Review

Clinical practice variation in cataract surgery


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A R T I C L E  I N F O

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A B S T R A C T

Purpose: Cataract surgery rates have dramatically increased in the last two decades. However, clinical practice variation in cataract surgery has not been thoroughly studied. The aim of this review is to analyze clinical practice variation, including the causes and consequences of this phenomenon. Then, its role in health care planning and health care quality is focused on, emphasizing the importance of reducing it and providing several practical strategies to accomplish it.

Recent findings: The latest researches are presented in this article. They identify the development and implementation of clinical practice guidelines as the best tool to standardize care processes.

Conclusion: Managing unwarranted or unwanted variation would improve quality of care and may lead to a significant saving in health care spending.

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V a r i a b i l i d a d  c l í n i c a  e n  l a  c i r u g i ñ a  d e  l a  c a t a r a t a

R E S U M E N

Propósito: Las tasas de la cirugía de la catarata han aumentado de forma espectacular en las últimas dos décadas. Sin embargo, las variaciones en la práctica clínica en esta cirugía no han sido estudiadas en profundidad. El objetivo de esta revisión es el análisis de dicha variabilidad, incluyendo los factores que la originan y las consecuencias sobre la calidad asistencial y la planificación sanitaria. Asimismo se resalta la importancia de reducirla y se exponen diversas estrategias que permiten su control.

Hallazgos recientes: A lo largo del artículo se presentan las últimas investigaciones en las que se considera que el desarrollo y la implementación de guías de práctica clínica constituyen la mejor herramienta para estandarizar los procesos de cuidados.

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Introduction

In the current health industry environment, focused on cost reductions, it must be taken into account that up to 30% of health assistance expenditure could be eliminated without a negative impact on results.\(^1\) In Spain, with a percentage of 8.4% of GDP dedicated to health expenditure (OECD Health Data 2008), said percentage would amount to 2.5% of GDP. Accordingly, if inappropriate procedures can be reduced, resources could be released to provide adequate and effective services to the entire population.

Medical practice variability (MPV) is accepted as inherent in clinical decision-making which cannot be eliminated completely. However, it is priority to identify unjustified or undesirable variabilities because MPV could indicate processes in which quality and efficiency processes are more predominant.

In this regard, a MPV study should be used to adopt different types of measures in clinical management, i.e., enhancing effective procedures in areas which are not sufficiently used and reducing excessive use of ineffective or inadequate services, managing the supply of resources and promoting more efficient policies\(^3\) because MPV analysis and reduction constitutes an opportunity for controlling health expenditure.

Cataract surgery (as a typical case of elective surgery) is also affected by MPV considering variability between countries, regions and hospitals which is not explained by the characteristics of patients. To this we must add the rapid increase of cataract surgery in the last 2 decades, a trend which will most likely continue to increase in the future.\(^4\)–\(^9\)

The recent establishment of a new Cataracts Departments in the Reina Sofia University Hospital of Córdoba has brought about modifications in the “cataract process” and implements a new standardized operational procedure which includes quality indicators. One of our objectives is to reduce process variabilities.

Accordingly, the objective of this article is to raise awareness amongst the ophthalmological community about MPV in cataract surgery because we consider that, under the present circumstances, it is important to control MPV on the basis of the best available evidence, placing all the above in the framework of a total quality management strategy.

Antecedents and concept of variability in medical practice

Concerns about inequalities in the use of health services are not new. A pioneering article on MPV was authored by Glover in 1938 on the rate of amigdalectomies in England,\(^10\)\(^11\) in which a huge variability was referred between different school districts. According to Glover, the only explanation for said inequalities was the lack of uniformity between the physicians who attended these children related to amigdalectomy indications and benefits.

The most relevant studies on variability were written after 1970 by Wennberg and his group,\(^12\) regarded nowadays as the essential reference on the subject. The first research they made on hospital admissions in Vermont revealed the existence of large variations in hospital usage rates, installed resources and health-related expenditure.\(^10\)\(^13\)

The successive publications of the Wennberg group in the following decade definitely broadened the view on variability by comparing the utilization of hospitals in Boston and New Haven.\(^14\) They observed that the citizens of Boston spent 74% more in hospital services than their neighbors in New Haven despite the similarity between both cities as regards age groups, ethnicity and income.\(^15\) Wennberg’s research was continued with the publication of the Darmouth Atlas of Health Care which systematically reviewed the American health system, concluding that if unnecessary expenses were controlled there would be sufficient resources to provide high-quality medical care to the entire population.

The MPV concept refers to systematic and nonrandom variations in the standardized rates as per age and sex for a determined clinical procedure at a given population aggregation level. MPV studies have an ecological nature and are focused on the analysis of small areas as the main methodological tool. The objective of these studies is to compare the rates of different geographical areas and assess whether variabilities involve different utilization of services as well as the magnitude and relevance of these differences.\(^10\)

In practice, MPV can be divided as justified and unjustified. The former occurs due to demographic and sociocultural differences whereas the latter appears once the above-mentioned factors are under control and involve a poor quality care and possible misuse of resources.

The factors which determine systematic variability can be analyzed on the demand side (morbidity, demographic structure, sociocultural level, patient expectations, etc.) and on the supply side, where we can differentiate between the characteristics of health professionals (knowledge, uncertainty, etc.) and the characteristics of the health system (structure, organization, accessibility, funding, etc.). The proportion of the variability explained by each factor is difficult to determine.\(^10\)\(^15\)–\(^17\)

On the basis of the relative importance of the above factors, several theories have been developed to explain MPV. One theory hypothesizes on the basis of uncertainty, patient practice styles, enthusiastic physicians and technological fascination.\(^10\)\(^15\)\(^16\)
The most widely used variability statistical measure is the variation ratio (high-low ratio, VR), which is the quotient between the highest and lowest observed values.\textsuperscript{18} Even though this measure hardly uses information (only the 2 extreme values), it is hardly used due to its simplicity and intuitive nature (one variation ratio of 2 indicates twice the amount of utilization).

**Global perspective of cataract surgery**

Initially, 3 concepts must be defined:

- **Operable cataracts.** This term is used to define cataracts on which of the ophthalmologist and the patient agree that must be operated.\textsuperscript{19} As surgery results have improved remarkably with phacoemulsification, the visual acuity (VA) threshold for which this surgery is indicated is increasingly lower\textsuperscript{20–22} and therefore the number of operable cataracts increases. To this we must add increased longevity, not only in Western societies but also in developing countries.

- **Cataract surgery rate (CSR).** This is the number of cataract operations per million inhabitants per year in a given area (WHO), even though other statistics (OECD) take 100,000 inhabitants. CSR is an action indicator, indicating the amount of effort required for controlling loss of vision due to cataracts and enabling comparisons between hospitals, regions and countries. It is also useful for assessing accessibility and availability of health services.

- **Cataract surgery coverage (CSC).** The percentage of patients with operable cataracts who have undergone the surgery. This indicator measures the performance of cataract surgery programs and provides information on the remaining workload in a specific area at a given point in time. There is no linear correlation between CSR and CSC so that, in areas with high prevalence of cataracts, we can find a low CSC despite having a relatively high CSR.\textsuperscript{22,23}

A good approach to the issue was established by Foster’s CSR estimates\textsuperscript{24} drawn up in 1999 for different regions of the world. North America was at the top of the table with 5500, Australia-Japan with 5300 and Western Europe with 4000. In the middle range we find India with 3100 followed by Latin America, the Eastern Mediterranean and parts of Asia around 1000. At the bottom of the table, China with 500 and Africa with about 300.

When attempting to analyze CSR in greater detail in each region, we encounter a lack of reliable official statistics in many countries, leading to the use of data and estimates drawn up by different organizations (WHO, OPS, SEARO, IAPB, OECD). Said data have been verified as far as possible with those published by other authors. However, even in Europe, the Ophthalmological Society of Belgium has questioned the quality of official statistics (Euro Times, October 2006). To this we must add the distortion caused by private sector surgery which is very difficult to assess in many countries. In Spain, approximately 275,000 surgeries are performed in public hospitals,\textsuperscript{25} while an overall number of 420,000 surgeries are estimated including those of the private sector.\textsuperscript{26}

Clearly, the worst situation is that of Africa (Table 1), where CSR was in the area of 300–500 in 2005,\textsuperscript{27,28} with sharp contrast between the acceptable data for Namibia or Botswana and the poor estimates for the Congo Republic, Equatorial Guinea or Angola. The low estimate for regional powers such as Nigeria and South Africa is worthy of note.\textsuperscript{29,30} It is considered that the CSR required to eliminate blindness in Africa is within the range of 1500 and 2000,\textsuperscript{31} an objective which is difficult to achieve due to numerous economic, political and social factors.\textsuperscript{32–33}

China, with an estimated CSR between 290\textsuperscript{34} and 446,\textsuperscript{35} has one of the lowest ratios of Asia (Table 2) together with Indonesia and North Korea. On the other hand, we must emphasize the huge efforts carried out by India, with a CSR of 5300 in 2008.\textsuperscript{36} The CSR for the rest of the region is between 1000 and 2000.

The Eastern Mediterranean region comprises the majority of Arab countries (Table 3) with a CSR between 1000 and 2000.\textsuperscript{27,37}

Table 4 illustrates the significant regional differences in Latin America\textsuperscript{27,38–41} where CSR oscillates between 1000 and 3000. The worst indicators are for Haiti, Honduras and Guatemala.

Table 5 shows data for Western Europe.\textsuperscript{25,42,43} Austria and France hold top positions with a ratio of over 10,000. Spain, with a CSR of 6141 in the year 2011, is slightly below the United Kingdom although it would reach the same level of the Netherlands if private surgeries were included.

As for Eastern Europe (Table 6), the central European and Baltic countries (Hungary, Czech Republic, Estonia) have numbers similar to those of their Western counterparts, above those of the remaining countries. In addition, Russia with a ratio of 1600 has plenty of room for improvement.\textsuperscript{27,44}

Finally, Table 7 illustrates the high ratios of other OECD countries in North America and the Pacific, which are similar to those of Western Europe.\textsuperscript{25,38} A recent study carried out in Minnesota\textsuperscript{8} indicated for 2011 a CSR ratio of 11,000 with

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**Table 1 – CSR in Africa.**

<table>
<thead>
<tr>
<th>Country</th>
<th>CSR</th>
<th>Country</th>
<th>CSR</th>
<th>Country</th>
<th>CSR</th>
<th>Country</th>
<th>CSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
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<td>Ruanda</td>
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<td>575</td>
<td>Senegal</td>
<td>697</td>
<td></td>
<td></td>
</tr>
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<td>Cameroon</td>
<td>704</td>
<td>Madagascar</td>
<td>387</td>
<td>South Africa</td>
<td>1226</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chad</td>
<td>176</td>
<td>Mali</td>
<td>637</td>
<td>Tanzania</td>
<td>543</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. R. Congo</td>
<td>78</td>
<td>Mozambique</td>
<td>185</td>
<td>Togo</td>
<td>464</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td>95</td>
<td>Namibia</td>
<td>1880</td>
<td>Uganda</td>
<td>331</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethiopia</td>
<td>360</td>
<td>Nigeria</td>
<td>333</td>
<td>Zambia</td>
<td>518</td>
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### Table 2 – CSR in Asia.

<table>
<thead>
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<th>CSR</th>
<th>Country</th>
<th>CSR</th>
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</thead>
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<tr>
<td>Bangladesh</td>
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<td>India</td>
<td>5300</td>
<td>Myanmar</td>
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<tr>
<td>Cambodia</td>
<td>749</td>
<td>Indonesia</td>
<td>468</td>
<td>Nepal</td>
<td>1490</td>
</tr>
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<td>China</td>
<td>446</td>
<td>Laos</td>
<td>627</td>
<td>Singapore</td>
<td>4289</td>
</tr>
<tr>
<td>North Korea</td>
<td>200</td>
<td>Malaysia</td>
<td>2290</td>
<td>Thailand</td>
<td>2090</td>
</tr>
<tr>
<td>Philippines</td>
<td>1200</td>
<td>Maldives</td>
<td>700</td>
<td>Vietnam</td>
<td>997</td>
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</table>

### Table 3 – CSR in Mediterranean-Middle East.

<table>
<thead>
<tr>
<th>Country</th>
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<th>CSR</th>
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<tr>
<td>Afghanistan</td>
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<td>Jordan</td>
<td>1126</td>
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<tr>
<td>Saudi Arabia</td>
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<td>Kuwait</td>
<td>1308</td>
<td>Syria</td>
<td>1757</td>
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<tr>
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<td>692</td>
<td>Lebanon</td>
<td>1700</td>
<td>Somalia</td>
<td>510</td>
</tr>
<tr>
<td>Iran</td>
<td>1489</td>
<td>Libya</td>
<td>1887</td>
<td>Sudan</td>
<td>932</td>
</tr>
<tr>
<td>Iraq</td>
<td>1187</td>
<td>Morocco</td>
<td>1706</td>
<td>Tunisia</td>
<td>1329</td>
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</tbody>
</table>

### Table 4 – CSR in Latin America.

<table>
<thead>
<tr>
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<th>Country</th>
<th>CSR</th>
<th>Country</th>
<th>CSR</th>
</tr>
</thead>
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<td>Argentina</td>
<td>5953</td>
<td>Dominican Rep.</td>
<td>2000</td>
<td>Nicaragua</td>
<td>1790</td>
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<tr>
<td>Bolivia</td>
<td>930</td>
<td>Ecuador</td>
<td>842</td>
<td>Panama</td>
<td>1410</td>
</tr>
<tr>
<td>Brasil</td>
<td>3277</td>
<td>El Salvador</td>
<td>2100</td>
<td>Paraguay</td>
<td>1539</td>
</tr>
<tr>
<td>Chile</td>
<td>4100</td>
<td>Guatemala</td>
<td>765</td>
<td>Peru</td>
<td>1682</td>
</tr>
<tr>
<td>Colombia</td>
<td>1752</td>
<td>Haiti</td>
<td>487</td>
<td>Trinidad</td>
<td>2600</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>3140</td>
<td>Honduras</td>
<td>830</td>
<td>Uruguay</td>
<td>400</td>
</tr>
<tr>
<td>Cuba</td>
<td>2827</td>
<td>Mexico</td>
<td>1950</td>
<td>Venezuela</td>
<td>2038</td>
</tr>
</tbody>
</table>

### Table 5 – CSR in Western Europe.

<table>
<thead>
<tr>
<th>Country</th>
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<th>Country</th>
<th>CSR</th>
<th>Country</th>
<th>CSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>7344</td>
<td>Spain</td>
<td>6141</td>
<td>Luxembourg</td>
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</tr>
<tr>
<td>Austria</td>
<td>10,697</td>
<td>Finland</td>
<td>8007</td>
<td>Norway</td>
<td>4618</td>
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<tr>
<td>Belgium</td>
<td>10,601</td>
<td>France</td>
<td>10,775</td>
<td>United Kingdom</td>
<td>6647</td>
</tr>
<tr>
<td>Denmark</td>
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<td>Holland</td>
<td>8456</td>
<td>Sweden</td>
<td>8481</td>
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<tr>
<td>Slovenia</td>
<td>8883</td>
<td>Iceland</td>
<td>5167</td>
<td>Switzerland</td>
<td>4377</td>
</tr>
</tbody>
</table>

### Table 6 – CSR in Eastern Europe.

<table>
<thead>
<tr>
<th>Country</th>
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<th>Country</th>
<th>CSR</th>
<th>Country</th>
<th>CSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belarus</td>
<td>800</td>
<td>Slovakia</td>
<td>2243</td>
<td>Poland</td>
<td>3074</td>
</tr>
<tr>
<td>Bosnia-Herzegovina</td>
<td>1275</td>
<td>Estonia</td>
<td>10,300</td>
<td>Romania</td>
<td>1511</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>1730</td>
<td>Hungary</td>
<td>9091</td>
<td>Russia</td>
<td>1600</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>10,450</td>
<td>Latvia</td>
<td>2921</td>
<td>Serbia</td>
<td>1419</td>
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<tr>
<td>Croatia</td>
<td>3180</td>
<td>Lithuania</td>
<td>2502</td>
<td>Ukraine</td>
<td>1222</td>
</tr>
</tbody>
</table>

### Table 7 – CSR in other OECD countries.

<table>
<thead>
<tr>
<th>Country</th>
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</thead>
<tbody>
<tr>
<td>Australia</td>
<td>9385</td>
</tr>
<tr>
<td>Canada</td>
<td>10,743</td>
</tr>
<tr>
<td>South Korea</td>
<td>8601</td>
</tr>
<tr>
<td>Israel</td>
<td>5882</td>
</tr>
<tr>
<td>Japan</td>
<td>6830</td>
</tr>
<tr>
<td>New Zealand</td>
<td>3283</td>
</tr>
<tr>
<td>USA</td>
<td>9155</td>
</tr>
</tbody>
</table>

upward tendency, in contrast with Sweden where the ratio seems to have stabilized.7

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**Studies on variability in cataract surgery**

The first studies45-55 were carried out in Anglo-Saxon and Scandinavian countries which have a national health system (Canada, United Kingdom, Australia, Finland, Sweden). In the United States, MPV has been analyzed in some health care...
networks such as Medicare or the Veterans Health Administration (VHA), with the results that the Medicare ratios are 5.5 times higher than those of VHA.

Table 8 shows a selection of the most relevant international publications where a high degree of variability can be seen throughout time, both in local as well as regional and international comparisons. VR oscillates between 1.2 and 4.7. The consistency of MPV studies must be emphasized once the outliers have been discarded, so that elective surgical procedures (such as cataract surgery) which exhibit high variations in a given region will continue exhibiting them in other regions. Accordingly, it can be concluded that, with some extreme exceptions, the amount of variation is mainly based on the procedure and not the geographic area being analyzed.

Therefore, the mechanism mentioned above is repeated in other geographical areas. For instance, in Latin America we find large variabilities wherever studies have been carried out. In Argentina the VR is of 9.6, in Perú, 10, and Brazil it is of 5.3. Likewise in Africa we have Togo with a VR of 3.7, South Africa with a VR of 1.7 and Ethiopia with a VR of 6.6.

There are not many studies in Spain about MPV in relation to cataract surgery. The first papers described large differences between autonomous communities in mean hospital admissions during the period 1985–1989 which, in the case of cataracts, ranged between just over 40 operations for every 10,000 inhabitants over 65 in Galicia to nearly 100 per 10,000 inhabitants in the Basque country.

Subsequently, variabilities in surgical interventions and standardized rates of surgical interventions were analyzed in 8 areas of the province of Alicante during the period 1994–1995, evidencing the existence of broad variations, with a VR of 7.5 in cataract surgery. As this surgery is characterized by its high frequency, the population impact is translated into a significant volume of patients who would be operated or not depending on the region where they live. An additional conclusion of interest is that the rate of surgeries is directly related to the volume of supply, measured in hours of available operating theaters and not on the number of ophthalmologists.

A series of studies carried out by the Agència d’Avaluació de Tecnologia i Recerca Mèdiques del Servei Català de la Salut researched the adjusted rates for the 8 health regions of Catalonia in the period 1995–2000. A rising tendency for CSR was observed, which went from 3240 in 1995 to 7710 in 2000. However, the variation ratio is quite constant and ranges between 1.5 and 2.2 from one year to another. This means that the people who live in the region with the highest rate (center region) will receive the surgery about twice the amount than the inhabitants of the region with the lowest ratio (Tortosa).

A significant increase of surgical activity is also observed in the chapter on incidence and prevalence of cataracts in the 2008 report of the Ophthalmology Society of Spain. Accordingly, in the Basque country the CSR was 4350 in 1996 and 8172 in 2006, which means that the surgery rate nearly doubled during that period. On the other hand, high variability for the year 2005 was observed in the intervention ratios between different autonomous communities, the highest being found in Catalonia with a CSR of 7731 and the lowest in the Canary islands with a CSR of 3463, signifying a variation ratio of 2.2.

The data for the period 2008–2011 in Andalucía show that in 2011 42,435 cataract operations were performed while 41,774 were carried out in 2010 and 42,009 in 2008. From this data we can conclude that the numbers have stabilized around 42,000. In 2009, the CSR was of 6837 and in 2009 of 6579. These numbers are similar to those of the United Kingdom, whereas the CSR for Spain was of 5765. After adjusting the ratios, we have a VR of 3.7 in 2008, 3.2 in 2009 and 3 in 2010, revealing a progressive reduction in variability. By way of conclusion, it can be said that in general the provinces of Western Andalucía achieve higher rates than those of Eastern Andalucía. In addition, the higher ratios are due to the large hospitals of Sevilla and Málaga and the lower ones to the more remote regional hospitals. In addition, there is a striking contrast between the hospitals of Andújar and Úbeda, separated by about 70 km and having populations with a similar demographic structure. The former hospital indicates 3 times more cataract surgeries than the latter one. The explanation could lie in the different availability of operating theaters or different practices.

### Variability and health planning

In many OECD countries the increase of cataract surgery in the past 2 decades has been quite significant. However, it must be emphasized that in the past 5 years some countries have stabilized or slightly diminished their ratios. This could have several explanations; the first possibility is that waiting lists were finished so that only new cases were intervened. Another explanation would be an increase in thresholds for surgery due to budgetary restrictions. Certainly, and this could be the most likely possibility, the waiting lists have increased once again.

In recent years, several authors have expressed their concern at the increase of surgical volume, which...
depends on a number of factors, of which the most important is likely to be the increased longevity of the population\textsuperscript{4–9,20,78} and the corresponding increase in prevalence.\textsuperscript{4–9,51,79–82}

As the second factor which determines a CSR we have, together with the increased life expectancy, the threshold level utilized to decide whether a specific patient is candidate for surgery or not.

Starting from the basis that cataract surgery is a cost effective procedure,\textsuperscript{83–85} with increased quality of life after the operation being unquestionable\textsuperscript{86} regardless of the cultural environment,\textsuperscript{87} the cost-effectiveness relationship of cataract surgery is even higher if we consider the indirect benefits of the operation for patients with significant cataracts such as reduction in traffic accidents\textsuperscript{88} and hip bone fractures.\textsuperscript{89}

In summary, increased VA does not only entail a significant improvement of daily life activities but also of other personal and social activities, including increased survival.\textsuperscript{90}

Therefore it is not surprising that the thresholds to access cataract surgery have been modified globally: in 1994, the mean VA of patients was 20/60, while at present the threshold is at 20/40 or even 20/30. For instance, in the United Kingdom 42.9% of patients exhibit presurgery VA of 20/40 or higher\textsuperscript{21,58,74,91,92} and in Sweden this percentage reaches 78%.\textsuperscript{7}

The pressure for reducing said threshold can be seen when analyzing both supply as well as demand. Thus, higher patient expectations, premium intraocular lenses, publicity by private centers, incentives for increasing surgical activity and the payment schemes for surgeons,\textsuperscript{93–95} among other reasons, are pushing down said threshold and this produces a significant increase in the number of cases. On the contrary, budgetary restrictions and short availability of operating theaters tend to raise the thresholds and lower the amount of procedures. Therefore, significant changes in the threshold for cataract surgery could have a significant impact on the number of subjects requiring surgery.\textsuperscript{15,16,96–101}

Several publications\textsuperscript{20,102} report the Taylor estimates which detailed the existing relationship between threshold VA and CSR. For 0.33 (20/60), CSR is of 3200; for 0.5 (20/40) of 6000 and finally for 0.66 the CSR would be of 11500. As can be seen, the ratio is practically double when the threshold diminishes from 20/60 to 20/40 or from 20/40 to 20/30, which would require doubling expenditure for this intervention every time we reduce the threshold level. For Spain, the CSR calculation for different thresholds\textsuperscript{103} mean that for 0.4 (20/50), CSR would be of 5131 and for 0.5 (20/40) it would increase to 6921, an increase of 35% in the ratio and therefore in the expenditure.

Clinical Practice Guides (CPG) have become popular in an effort to reduce variability and standardize medical practice under the assumption that these guides summarize the best available evidence for best quality. The most recent guides on cataract surgery have been reviewed in depth utilizing the AGREE application.\textsuperscript{104} It goes without saying that after implementing a CPG it is necessary to carry out regular audits to verify the degree of compliance.\textsuperscript{105}

Spanish public organizations have published at least 5 guides on this topic: the Insalud recommendations in 1997, the Basque country protocols in 1995, similar protocols in Catalonia and Andalucia (2002) and Madrid (2004).\textsuperscript{106–110}

The recommended threshold VA is between 0.4 and 0.5 (20/50 and 20/40) with some exceptions. The CPG proposed by Blanco-Rivera in 2008\textsuperscript{81} follows along the same lines.

At present, the establishment of fixed VA thresholds for accessing surgery is being questioned, proposing instead a functional visual examination.\textsuperscript{111} The current trend is focused on individualized and global assessments including difficulties for carrying out daily activities and symptoms attributable to cataracts.\textsuperscript{112,113} However and for health planning purposes, we must not forget the experience gained in the past years which indicates that the absence of a predetermined VA threshold produces an increase of surgical volume which can sometimes run out of control.

Together with the increasing age of our population and the lowering of the threshold, the third factor which determines CSR concerns second eye surgery. Its importance stems from the fact that 30–60% of surgical interventions involve the second eye.\textsuperscript{58,114,115} In addition, numerous studies demonstrate clear benefits in the intervention when improving binocular vision.\textsuperscript{116,117} It is estimated that in the future the number of second eye surgeries would increase significantly, which in turn would increase the CSR.\textsuperscript{8,118}

The last factor to be taken into account in this subject is the level of surgical activity developed by a given health service and the social or political tolerance to the existence of waiting lists,\textsuperscript{20} which brings up a number of significant issues such as the repercussions derived from remaining in waiting lists for long periods of time\textsuperscript{119} as well as the prioritization of patients for accessing said surgery.\textsuperscript{120–122} Several countries have passed laws regulating the maximum time of waiting lists. In the case of Spain, Royal Decree 1039/2011, dated July 15 (Official Gazette #207), establishes the maximum period of 180 days for cataract surgery. In Andalucia, this period has been reduced to 120 days (Order dated December 20, 2006, Andalucia Official Gazette #3).

### Variability and health services quality

It was pointed out in previous sections that MPV can give rise to problems in the quality of medical actions, partly due to inadequate utilization of resources.\textsuperscript{10,15,99} We shall focus on the evacuation of procedures, their results and patient satisfaction within the range of dimensions of health services polity.

Cataract surgery is the most frequent surgery in OECD countries, which has been demonstrated to be a cost-effective intervention when adequately prescribed. However, its high prevalence together with its slow progression and the varied functional repercussion on each patient can make it difficult to take decisions on the appropriateness of the surgery and the priority it must be given.

In order to assess appropriateness of a specific surgical indication, explicit criteria must be previously established to carry out a comparison and verify compliance. For instance, in the case of a patient who is a candidate for cataract surgery, if the patient has a corrected VA under 20/40 (0.5). Another
methodology which has been developed to assess appropriateness is that known as RAND/UCLA, focused on measuring infra- and overutilization of diagnostic or therapeutic procedures, which combines the best available scientific evidence and the opinion of experts.\textsuperscript{109}

The American literature has shown a strikingly low interest on this topic. This could be due to the peculiarities of its health system. In the White Paper by the American Academy of Ophthalmology, American Society of Cataract and Refractive Surgery and the European Society of Cataract and Refractive Surgeons\textsuperscript{123} Obstraum was able to reference only one study\textsuperscript{124} published in 1990. The said study considered that the percentage of inappropriate cataract surgeries amounted to 2%. The validation of the methodology was discussed in another article\textsuperscript{125} which admitted that 11% of the cases classified as appropriate do not gain 2 VA lines. It is likely that the broad criterion of the American Academy of Ophthalmology,\textsuperscript{113} when it stated that the main indication for surgery is the visual function which no longer fulfills the needs of a patient, allows almost all clinical assumptions to be regarded as appropriate.

On the other hand, worthy of note is the research activity carried out by the IRYSS Cataract Group on the determination of explicit criteria, decision trees, prioritization of patients, inter-hospital appropriateness variations, etc.\textsuperscript{64,103,126-133} The most common assumption for inappropriate surgery is a patient with VA above 20/40 (0.5) in both eyes. The percentage of inappropriate cases in a recent study carried out in Spain was of 7.3%\textsuperscript{128} and the significant inter-hospital variation was evidenced by percentage range between 1.2 and 24%.\textsuperscript{65} Similar data were found in South Korea, with a percentage of inappropriate surgeries of 7.7%\textsuperscript{32,133}

However, when analyzing appropriateness we must take into account the case mix of the hospital being analyzed. For example, a study carried out in Israel\textsuperscript{134} produced an inappropriate surgery ratio of 1.3% but 62.2% of patients had a presurgery VA of hand movements or worse. In contrast, a British study\textsuperscript{66} found 20% of inappropriate surgery even though in the United Kingdom 43% of patients\textsuperscript{77} exhibited presurgery VA of 20/40 or higher (0.5). The conclusion is obvious; appropriateness increases when lowering the threshold for indicating surgery. Similarly, a study carried out in Bristol\textsuperscript{135} analyzing the profile of patients in the waiting list for surgery with VA of 20/40 or above (0.5) in the eye with poorest vision concluded that a high percentage only presented a slight repercussion in quality of life according to the Vision-related quality of life (VR-QOL) Questionnaire, giving rise to doubts about the necessity of carrying out surgery in a high number of such cases.

In addition to presurgery VA, another factor to be considered when comparing studies on appropriateness is whether the surgical technique was the same. For instance, the study by Norreggaard et al.\textsuperscript{97} reported that half of the cataracts cases were operated with phacoemulsification, while in a multicenter study in Spain, 100% of the cases were intervened with said technique.\textsuperscript{128}

In what concerns cataract surgery outcomes, different criteria can be applied for measuring it, including VA and visual function increase, approximation to the refractive objective, reduction of symptoms, quality-of-life improvement, etc.,\textsuperscript{136,137} as well as analyzing specifically the intra- or post-surgery complications.

All the studies which analyzed outcomes are unanimous in reporting significant results of the surgery regardless of the geographical region. If we apply the criterion of percentage of patients with VA of 20/40 or higher (0.5), we have that the European Cataract Outcome Study\textsuperscript{138} reports 89%. Similar percentages (89%, 88% and 84%) can be found in the AAO National Eye Care Outcomes Network database,\textsuperscript{139} in the Auck-land Cataract Study\textsuperscript{140} and in the Swedish National Cataract Register.\textsuperscript{57} A recent multicenter study carried out in the United Kingdom\textsuperscript{77} reports 91% of cases with VA of 20/40 or higher (0.5), while another multicenter study in Germany\textsuperscript{141} obtained even better results, with 98.5% of cases with VA of 20/40 or higher (0.5) and 87.3% with VA of 20/25 or higher (0.8). Similarly, the results of the European Registry of Quality Outcomes for Cataract and Refractive Surgery\textsuperscript{142} are also outstanding, with 94.3% having VA of 20/40 or higher (0.5) and 61.3% with VA of 20/20 (1.0).

Increased variability can be seen in the patient satisfaction section. In this regard, it must be taken into account that this is a multifactor, highly complex, subjective and difficult to measure variable.

Some elements which depend on the health system can give rise to dissatisfaction, such as easy or difficult access to health centers\textsuperscript{143}, the need for admission for surgery or ambulatory procedures\textsuperscript{144}: the time spent on waiting lists,\textsuperscript{145,146} the right to choose the surgeon and the different types of treatment given to patients depending on whether the health service is public or private.\textsuperscript{147}

On the other hand, it must also be borne in mind that patient expectations are one of the primary factors which determine satisfaction.\textsuperscript{148} Nowadays, these expectations are generally too high\textsuperscript{149-151} and sometimes unrealistic. Given that VA increase (Snellen) and visual function improvement (VF-14) do not necessarily correlate with patient satisfaction, it is necessary to address unrealistic expectations by providing sufficient previous information and addressing it in writing.\textsuperscript{152-154} Special emphasis must be made in the event of comorbidity (maculopathy, neuropathy, amblyopia, etc.) as this is a frequent cause of dissatisfaction.

For many patients cataract surgery is an important opportunity to get rid of their spectacles,\textsuperscript{155} and in public systems where monofocal intraocular lenses are utilized this aspiration can hardly be realized. Having said that, multifocal lens implants can also give rise to dissatisfaction.\textsuperscript{156,157} Along the same lines, presurgery VA is a usual predictor of future dissatisfaction as it seems obvious that the higher it is (predominantly when it exceeds 20/40 [0.5]), the higher patient expectation would be.

The above factors, among many others,\textsuperscript{158} can be the cause of variations observed in published papers. On the one hand, some studies\textsuperscript{139,151,159,160} report satisfaction levels above 90% (95%; 96.4%; 91.3% and 92.1%), while others\textsuperscript{161-163} are clearly below those percentages (70%; 79.5% and 85%).

It is obvious that to some extent and without being able to discard a publication bias, patient dissatisfaction is detected in daily practice despite outstanding surgical results.
Variability control in cataract surgery as a management tool

In addition to giving rise to an expenditure that the health system cannot afford, the execution of inappropriate procedures is ethically questionable as it generates unnecessary risks for patients. It follows that managing clinical variability involves diminishing the unjustified or undesirable components. In addition, in the “cataract process” control of variability can be a valuable management tool. A number of positive experiences in the Health Service of Galizia have already been published.  

Some of the strategies that have demonstrated effectiveness and diminishing of variability are the following:  

- To define, agree and standardize surgical indication for cataracts, and preparing protocols or clinical practice guides which include the best scientific evidence available. Standardizing processes is the first step that must be taken at the local as well as regional level.  
- Having updated data on the local CSR as well as of historic series in order to analyze its evolution. The next step is to establish a reference model for comparison purposes (benchmarking); for example, in our area, the mean standard deviation (mean CSR for Andalucia) in 2012 was of −5.6%.  
- Review of clinical histories, focusing on their compliance with the protocol or CPG, in other words verifying the appropriateness of the surgical indication. It could be necessary to reassess patients in order to screen the waiting list. Taking into account that the main criterion for surgical indication, both for the first and the second eye, is corrected VA, it is crucial to ensure that this is measured precisely.  
- Monitoring individual variability, acting on practice styles and promoting adherence to protocols and CPG. The implementation of incentive or dissuasive measures could be very useful.  
- Carrying out audits of the health care process, identifying problems or areas of improvement, subsequently analyzing the causes thereof and establishing improvement actions, finishing with an assessment of the effects of the introduced changes. The introduction of new technologies, in our case femtosecond laser, should involve increased surgical performance in order to amortize the investment and make best use of a scarce resource such as the availability of operating rooms.  
- Research on clinical results, including complications, which must always be considered as opportunities for improvement.  
- Economic analysis of variations and dissemination of findings to raise awareness amongst all stakeholders.

Of all the information presented in this review, there are 3 basic take-home messages:

First, that the existence of variations is inherent to clinical practice and that these variations increase in elective procedures such as cataract surgery. There are many reasons for this, mainly differences in prevalence, demographic structure, accessibility, allocation of resources, availability of operating rooms, etc.

Second, once the above factors have been controlled, we are left with unjustified or undesired variability. The main source of variations are the different practice styles and the best methods to control this is establishing protocols for procedures, utilizing the best available evidence, and subsequently monitoring compliance.

Finally, it is obvious that inappropriate procedures produce considerable expenses. It is important to detect this unnecessary component of variability because it allows us to allocate those resources to other purposes. This begs the question about the cost to the society for resources that are used inappropriately.

In 2011, 275,349 cataract operations were carried out in the National Health System (OECD Health Data 2013). If we accept that 7.3% of these were inappropriate (the percentage found by the Spanish multicenter study), we would have about 20,100 unnecessary interventions. In addition, if we consider that the cost per intervention is in the area of 1000 euros (specifically, 1032.19 euros was the rate for billing health services in Osakidetza, 2014), we could conclude that over 20,000,000 euros are being spent uselessly every year, only on cataract surgery. Accordingly, it can be clearly stated that control of MPV is not only an academic issue and that, on the contrary, it has a direct repercussion on the operation and quality of our health system.

It has been stated that the presence of MPV cannot be regarded with indifference or conformity. From this point of view, we consider that the National Health System must apply clinically appropriate and financially sustainable protocols, and that health service managers and professionals have a shared responsibility in reducing avoidable variability and inappropriate surgery.

Conflict of interests

No conflict of interests have been declared by the authors.

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