Surgical Care in Specialist Ophthalmology Departments:
Structure and Impact of the COVID-19 Pandemic

Chirurgische Versorgung in ophthalmologischen Hauptabteilungen:
Struktur und Auswirkungen der COVID-19-Pandemie

ABSTRACT

Background Specialist ophthalmology departments contribute to the surgical care of German patients. Outpatient and inpatient surgeries were restricted during the COVID-19 pandemic and led to a sharp decline in the number of cases in ophthalmological care. The aim of this analysis was to improve the understanding of the logistic structures of medical facilities as well as the effects of the pandemic.

Material and Method Based on reported process data, a sample of the specialist ophthalmological departments were examined based on operation and procedure codes (OPS) and data submitted between 01.01.2017 and 31.05.2021 according to the benchmarking programmes of the Professional Association of German Anaesthetists (BDA), the Professional Association of German Surgeons (BDC), and the Association for Operating Theatre Management (VOPM).

Results Eighteen ophthalmology departments from Germany were analysed. After the decline in the number of cases (by temporarily up to 48%) during the first wave of the pandemic, the case numbers of all interventions assessed as non-urgent continued to be reduced. While intravitreal injections hardly decreased during the first wave (−16%), significant drops in the coverage of cataract surgery (−79%), vitrectomies (−35%), glaucoma surgery (−59%), strabismus surgery (−95%), and eyelid surgery (−52%) were found. One exception was intravitreal injection, which stabilised at a lower level early on during the pandemic. Overall, the number of cases during the later phases of the pandemic were significantly reduced below the level of previous years, despite the maintenance of emergency care. The underuse was variable for different interventions.
**Background**

At the onset of the COVID-19 pandemic in March 2020, all German hospitals were ordered to postpone elective surgeries. Accompanied by the general uncertainty in the population, a sharp drop in the number of cases – the highest among all major surgical departments – was reported in ophthalmology [1–6]. A recent survey by the “Commission on Intersectoral Ophthalmology” reported that the reduction in the number of cases was highest in the inpatient sector, especially among the specialised departments as a consequence of the COVID-19 pandemic, during the period from 15.03.2020 to 15.04.2020 when compared to other providers such as individual practices. Of the 105 main departments evaluated, defined as hospitals with ophthalmological departments for outpatient care, a high proportion of outpatient operations. However, so far, most assessments to quantify the undersupply and ambulant procedures such as individual practices. Of the 105 main departments evaluated, defined as hospitals with ophthalmological departments for outpatient care, a high proportion of outpatient operations. However, so far, most assessments to quantify the undersupply and ambulant procedures such as individual practices. Of the 105 main departments evaluated, defined as hospitals with ophthalmological departments for outpatient care, a high proportion of outpatient procedures was most frequently cited as a reason for the reduction in case numbers [3]. Staff and anaesthesia personnel had to be sent to other disciplines, hence, a large proportion of ophthalmology departments had to significantly reduce their bed capacity. In some cases, the teams were divided into groups in order to be able to break through possible chains of infection and thus ensure an unrestricted operational capability [1,3].

Certain important characteristics of ophthalmology must be given special consideration here. The specific age profile (bipartite, including a focus on very old people) and the partly elective character of numerous operations shape the structures of eye care within the hospitals [7]. Due to advanced age, the frequent confluence of frailty and comorbidities, and more intensive care, perioperative monitoring and nursing are required [8,9].

**Conclusion**

In addition to self-reported figures, the analysed process data demonstrates the effect that various factors had on elective as well as urgent operations within hospital care during the pandemic. Despite partial stabilisation of some services, a relevant supply gap for outpatient and inpatient interventions was identified, with corresponding effects on the eye health of the population, while compensation or performance enhancement have not taken place to date. Facing the growing preload and the demographic development, future structures must therefore allow for an increase in the performance of specialist ophthalmological departments.

**ZUSAMMENFASSUNG**

**Hintergrund**


**Material und Methode**

Auf Basis gemeldeter Prozessdaten wurde eine Stichprobe ophthalmologischer Hauptabteilungen untersucht, die OPS-Codes und Daten zwischen dem 01.01.2017 und 31.05.2021 an das Benchmarking-Programm des Berufsverbandes Deutscher Anästhesisten (BDA), des Berufsverbandes der Deutschen Chirurgen (BDC) und des Verbands für OP-Management (VOPM) übermittelten.

**Ergebnisse**

Die ausgewerteten 18 ophthalmologischen Hauptabteilungen zeigten einen starken Rückgang stationärer und ambulanter Fallzahlen. Während die Anzahl intravitrealer Injektionen in der ersten Welle kaum zurückging (−16%) waren für die Kataraktchirurgie (−79%), Vitrektomie (−35%), Glaukomchirurgie (−59%), strabologische Eingriffe (−95%) und Lidchirurgie (−52%) deutliche Rückgänge zu verzeichnen. Auch nach der ersten Pandemiewelle blieben die Fallzahlen aller nicht dringlich bewerteten Eingriffe reduziert. Unabhängig von der aufrecht erhaltenen Notfallversorgung war die Minderversorgung für die untersuchten Prozeduren unterschiedlich ausgeprägt.

**Schlussfolgerung**

along with objective process data, was to investigate the impact of the SARS-CoV-2 pandemic up to the 31.05.2021. This approach helps to provide an understanding of the current structural conditions and to assess their potential long-term effects on the future need for surgical capacity by German eye care providers.

**Methods**

The sample was drawn from the benchmarking programmes of the Professional Association of German Anaesthetists (BDA), the Professional Association of German Surgeons (BDC), and the Association for Operating Theatre Management (VOPM), in which more than 320 hospitals nationwide have participated since 2008. The service providers of different care levels transmit their operating theatre process data, which includes surgery-related information such as the OPS [18] and this was used to evaluate the process data in a standardised manner, thus enabling a direct comparison with other healthcare providers [19].

The index period of analysis was defined from the beginning of the COVID-19 pandemic to 31.05.2021. Although the incidence of infection differed greatly from region to region in Germany [20, 21], a demarcation of different phases was made. The "first" wave was defined as the period between 4th March 2020 (10th calendar week) – considered as the beginning of the pandemic – and the 20th calendar week in May 2020 [22]. The definition of the "second" and "third" waves in this work was based on the reported cases infected by the Robert Koch Institute (RKI). Accordingly, the second wave begins in early October 2020 and ends in late February 2021, with a seamless transition to the third wave, which begins in early March and ends in late July 2021, but peaks in April [23].

The development of case numbers from six common interventions was evaluated: intravitreal injection (IVI) (OPS code 5-156.9 and 6-003.c), cataract surgery (OPS code starting with 5-144), eyelid surgery (OPS code starting with 5-091), glaucoma surgery (OPS code starting with 5-131), eye muscle surgery (OPS code starting with 5-158), and vitrectomy (OPS code starting with 5-158). To determine the percentage decrease in the number of cases, the number of cases per month and the number of working days per month were calculated for all years during the index period and from this it was possible to determine the average number of cases per working day in each month. Weekends and public holidays were not included to minimise the influence of fluctuations they cause. An average value of the number of cases per working day was calculated for the months from 2017 to 2019, which served as a reference value for each month in 2020 and 2021.

Healthcare providers were excluded if the surgical process data were not completely available for the evaluation period or the information on the OPS was less than 90% complete for all operations.

In addition, heterogeneity and robustness of the figures were checked to assess a trend. Service providers with IVIs accounting for less than 30% of the total were excluded in a separate step, as it was assumed that this intervention was otherwise not regularly provided by the specialist department.

For cataract and eyelid surgery, the analysis was carried out separately for outpatient and inpatient treatment. Service providers who did not completely transmit the case type to the database of the benchmarking programme were excluded from the analysis.

Values are reported as the mean and standard deviation. Wilcoxon-Mann-Whitney tests were used to determine statistically significant differences in the distribution of means. A p value of ≤ 0.05 was set for the statistical significance level. The statistical analyses were carried out using Stata Statistical Software 14.2 (release 17) (StataCorp LLC: College Station, TX, USA).
Results

Eighteen hospitals with a main ophthalmology department were included and a total of 296,255 surgical procedures were reported during the analysis period. The main ophthalmology departments were assigned to two primary care providers, four specialty care providers, five maximum care providers, and seven university hospitals.

In absolute numbers, the majority (89%) provided fewer cases overall in 2020 when compared with the values calculated in 2017 and 2019. Only two departments provided a higher extent of procedures in 2020 than the previous year’s average.

Table 1 compares the number of cases before and since the pandemic in the main ophthalmology departments analysed. The maximum number of procedures, the median, and the average number (including standard deviation) per day in the main ophthalmology departments overall before (until calendar week 10 in 2020) and since the beginning of the pandemic (from calendar week 10 in 2020) are described, as well as the significance level for the comparison of the mean values.

Procedure-specific Structures

Intravitreal Injection (OPS 5-156.9 and 6-003.c)

A total of 18 main ophthalmology departments with a total of 83,363 procedures were included. The performance of providers varied widely, with seven main departments administering 90% of IVIs, for which this service then also accounted for at least 30% of the number of procedures reported.

Fig. 2 shows the development of the number of IVI cases in the 18 main ophthalmology departments. Even in the first “shock” wave of the pandemic (March 2020), the daily numbers did not drop by more than 20%. Following this, however, there was no clear recovery to the initial levels throughout the pandemic. Since the beginning of the pandemic in March 2020, the case numbers of the comparison years were only reached in 1 month (i.e., June 2020). In 14 of the 15 months considered since the beginning of the pandemic, the number of cases remained below the previous years.

Intraocular surgery: Cataract

For cataract surgery, Fig. 3 shows the overall decline in the number of cases for the 18 hospitals. Also shown are the divided types (as outpatient and/or inpatient treatment for 14 main ophthalmology departments. The total number of cases clearly remained below the level of previous years, beginning with the early pandemic (with the exception of September 2020). In the second and third wave, the analysis indicated a more severe decrease in the percentage of inpatient surgeries compared with the percentage of outpatient cataract surgeries. The half-yearly comparison illustrates the short-term fluctuation well (see Table 2) in case numbers by case type (outpatient/inpatient). The proportion of outpatient procedures in the total number increased in the 14 main ophthalmology departments since the beginning of the pandemic.

Vitrectomy, glaucoma surgery, and eye muscle surgery

There was a 35% decrease in the number of vitrectomy procedures during the first wave. As the pandemic developed, roughly the same, or slightly more, vitrectomies were performed compared with the reference period.

Table 1 Case numbers per procedure, maximum value, median, and mean daily levels before and since the pandemic as well as statistical significance using the Wilcoxon-Mann-Whitney test.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>n Departments</th>
<th>n Cases</th>
<th>Max before pandemic</th>
<th>Max since pandemic</th>
<th>Median before pandemic</th>
<th>Median since pandemic</th>
<th>Mean (± SD) before pandemic</th>
<th>Mean (± SD) since pandemic</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVI (5-156.9, 6-003.c)</td>
<td>18</td>
<td>83363</td>
<td>158</td>
<td>135</td>
<td>81</td>
<td>65.5</td>
<td>79.96 (± 30.73)</td>
<td>68.94 (± 25.61)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Cataract (5-144*)</td>
<td>18</td>
<td>69230</td>
<td>127</td>
<td>102</td>
<td>73</td>
<td>58.5</td>
<td>67.83 (± 24.97)</td>
<td>53.89 (± 24.83)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Eyelid surgery (5-091*)</td>
<td>17</td>
<td>12316</td>
<td>30</td>
<td>22</td>
<td>12</td>
<td>10</td>
<td>12 (± 4.5)</td>
<td>9.9 (± 4.58)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Glaucoma surgery (5-131*)</td>
<td>16</td>
<td>6095</td>
<td>18</td>
<td>12</td>
<td>6</td>
<td>5</td>
<td>5.91 (± 2.92)</td>
<td>5.07 (± 2.53)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Muscle surgery (5-10k*)</td>
<td>11</td>
<td>4764</td>
<td>14</td>
<td>13</td>
<td>5</td>
<td>4</td>
<td>5.17 (± 2.54)</td>
<td>4.58 (± 2.39)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Vitrectomy (5-158*)</td>
<td>14</td>
<td>33285</td>
<td>50</td>
<td>45</td>
<td>31</td>
<td>31</td>
<td>30.67 (± 6.48)</td>
<td>30.41 (± 6.94)</td>
<td>&gt; 0.05</td>
</tr>
</tbody>
</table>

*All end-digit OPS beginning with these digits
Glaucoma surgeries decreased by up to 59% during the first wave. After an increase, case numbers in August and September 2020 reached the same level as previous years, but case numbers remained lower during the second and third waves of the pandemic.

For eye muscle surgery, which affects a relevant proportion of young patients (Fig. 1), the largest decrease (i.e., 95%) was seen in April 2020 and for a few weeks, operations were almost stopped. A pronounced decline in the number of cases was also observed during the second wave. The declines were followed by...

Fig. 2 The percentage number of outpatient IVI cases during the pandemic in the 18 main ophthalmology departments (reference values 2017–2019).

Fig. 3 The percentage number of cataract operations (reference values 2017–2019).
visible bursts of activity where surgeries caught up to levels recorded in January and February 2020 (Fig. 4). An exploratory analysis of corneal transplants (OPS 5-125) indicated an upward trend in the years before the pandemic (for 15 main departments). Here, during the first wave, case numbers decreased significantly. However, there are some differences. On the one hand, the numbers collapse again significantly in summer. Afterwards, the numbers during the second and third waves are even above the level of the previous years.

Excisional eyelid surgery
Lesions and tumours of the eyelid skin show a significant increase with age. Therefore, when considering procedure OPS 5-091, an increasing need would be expected as the population ages. However, Fig. 5 showed a decrease in the total number of eyelid operations in 17 of the main ophthalmological departments and for the 13 main ophthalmological departments when separated by case type (outpatient/inpatient).

The total number of cases remained below those reported in previous years. Moreover, the mean number of outpatient excisions significantly decreased compared to the averages reported in previous years. While inpatient eyelid surgeries increased compared to the reference value, a substantial decline in outpatient eyelid surgeries was observed throughout the observation period (Table 3).

**Table 2** Distribution of cataract case numbers by case type at half-yearly (HY) intervals.

<table>
<thead>
<tr>
<th>Total Change to prior half year</th>
<th>Outpatient (n)</th>
<th>Outpatient (%)</th>
<th>Inpatient (n)</th>
<th>Inpatient (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HY 2017 6712</td>
<td>3692</td>
<td>55%</td>
<td>3020</td>
<td>45%</td>
</tr>
<tr>
<td>2. HY 2017 6095</td>
<td>3378</td>
<td>55%</td>
<td>2717</td>
<td>45%</td>
</tr>
<tr>
<td>1. HY 2018 6801</td>
<td>3637</td>
<td>53%</td>
<td>3164</td>
<td>47%</td>
</tr>
<tr>
<td>2. HY 2018 6117</td>
<td>3113</td>
<td>51%</td>
<td>3004</td>
<td>49%</td>
</tr>
<tr>
<td>1. HY 2019 6550</td>
<td>3331</td>
<td>51%</td>
<td>3219</td>
<td>49%</td>
</tr>
<tr>
<td>2. HY 2019 6365</td>
<td>3328</td>
<td>52%</td>
<td>3037</td>
<td>48%</td>
</tr>
<tr>
<td>1. HY 2020 4625</td>
<td>2476</td>
<td>54%</td>
<td>2149</td>
<td>46%</td>
</tr>
<tr>
<td>2. HY 2020 5940</td>
<td>3241</td>
<td>55%</td>
<td>2699</td>
<td>45%</td>
</tr>
<tr>
<td>1. HY 2021* 4277</td>
<td>2509</td>
<td>59%</td>
<td>1768</td>
<td>41%</td>
</tr>
</tbody>
</table>

*2021 until 31.05.21

Fig. 4 The percentage number of vitrectomy operations, glaucoma operations, and eye muscle operations (reference value 2017–2019).
Anaesthesia involvement and relative proportions

Even before the index interval, a relative increase in anaesthesia involvement could be observed in the form of an increasing number of patients requiring anaesthesia (Fig. 6). This applies to all procedures except intravitreal injections. With the onset of the pandemic, a reduction in the absolute numbers was observed. Looking at the proportions of procedures in relation to each other (Table 4), it is clear that both cataract surgery, but also other procedures with a presumably higher proportion of more urgent surgery such as vitrectomy (retinal detachment surgery), and filtration surgery (pressure decompensations) recovered less well than IVIs during the 14 months of the pandemic.

Discussion

Different causes must be discussed for the decreases in ophthalmic surgery depending on the different phases of the pandemic. During the first phase, there was a political order and socially consented lockdown, when there were hardly any protective masks and the uncertainty was still great, in the later phase, other factors such as testing and regional outbreaks played a role.

Patients who wanted to postpone an intervention that they felt might not be lifesaving and reduced care capacities, especially for the particularly ill and very old, contributed to the systematic reductions [24]. Patient fear of infection in the hospital or on the floor.

Table 3 Case numbers by surgery type for excisional biopsies at half-yearly (HY) intervals.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Change to prior half year</th>
<th>Outpatient (n)</th>
<th>Outpatient (%)</th>
<th>Inpatient (n)</th>
<th>Inpatient (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HY 2017</td>
<td>1213</td>
<td></td>
<td>868</td>
<td>72%</td>
<td>345</td>
<td>28%</td>
</tr>
<tr>
<td>2. HY 2017</td>
<td>1148</td>
<td>−5.4</td>
<td>775</td>
<td>68%</td>
<td>373</td>
<td>32%</td>
</tr>
<tr>
<td>1. HY 2018</td>
<td>1193</td>
<td>+3.9</td>
<td>785</td>
<td>66%</td>
<td>408</td>
<td>34%</td>
</tr>
<tr>
<td>2. HY 2018</td>
<td>1174</td>
<td>−1.6</td>
<td>748</td>
<td>64%</td>
<td>426</td>
<td>36%</td>
</tr>
<tr>
<td>1. HY 2019</td>
<td>1263</td>
<td>+7.6</td>
<td>812</td>
<td>64%</td>
<td>451</td>
<td>36%</td>
</tr>
<tr>
<td>2. HY 2019</td>
<td>1218</td>
<td>−3.6</td>
<td>803</td>
<td>66%</td>
<td>415</td>
<td>34%</td>
</tr>
<tr>
<td>1. HY 2020</td>
<td>994</td>
<td>−18.4</td>
<td>567</td>
<td>57%</td>
<td>427</td>
<td>43%</td>
</tr>
<tr>
<td>2. HY 2020</td>
<td>1051</td>
<td>+5.7</td>
<td>628</td>
<td>60%</td>
<td>423</td>
<td>40%</td>
</tr>
<tr>
<td>1. HY 2021*</td>
<td>854</td>
<td>−18.7</td>
<td>532</td>
<td>62%</td>
<td>322</td>
<td>38%</td>
</tr>
</tbody>
</table>

*2021 until 31.05.21
way to the hospital has a potential impact on case trends during the pandemic [25, 26]. However, having described deficits for health literacy in ophthalmic patients [27, 28], it must be questioned to what extent affected individuals themselves are able to assess the impact of treatment delays and undertreatment [29].

In this context, it is likely to be decisive for the individual procedures which proportions come together in relation to the elective character or the restrictions.

Previously, other papers have already reported the sharp drop in the number of cases in ophthalmic care during the first wave of the pandemic [1 – 6]. However, most of these were monocentric evaluations or presented only self-reported figures that did not report trends from previous years, the proportion of full inpatient procedures, or intubation anaesthesia. Measures by the hospitals to prevent infection and treat coronavirus-infected cases further exacerbated case reductions in main ophthalmology departments during the pandemic [1, 3, 13]. Case load trends during the second/third wave of the pandemic showed a less severe but still noticeably persistent decline for most of the procedures studied here, which is likely to have a painful impact on funding for major departments after financial compensation expired in 2020.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Relation IVIs vs. intraocular surgery.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total</td>
</tr>
<tr>
<td>1. HY 2017</td>
<td>35017</td>
</tr>
<tr>
<td>2. HY 2017</td>
<td>33422</td>
</tr>
<tr>
<td>1. HY 2018</td>
<td>35729</td>
</tr>
<tr>
<td>2. HY 2018</td>
<td>34084</td>
</tr>
<tr>
<td>1. HY 2019</td>
<td>35339</td>
</tr>
<tr>
<td>2. HY 2019</td>
<td>34758</td>
</tr>
<tr>
<td>1. HY 2020</td>
<td>29503</td>
</tr>
<tr>
<td>2. HY 2020</td>
<td>32510</td>
</tr>
<tr>
<td>1. HY 2021*</td>
<td>25693</td>
</tr>
</tbody>
</table>

*2021 until 31.05.21
Providers seemed to have adapted partly to infectious events with the Third Public Protection Act in the event of an epidemic situation of national significance on November 18, 2020 [30]. Providers located in counties where the COVID-19 incidence averaged (11/18/2020–05/31/2021) less than 100 experienced a smaller decrease in the number of cases than providers located in counties where the incidence averaged more than 100. Cataract surgeries were more likely to be postponed during the first pandemic wave along with eyelid and refractive surgeries according to a press release from the German Ophthalmological Society [31]. The case numbers were still reduced during the later period by over 30% compared to previous years. A similar gap in care must be assumed for strabismus surgery, which is often performed at preschool age to save children from social stigma due to an aesthetically compromising strabismus, but also urgently to prevent permanent effects of a recompensated normosensory strabismus or improve the field of single vision.

The most surprising trend observed is for vitrectomies, where at least for a large proportion of more emergency procedures in indications such as retinal detachments and endophthalmitis can be assumed. An analysis of diagnoses is likely to reveal only a relatively small proportion of slightly less urgent indications such as interface diseases or vitreous haemorrhages. Certainly, acute infections and detachments with threat to the macula are not the only factors (and largest subgroups) to consider here, but as with full-thickness macular holes, delays are often associated with reduced visual prognosis.

The relevance of infrastructure bottlenecks can presumably be gauged from the fairly constant proportion of anaesthesia involvement and the only slightly pronounced catch-up effects. Significant catch-up effects are minimally seen only in vitreoretinal procedures and strabismus surgery.

**Special development and special role of IVIs**

One of the best-documented and published outcomes for IVI is the impact of delayed (or no) treatment on vision [14–17]. Although the aggressive nature of retinal diseases is likely to differ for neovascular macular degeneration, even a few days is likely to be relevant – there is at least widespread awareness and a broad consensus that undertreatment has a major impact. Because IVI is considered a more urgent procedure [31], reductions in the first wave were still the lowest when comparing all procedures. Only recently, a paper for diabetic macular oedema had shown that although morphology may recover after a 1-year treatment break, the potential benefit in therapy of terms of visual gains should no longer be expected [32]. On the one hand, it is gratifying that the number of injections showed the least decline. Nevertheless, the data suggest a need to pay attention to the effective use of medications in the long term. If factors such as treatment delay and undertreatment are not focused on at the systemic policy level, the failure to provide effective quality assurance may contribute to avoidable loss of visual acuity [33–35]. The impact of the drop in the number of cases is more pronounced because a steady increase in the number of procedures in both clinical and office-based settings has been reported from 2017 to 2019, both in the sample and in the literature [7, 36]. Thus, a further increase would have been expected, especially against the background of an increasingly aging population in the following years. The actual gap in care is thus likely to be much larger. This becomes clear when one considers the projected development (Fig. 7).

Policy decisions and local curtailments of authorisations (e.g., IVI via EBM since October 2014) limit main ophthalmology departments in Germany, although they frequently initiate the treatment chain, e.g., when active choroidal neovascularisation (CNV) in the form of subretinal haemorrhage is detected in the emergency department. The evaluation of process parameters and OPS codes do not allow detailed statements about diagnoses or the use of depot preparations, which have the potential to cover longer intervals despite less frequent treatments. Further analysis of billing data may provide insight into whether there has been a cluster of treatment discontinuations by patients [37, 38] or an overall shift in care to fully ambulatory care. Structurally, the growing need for qualified professionals and nursing staff is a relevant determinant, the influence of which, however, could not yet be adequately captured by our analysis.

**Limitations and outlook**

Aggregated data across many centres were analysed and measures were taken to exclude the influence of temporary or structural changes of the providers; however, caution is needed. Although the sample is large and no structural changes were included, it cannot be proven with certainty how representative the data are. The data is limited to the main departments; however, a sample audit revealed that the sites surveyed do not provide or submit surgical services to medical care centres owned by the institutions. This work did not consider the effective amount of care provided by each department, so that the question of underuse cannot be conclusively addressed.

Neither differentiation of emergencies nor follow-up of individual treatment paths was possible, which excluded also an even more interesting differentiation by diagnosis. During the observation period, both case number declines and catch-up effects may have occurred in some centres at the same time. Due to hygiene measures and restrictions on accompanying persons during COVID-19, full utilisation or overutilisation was probably not possible from a provider perspective and so this may have biased the overall numbers reported. Although a somewhat smaller decrease in injections was detected compared with other services such as cataract surgery, the impact of these findings for patients with chronic conditions remains unclear [39].

**Conclusions**

The data indicated that the decline in even urgent and time-critical interventions within ophthalmology were not compensated for in the months following the first three waves. The level of care continues to be significantly below that of previous years.

Additional strategies are needed to quantify and address potential gaps in healthcare coverage due to the pandemic [40, 41]. This also includes the analysis of possible migration of patients to outpatient offices and medical care centres outside of hospitals. One possible approach is improved demand monitoring, which
also utilises the expertise of people in the ophthalmic care centres and would be based on baseline demographic data.

In addition, any pandemic response should always consider the implications for non-pandemic diseases in the various specialties. The range of therapies must be made more accessible even under pandemic conditions, especially for chronically ill patients. The needs of the patient groups must be continuously evaluated. The data presented should motivate providers and healthcare research to initiate further analyses with greater explanatory power.

Conflict of Interest

Focke Ziemssen has received honoraria for speaking engagements from Allergan/Abbvie, Bayer, Novartis and Roche and for consulting engagements from Alimera, Allergan/Abbvie, Bayer, Boehringer-Ingelheim, Novartis, NovoNordisk, MSD, Oxurion and Roche/Genentech. Aljoscha Neubauer has received honoraria for research projects from Alimera. Enno Bialas is a director of digmed GmbH, a consulting company, has worked for pharmaceutical companies and is a director of digmed GmbH. The company Alimera Sciences Ophthalmologie GmbH commissioned digmed GmbH, to which Dr. Bialas and Olga Karaca belong, with the data evaluation and text writing (fee of 15,000 € plus VAT).

No influence was exerted on the evaluation nor on the contents of the manuscript. Ms Subert is an employee of the Alimera company.

References


