumables were reused. If consumables were used only once, the average costs of phacoemulsification and manual SICS increased to US$69.40 and 38.95, respectively. This increase in cost highlights the fact that cost can be reduced in high-volume programs where consumables can be maximized.

The higher cost of phacoemulsification can be attributed to the cost of a high-technology machine that requires regular maintenance, the requirement of a dependable source of electricity, and consumables such as phacoemulsification tips, sleeves and tubing. Manual SICS can be performed with a relatively inexpensive microscope powered by battery or small diesel generator. Remote eye camps in Chaughada, for example, utilize portable microscopes (model 161-50; Scan Optic, Adelaide, Australia) that cost approximately US$4800 each [39]. Phacoemulsification also requires imported foldable IOLs. Poly(methyl methacrylate) lenses locally manufactured in Nepal or India are roughly 1/10 the cost of foldable IOLs that are imported from the US [35••]. The use of locally manufactured IOLs and other consumables has lowered the cost of manual SICS at the Tilganga Eye Center in Nepal to less than US$20 per case.

Phacoemulsification also requires specially trained surgeons and support staff, and the learning curve is steep. Comparatively, manual SICS may be easier to learn as it is more similar to the ECCE technique that is already familiar to many eye surgeons in developing countries [33].

## Conclusion

As the number of blinding cataracts worldwide continues to increase, attention needs to be given to increasing surgical coverage, improving visual outcomes and reducing cost. Although phacoemulsification is the surgical technique of choice in developed countries, manual SICS has been shown to achieve similar excellent visual outcomes with low complication rates, while being significantly faster, costing less, and requiring less technology and training than phacoemulsification. Therefore, manual SICS may be the preferred technique for cataract surgery in developing countries where the high prevalence of cataract blindness necessitates high-quality, high-volume, low-cost cataract surgery programs.

## References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- • of special interest
- •• of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 74–75).


1 Resnikoff S, Pascolini D, Etya'ale D, *et al.* Global data on visual impairment in the year 2002. Bull World Health Organ 2004; 82:844–851.

2 Baltussen R, Sylla M, Mariotti SP. Cost-effectiveness analysis of cataract surgery: a global and regional analysis. Bull World Health Organ 2004; 82:338–345.

**3** Thylefors B. A simplified methodology for the assessment of blindness and its main causes. World Health Stat 1987; Q40:129–141.

**4** Frick KD, Foster A. The magnitude and cost of global blindness: an increasing problem that can be alleviated. Am J Ophthalmol 2003; 135:471–476.

**5** World Health Organization. ICD-10 updates 2006. World Health Organization: Geneva; Last accessed 4 August 2007. Available at http://www.who.int/classifications/icd/2006Updates.pdf.

**6** World Health Organization. Prevention of blindness and visual impairment. World Health Organization: Geneva; Last accessed 4 August 2007. Available at http://www.who.int/blindness/en/.

**7** • Dineen B, Bourne RR, Jadoon Z, *et al.*, on behalf of the Pakistan National Eye Survey Study Group. Causes of blindness and visual impairment in Pakistan. The Pakistan National Blindness and Visual Impairment Survey. Br J Ophthalmol 2007; 91:1005–1010.
This article reported the results of an extensive, comprehensive national survey concerning the prevalence of blindness and its causes in Pakistan.

**8** Vijaya L, George R, Arvind H, *et al.* Prevalence and causes of blindness in the rural population of the Chennai Glaucoma Study. Br J Ophthalmol 2006; 90:407–410.

**9** Sapkota YD, Pokharel GP, Nirmalan PK, *et al.* Prevalence of blindness and cataract surgery in Gandaki Zone, Nepal. Br J Ophthalmol 2006; 90:411–416.

**10** Casson RJ, Newland HS, Muecke J, *et al.* Prevalence and causes of visual impairment in rural Myanmar: the Meiktila eye study. Ophthalmology 2007; Epub ahead of print.

**11** Garap JN, Sheeladevi S, Shamanna BR, *et al.* Blindness and vision impairment in the elderly of Papua New Guinea. Clin Experiment Ophthalmol 2006; 34:335–341.

**12** Eusebio C, Kuper H, Polack SR, *et al.* Rapid assessment of avoidable blindness in Negros Island and Antique District, Philippines. Br J Ophthalmol 2007; Epub ahead of print.

**13** Brian G, Palagyi A, Ramke J, *et al.* Cataract and its surgery in Timor-Leste. Clin Exp Ophthalmol 2006; 34:870–879.

**14** Nkomazana O. A national survey of visual impairment in Botswana. Community Eye Health 2007; 20:9.

**15** Enyegue Oye J, Kuper H. Prevalence and causes of blindness and visual impairment in Limbe Urban Area, South West Province, Cameroon. Br J Ophthalmol 2007; Epub ahead of print.

**16** Oye JE, Kuper H, Dineen B, *et al.* Prevalence and causes of blindness and visual impairment in Muyuka: a rural health district in South West Province, Cameroon. Br J Ophthalmol 2006; 90:538–542.

**17** Schémann JF, Inocencio F, de Lourdes Monteiro M, *et al.* Blindness and low vision in Cape Verde Islands: results of a national eye survey. Ophthalmic Epidemiol 2006; 13:219–226.

**18** Mathenge W, Kuper H, Limburg H, *et al.* Rapid assessment of avoidable blindness in Nakuru district, Kenya. Ophthalmology 2007; 114:599–605.

**19** Ndegwa LK, Karimurio J, Okelo RO, Adala HS. Prevalence of visual impairment and blindness in a Nairobi urban population. East Afr Med J 2006; 83:69–72.

**20** Adegbehingbe BO, Majengbasan TO. Ocular health status of rural dwellers in south-western Nigeria. Aust J Rural Health 2007; 15:269–272.

**21** Patrick-Ferife G, Ashaye AO, Qureshi BM. Blindness and low vision in adults in Ozoro, a rural community in Delta State, Nigeria. Niger J Med 2005; 14:390–395.

**22** Mathenge W, Nkurikiye J, Limburg H, Kuper H. Rapid assessment of avoidable blindness in western Rwanda: blindness in a postconflict setting. PLoS Med 2007; 4:e217.

**23** Ngondi J, Ole-Sempele F, Onsarigo A, *et al.* Prevalence and causes of blindness and low vision in southern Sudan. PLoS Med 2006; 3:e477.

**24** Taylor H. Cataract: how much surgery do we have to do? Br J Ophthalmol 2000; 84:1–2.

**25** • Jadoon Z, Shah SP, Bourne RR, *et al.* Cataract prevalence, cataract surgical coverage and barriers to uptake of cataract surgical services in Pakistan: The Pakistan National Blindness and Visual Impairment Survey. Br J Ophthalmol 2007; Epub ahead of print.
This article reported the results of an extensive, comprehensive national survey concerning the cataract surgical coverage and barriers to cataract surgery in Pakistan.

**26** • Bourne R, Dineen B, Jadoon Z, *et al.* Outcomes of cataract surgery in Pakistan: results from The Pakistan National Blindness and Visual Impairment Survey. Br J Ophthalmol 2007; 91:420–426.
This article reported the results of an extensive, comprehensive national survey concerning the outcomes of cataract surgery in Pakistan.

**27** Norregaard JC, Bernth-Petersen P, Alonso J, *et al.* Visual functional outcomes of cataract surgery in the United States, Canada, Denmark, and Spain: report of the International Cataract Surgery Outcomes Study. J Cataract Refract Surg 2003; 29:2135–2142.

**28** Linebarger EJ, Hardten DR, Shah GK, Lindstrom RL. Phacoemulsification and modern cataract surgery. Surv Ophthalmol 1999; 44:123–147.

**29** Oliver JE, Thulasiraj RD, Rahmathullah R, *et al.* Vision specific function and quality of life after cataract extraction in south India. J Cataract Refract Surg 1998; 24:222–229.

**30** Gupta AK, Tewari HK, Ellwein LB. Cataract surgery in India: results of a 1995 survey of ophthalmologists. Indian J Ophthalmol 1998; 46:47–50.

**31** Bourne RR, Minassian DC, Dart JK, *et al.* Effect of cataract surgery on the corneal endothelium: modern phacoemulsification compared with extracapsular cataract surgery. Ophthalmology 2004; 111:679–685.

**32** Minassian DC, Rosen P, Dart JKG, *et al.* Extracapsular cataract extraction compared with small incision surgery by phacoemulsification: a randomised trial. Br J Ophthalmol 2001; 85:822–829.

**33** Gogate PM, Kulkarni SR, Krishnaiah S, *et al.* Safety and efficacy of phacoemulsification compared with manual small-incision cataract surgery by a randomized controlled clinical trial: six-week results. Ophthalmology 2005; 112:869–874.

**34** •• Gogate P, Deshpande M, Nirmalan PK. Why do phacoemulsification? Manual small-incision cataract surgery is almost as effective, but less expensive. Ophthalmology 2007; 114:965–968.
The authors conducted a randomized controlled trial comparing phacoemulsification with manual sutureless SICS, and concluded that SICS is comparable in visual outcomes and safety, but more economical.

**35** •• Ruit S, Tabin GC, Chang D, *et al.* A prospective randomized clinical trial of phacoemulsification vs manual sutureless small-incision extracapsular cataract surgery in Nepal. Am J Ophthalmol 2007; 143:32–38.
The authors compared the efficacy and visual results of phacoemulsification with manual sutureless SICS, and found that both phacoemulsification and SICS achieved comparable excellent visual outcomes with low complication rates, but SICS was significantly faster, less expensive and less technology dependent than phacoemulsification.

**36** Venkatesh R, Muralikrishnan R, Balent LC, *et al.* Outcomes of high volume cataract surgeries in a developing country. Br J Ophthalmol 2005; 89:1079–1083.

**37** Prajna NV, Chandrakanth Ks, Kim R, *et al.* The Madurai intraocular lens study II: clinical outcomes. Am J Ophthalmol 1998; 125:14–25.

**38** Muralikrishnan R, Venkatesh R, Venkatesh Prajna N, Frick KD. Economic cost of cataract surgery procedures in an established eye care centre in Southern India. Ophthalmic Epidemiol 2004; 11:369–380.

**39** Ruit S, Tabin GC, Nissman SA, *et al.* Low-cost high-volume extracapsular cataract extraction with posterior chamber intraocular lens implantation in Nepal. Ophthalmology 1999; 106:1887–1892.