Table 1 Rates of patient satisfaction with the glaucoma services and their health professionals

	Dissatisfied (%)	*Neither satisfied nor dissatisfied (%)*	*Satisfied (%)*
Community optometrist	0	5	95
Hospital doctor	2	16	82
Community scheme overall	1	24	75
Hospital service overall	1	26	73

patients in the hospital service were asked if they would be happy to be transferred to the community scheme. Sixty-two out of 66 patients in the community scheme were happy to remain, whereas only 33/65 of hospital patients would be happy to be transferred to the community optometrist scheme.

The difference in satisfaction between the optometrist and doctor may reflect differences in training (with a more client-oriented approach in optometry) or differences in perceived time pressures. Satisfaction rates were equivalent between the schemes overall.

Both previous publications on satisfaction in community schemes found higher satisfaction with the community service, whereas we have found them equivalent. In comparison with the Bristol scheme,[3] we did not randomise our patients to each group, and therefore some of the hospital patients may have been ineligible for the community scheme. In contrast to Levy and Booth's[1] series, we asked patients to comment on satisfaction with their current scheme, rather than making a comparison.

Patients in the scheme were happy to remain there, whereas of those in the hospital only half would be happy to be transferred. This may be due to more complicated requirements (whether perceived or real) of the hospital patients' glaucoma. Without adequate explanation, the patient may feel that they are being 'downgraded' or outsourced. We would like to highlight the importance of adequate information given to patients when they are transferred to a community scheme.

Conflict of interest

The authors declare no conflict of interest.

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Sir,
Comment on 'Cost effectiveness of collagen crosslinking for progressive keratoconus in the UK NHS'

It is difficult to overestimate the importance of the UK National Health Service (NHS) policy to structurally assess the cost effectiveness of novel treatments. This policy serves as an example for policy makers in many developed countries, and the outcomes of the analyses are made available to fellow researchers in the field. The recent publication by Salmon *et al*[1] regarding the cost effectiveness of crosslinking for progressive keratoconus is an excellent example of this. The authors concluded that crosslinking is likely to be cost effective, with an incremental cost of £3174 per quality-adjusted life year (QALY), supporting the NHS' decision to reimburse this treatment.

We would like to address the methods used in this study, specifically the authors' calculation of QALYs in keratoconus. QALYs represent the value of the impact of disease on quality of life measured over a lifetime. The concept is based on the measurement of utilities. A utility is represented on a scale anchored at 0 (representing death) and 1 (representing full health) and can be assessed using specific questionnaires (eg, the Euroqol EQ-5D (Euroqol group http://www.euroqol.org/about-eq-5d.html)) or calculated from patient-reported health surveys (eg, SF-6D[2] derived from Short From 36 Health (SF-36) survey questionnaires[3]). QALYs and utilities are the preferred outcome measures used when performing a cost effectiveness analysis. The authors state that direct measures of utilities in keratoconus are not available and therefore estimated utilities based on expected visual acuity (VA) in various stages of keratoconus, leading to decreased utilities in advanced keratoconus.

However, the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) study measured SF-36 in more than 1200 keratoconus patients, including appropriate descriptions of the patients' VA, keratometry, and subsequent staging using the Amsler–Krumeich classification.[4] Using the CLEK database, we classified all of the included subjects according to their keratometry readings, and we linked these results to SF-6D-derived utilities, following the method developed by Brazier *et al*.[2]

Table 1 Utilities of keratoconus patients in various disease stages from the CLEK cohort

Better eye (stage)	*Worse eye (Stage)*	*Utilities (SF-6D)*	*SD*	N
I	I	0.85	0.122	2629
I	II	0.83	0.123	1799
I	III	0.85	0.127	209
I	IV	0.84	0.119	446
II	II	0.85	0.124	1071
II	III	0.82	0.136	368
II	IV	0.83	0.125	555
III	III	0.82	0.139	64
III	IV	0.84	0.127	181
IV	IV	0.85	0.124	372
After corneal transplantation				
I	Tx	0.82	0.135	458
II	Tx	0.83	0.130	337
III	Tx	0.83	0.130	124
IV	Tx	0.83	0.129	250
Tx	Tx	0.80	0.137	204

Abbreviations: *N*, number of measurements; stage, disease severity based on the keratometry value using the Amsler–Krumeich classification; SF-6D, mean utility derived from SF-36; Tx, corneal transplantation.

To our surprise, we found virtually no difference in utilities among the various disease stages in keratoconus; strikingly, the utilities in patients with bilateral stage I keratoconus were identical to the utilities in patients with bilateral stage IV keratoconus (Table 1). Similar results were obtained when the results were stratified based on age and gender. Thus, if perceived quality of life does not deteriorate as the disease progresses, hardly any therapy will be cost effective.

We hypothesize that either SF-36-derived utilities lack the sensitivity to detect the apparent differences per disease stage that subjects adjust to their disease stage over time, or that a keratometry-based classification is not appropriate. Keratometry is not a clinical endpoint, and its relationship with VA is multifactorial and complex. Both VA and the patient's dependence upon visual aids are arguably more relevant for determining quality of life in keratoconus patients. Although vision-related quality of life is related to VA in the better eye,[5] we investigated the correlation between (LogMAR) VA in the better eye and utilities, and found a significant relation ($P<0.001$, Pearson's $r=-0.113$). The utilities obtained for various VA groups are summarized in Table 2. The largest decrease in utilities occurs when LogMAR VA in the better eye is 0.6 or larger (Snellen equivalent <0.25), particularly in patients who underwent either unilateral or bilateral corneal transplantation.

In conclusion, quality of life as measured by SF-6D in keratoconus patients is related to VA in the better eye, whereas no correlation could be identified between quality of life and keratometry values or disease stage. We postulate that VA may be a better intermediate outcome to base QALYs on than either keratometry or disease stage.

Table 2 Utilities measured in keratoconus patients depend on visual acuity in the better eye

LogMAR VA better eye	*Snellen VA better eye*	*Utilities (SF-6D)*	*SD*	N
No previous corneal transplantation				
≤0.3	≥0.5	0.85	0.119	5168
0.3–0.6	0.25–0.5	0.83	0.131	2417
>0.6	<0.25	0.81	0.140	241
After unilateral corneal transplantation				
≤0.3	≥0.5	0.84	0.119	725
0.3–0.6	0.25–0.5	0.82	0.158	414
>0.6	<0.25	0.69	0.132	79
After bilateral corneal transplantation				
≤0.3	≥0.5	0.81	0.132	125
0.3–0.6	0.25–0.5	0.83	0.137	55
>0.6	<0.25	0.68	0.186	13

Abbreviations: LogMAR VA best eye, LogMAR visual acuity in the best eye, measured with the patient's usual correction (unaided or lenses and/or spectacles); *N*, number of measurements; snellen VA best eye, snellen visual acuity in the best eye; utilities, mean SF-6D utility.

Conflict of interest

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Sir,
Response to: Comment on 'Cost effectiveness of collagen crosslinking for progressive keratoconus in the UK NHS'

We thank Dr Godefrooij and his colleagues[1] for their interest in, and their thought-provoking comments regarding, our work. We are aware of the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) study,[2] which was a repeated measures evaluation of 1209 patients recruited from 16 centres in the USA and followed up for 8 years beginning in the mid to late 1990s.[2] All except two centres recruited over 60 patients. The patients' mean age at enrolment was around 39 years, with around 250 aged under 30.[2] Patients were not specifically selected according to any progression rate criteria. All patients completed the SF36 at baseline but not so far as we are aware, thereafter, although NEI VFQ scores were measured year on year.[2] The SF36 raw scores have not been published. There are also some practical problems using this data for our type of analysis. These are, first, the fact that it has a multi-centre structure that might lead to difficulties modelling the correct uncertainty.[3] Second, the number of patients in the set who correspond to our decision problem criteria might be very small.

Dr Godefrooij and colleagues have provided valuable further insight into the difficulties of estimating utility values from clinical data. We are not surprised by the poor association between keratometry values and utility values, as these represent opposite ends of the proximal–distal continuum of outcome measurements. Their findings with regard to utility *vs* keratometry on the SF36 are certainly perplexing, and would imply that not even corneal grafting could be offered to keratoconus patients. Quality of life is obviously modulated by many factors apart from simple clinical measurements. However, cost effectiveness studies are essentially of a comparative nature. The comparison in this case is between collagen crosslinking (CXL) and standard treatment, including corneal transplantation. We find that if Dr Godefrooij's keratometry-derived utility values are modified so that any increments in utility associated with obvious disease worsening are amended to no change, as seems reasonable, then our model predicts that CXL would be cost effective at willingness to pay thresholds greater than around £14 000 per QALY in our base case scenario. Utilities based on visual acuity are therefore likely to give similar results to our own. It seems that the present need is for progress on how utility is measured in keratoconus.

The correlation between visual acuity in the better eye and utility has been demonstrated many times[4–7] and seems to persist in multivariate regression models.[6] It has also assumed a central role in cost effectiveness modelling. The most vivid example of this, perhaps, remains the decision by the UK National Institute of Health and Care Excellence regarding licencing of treatment for age-related macular degeneration.[8] We note that the correlation appears well demonstrated on vision-specific scales[4,5] (absolute values of Pearson's r of the order of 0.4–0.67), but may be less on generic health-related quality of life (HRQoL) scales such as the SF6D and EQ-5D,[6,7,9,10] as Dr Godefrooij's absolute value of 0.113 also suggests. The square of Pearson's r is equal to the proportion of measured variance in an outcome variable that is explained by the predictor variable in a univariate regression model.[11] This result means that better eye visual acuity 'explains', at best, up to around 45% of the overall variance in patients' utility scores. Dr Godefrooij and his colleagues' result thus corresponds to around 1.3% of the total variance in the SF36 scores in CLEK.[2] These estimates perhaps partly explain why not all are convinced that better eye visual acuity should be accorded such importance,[12] and that other correlations for example with worse eye visual acuity and visual field defects may also be relevant. We feel confident that Dr Godefrooij and many others would welcome a reappraisal of the situation, especially with regard to generic HRQoL *vs* vision specific scales, patient *vs* public elicitation, and disease specific factors.[12] Dr Godefrooij and his colleagues' suggestion that the SF36/SF6D is a poor instrument for measuring disutility in visual disease is very likely to be correct.[9,10] The implications with regard to the EQ-5D and decision-making have been highlighted previously.[13] Their further suggestion that patients show adaptation to their condition over time also seems very plausible. We would also propose that the patients in the CLEK data are subject to a variety of confounding factors such as chronic disease, age, economic status etc. For example, there were 99 reports of coexisting cardiovascular disease, diabetes, or cystic fibrosis.[2] On the other hand, the numerous additional reports of asthma and other atopic conditions,[2] which have been linked to keratoconus,[2] suggest that even if the disutility of diminished visual function is adequately measured, the overall disutility of keratoconus has additional dimensions.

At the present time, we still feel that the largest degree of parameter uncertainty is to be found in the duration of treatment effect, which is also clearly illustrated in our results. In this context, the recently published follow up results of the Wittig-Silva RCT[14] (for example) are welcome, but it will be sometime before the results of more substantial follow-up are available.

Conflict of interest

The authors declare no conflict of interest.