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Cornea specialists are the highest opioid prescribers at a large academic eye institute in the USA

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AABSTRACT

Background/aim To evaluate the opioid prescription patterns across ophthalmic subspecialties at a large academic eye centre.

Methods A single site, retrospective cross-sectional study. Electronic medical records from the year 2018 were screened. Ophthalmology patients ≥18 years of age were included. The main outcome measures were patient demographics, outpatient opioid prescriptions, ophthalmic procedure and prescriber details, including department and training level.

Results 1654 opioid prescriptions were written, accounting for 2.2% of all ophthalmic procedures in a calendar year. Of the patients who received prescriptions, 51.4% were female (n=851) with a mean age of 52.3±18.5 (range 18–95 years). In general, the morphine equivalent dose was low, with an average of 12.4±6.75 pills dispensed (range 1–60) with 0.0±0.01 refills (range 0–3). Cornea specialists were the highest opioid prescribers (22.7% of all providers who wrote a prescription), followed by oculoplastics (22.2%) and retina (18.4%). The most common procedure for which an opioid was prescribed was cornea crosslinking (14.3% of all opioid prescriptions).

Conclusions While opioid prescriptions are generally low for ophthalmic procedures across departments, cornea specialists accounted for nearly a third of opioid prescriptions. Over half of corneal crosslinking patients received opioid prescriptions; there remains an unmet need for opioid-sparing therapy for these patients and others with severe eye pain.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The opioid epidemic, declared a public health crisis in 2017, has resulted in a significant number of overdose deaths, with a notable increase from 47 000 in 2018 to 81 000 000 in 2023. Previous research indicates that many heroin users were initially introduced to opioids through prescription drugs. While primary care and pain management specialists prescribe the majority of opioids, surgical specialties, including ophthalmology, also contribute to opioid prescriptions. Despite ophthalmologists prescribing fewer opioids than average, there has been a reported increase in opioid prescriptions following ocular surgeries.

WHAT THIS STUDY ADDS

⇒ This study reveals that the cornea department at a large academic eye centre is responsible for a third of all opioid prescriptions, with over 50% of corneal crosslinking patients receiving opioids postprocedure. The study highlights that most of these prescriptions had low morphine equivalent doses and limited refills. Additionally, it was found that trainees, particularly fellows, wrote a significant portion of these prescriptions, indicating a potential gap in opioid prescribing training among ophthalmology trainees.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings emphasise the need for standardised opioid prescribing guidelines in ophthalmology, particularly for corneal procedures, to mitigate opioid misuse. The study suggests that future guidelines should be distributed to both trainees and faculty to ensure comprehensive education on opioid management. Moreover, the results underscore the importance of developing opioid-sparing pain therapies and addressing geographic disparities in opioid prescribing patterns. This study could inform policy changes and training programmes to better equip ophthalmologists in managing postoperative pain while reducing the risk of long-term opioid dependence.

INTRODUCTION

The opioid epidemic was declared a public health crisis in 2017,[1] and the current opioid epidemic has led to a staggering number of deaths per year from drug overdose, with nearly 47 000 deaths in 2018 alone,[2] and almost doubling to a record 81 000 deaths in 2023.[3] This is notable since approximately 645 000 deaths were reported from prescription or illicit opioid overdose in the 22 years between 1999 and 2021.[3] While primary care providers and pain management specialties prescribe the most opioids overall, surgical specialties also contribute to opioid prescriptions in routine postoperative care.[4] Prior investigations for opioid-naïve patients undergoing major and minor surgical procedures suggest that about 6% continue to fill

opioid prescriptions more than 3 months later.[5] Opioid use following ophthalmic surgeries has been recently noted to predispose patients significantly more to opioid overdose, hospitalisations and mortality.[6] Thus, it is important to continue to understand and raise awareness of surgeons' opioid prescription patterns for postoperative pain control in the current opioid epidemic.

Opioid management training for prescribers varies across the USA. Several national surveys of trainees from different surgical specialties (eg, general surgery, plastic surgery, cardiac surgery and otolaryngology) found a high variability in the amount of training received for opioid prescribing during medical school and residency.[7–10] Moreover, a survey of general surgery training programmes found that roughly two-thirds of surgical residents reported feeling that they had received inadequate training in prescribing opioids.[8] A quality improvement study of over 5000 ophthalmic surgeries showed a reduction of overprescribing opioids in opioid-naïve patients after implementation of a standardised opioid prescribing guideline at a single academic institution.[11] These guidelines have been supported by the American Board of Ophthalmology and can be reviewed for maintenance of certification credit for all participating ophthalmologists.[12] Similar guidelines have been demonstrated to be effective in other specialties as well.[13]

Postoperative opioid prescribing for pain management is of particular interest to cornea surgeons given the unique sensory characteristics of the cornea.[1 14 15] The cornea is the most densely innervated tissue in the human body, with approximately 7000 nociceptors per square millimetre, making it 300 to 600 times more sensitive than skin.[15] This dense sensory innervation originates from the ophthalmic division of the trigeminal ganglion, with extensive branching into the subbasal nerve plexus that supplies the corneal epithelium.[15] As a result, even minor corneal injuries can cause significant pain and frequently prompt emergency department visits.[14] For corneal surgical procedures, such as photorefractive keratectomy (PRK), phototherapeutic keratectomy and corneal crosslinking, postoperative pain is common and often severe, correlating with nerve fibre exposure, epithelial damage and stromal tissue ablation.[14 15] Given the acute pain associated with these procedures and the relatively slow recovery of corneal nerves, opioids are frequently prescribed for short-term pain management.[16–18]

With this growing insight into the role ophthalmologists may play in the current opioid epidemic, as well as the variability in opioid management education among trainees, we sought to evaluate the opioid prescription pattern across ophthalmic subspecialties at a large academic eye centre. We also examined the level of prescriber training to better understand who is prescribing opioids.

MATERIALS AND METHODS

We conducted a retrospective cohort study at a single academic ophthalmology centre. All opioid prescriptions written for patients 18 years or older in the year 2018 were included in our analysis. Prescriptions were identified through electronic medical records. For each prescription, the patient demographics, the associated primary procedure or diagnosis code and the prescriber information were collected. All opioid prescriptions were collected, regardless of association with a procedure. A prescription was considered a duplicate and excluded if it included identical prescription information and was written within 1 hour of each other. If an alternate prescription was written within 1 hour of the first prescription, then this first prescription was excluded, and the latter prescription data was collected.

The department of the prescriber was categorised into subspecialties including cornea, oculoplastics, retina, strabismus, glaucoma, comprehensive ophthalmology or uveitis. The training level of each prescriber was categorised as either an attending, fellow or resident.

Descriptive statistics were calculated with means±SD for continuous variables, as well as frequencies and percentages for categorical variables. Statistical analysis was performed using SAS software (V.9.2, USA).

Research ethics approval

Massachusetts General Brigham's Institutional Review Board (IRB) declared this study (2019P000259) exempt from review as all data were deidentified; thus, patient consent was waived. Hence, the IRB/Ethics Committee ruled that approval was not required for this study. All research adhered to the tenets of the Declaration of Helsinki.

Patient and public involvement statement

Patients and the public were not involved in any way.

RESULTS

Total unique opioid prescriptions and patient characteristics

Our study found that in 2018, a cumulative 75 412 ophthalmic procedures were performed at Massachusetts Eye and Ear (MEE) (figure 1), large academic eye centre and 1654 (2.2%) unique opioid prescriptions were written (table 1). The patients who received prescriptions were 51.4% (n=851) female, 65.56% (n=1084) White and with an average age of 52.3±18.5 (range 18–95 years) (table 2).

Opioid prescriptions and their morphine equivalent dose (MED)

Oxycodone 5 mg tablets were most prescribed (n=553, 33.4%), followed by hydrocodone 5mg-acetaminophen 300 mg tablets (n=381, 23.0%) and oxycodone 5 mg–acetaminophen 325 mg tablets (n=368, 22.2%) (table 1). In terms of morphine equivalent dose (MED), 7.5 MED was the most prescribed dosage (n=921, 55.7%). Most prescriptions were written for 10 pills (mean 12.4±6.6 pills, median 10, mode 10). The range of pills dispensed was from 1 pill to 60 pills. Most had 0 refills (mean 0.0±0.01 refills, median 0, mode 0), with a single prescription of 1 refill and a single prescription of 3 refills.

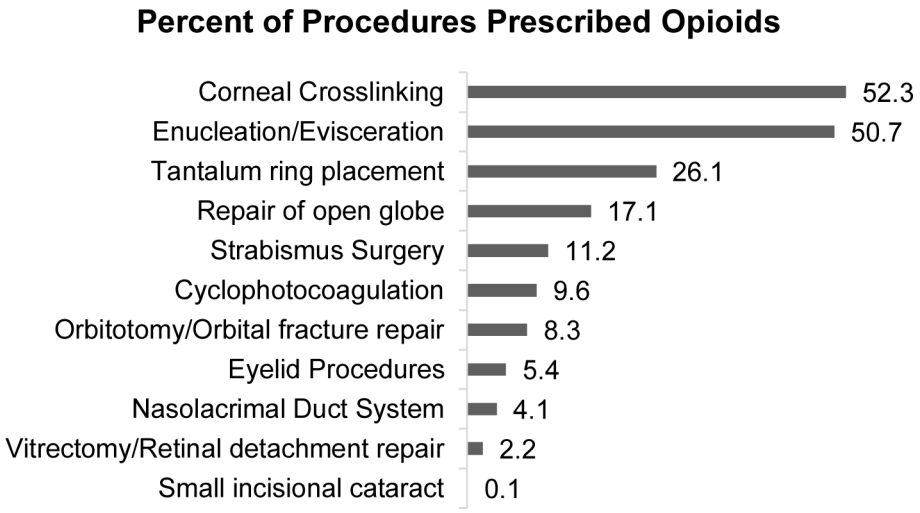

Figure 1 Patients and ophthalmic procedures receiving an opioid prescription. The % of procedures receiving an opioid prescription was calculated as the number of patients receiving opioids/number of total procedures performed for each type of procedure. Orbitotomy/orbital fracture repair procedures included those with or without bone flap; eyelid procedures included blepharoplasty, lid ptosis repair, entropion/ectropion repair and canthoplasty; vitrectomy/retinal detachment repair procedures included those with or without scleral buckle.

Patients and ophthalmic procedures receiving opioids

Of the 453 opioid prescriptions from the cornea department, the majority were for cornea crosslinking (237 prescriptions, 52.3% of all crosslinking procedures) (figure 1). Other less common cornea procedures associated with an opioid prescription included PRK (96), superficial keratectomy (53), phototherapeutic keratectomy (36), penetrating keratoplasty (31), pterygium excisions (28), deep anterior lamellar keratoplasty (9), conjunctival biopsy (8), Descemet membrane endothelial keratoplasty (7), Descemet stripping endothelial keratoplasty or Descemet stripping automated endothelial keratoplasty (7), laser-assisted in situ keratomileusis (LASIK) or LASIK revisions (7), amniotic membrane grafting (6) and cryotherapy (3). Additional opioid prescriptions were given for cornea diagnoses but had no associated procedure, including Acanthamoeba keratitis (9), ocular graft-versus-host disease (oGVHD) (3), recurrent corneal erosion (3), corneal chemical injury (2) and zoster ophthalmicus (1).

Table 1 Prescribed opioid-containing medications and corresponding dosages

Medication type	Morphine equivalent dose	N (%)
Oxycodone 5 mg tablet	7.5	553 (33.4)
Hydrocodone 5 mg acetaminophen 300 mg tablet	5.0	381 (23.0)
Oxycodone-acetaminophen 5–325 mg tablet	7.5	368 (22.2)
Acetaminophen 300 mg–codeine 15 mg tablet	2.25	315 (19.0)
Oxycodone 10 mg tablet	15	14 (0.8)
Tramadol 50 mg tablet	5.0	12 (0.7)
Oxycodone 30 mg tablet	45	3 (0.2)
Other*	--	8 (0.5)
TOTAL		**1654**

*Others include one prescription of each of the following: butalbital 50 mg acetaminophen 325 mg–caffeine 40 mg–codeine 30 mg capsule; oxycodone 5 mg/5 mL oral solution; oxycodone 10 mg tablet extended release 12 hours; oxycodone 20 mg tablet extended release 12 hours; oxycodone-acetaminophen 10 mg–325 mg tablet, oxycodone-aspirin 4.8355 mg–325 mg tablet; tramadol 37.5 mg–acetaminophen 325 mg tablet.

Table 2 Demographics of patients who received an opioid prescription in 2018 at a single academic ophthalmology institution

Demographics of patients who received any opioid prescription	
Age	**Years±SD**
Mean	52.3±18.5
Range	18–95 years
Gender	**N (%)**
Female	851 (51.4)
Male	803 (48.5)
Race	**N (%)**
White or Caucasian	1084 (65.6)
Other	245 (14.8)
Black	137 (8.3)
Unknown/Declined to say	126 (7.6)
Asian	57 (3.4)
Native Hawaiian or Pacific Islander	3 (0.2)
Hispanic or Latino	2 (0.1)

Of the 367 opioid prescriptions from the oculoplastics department, the majority were for blepharoplasty (185 prescriptions, 17.8% of all blepharoplasty procedures) (figure 1). Other opioid prescriptions associated with common oculoplastics procedures included enucleation or eviscerations (73, 50.7%), ptosis repair (43, 2.3%), entropion or ectropion repair (24, 4.3%), dacryocystorhinostomy (19, 3%), orbitotomy/orbital fracture repair/orbital decompression (18, 4.5%), brow ptosis repair (six prescriptions, 1%) or canalicular repair or punctoplasty (five prescriptions, 2.3%). Other less common procedures associated with an opioid prescription included post-Mohs reconstruction (22), eyelid or conjunctival biopsy (11), incision and drainage of abscess (2) and temporal artery biopsy (2). Other opioid prescriptions for oculoplastics diagnosis but without an associated procedure included orbital fractures without repair (3) and facial cellulitis (1).

Of the 305 opioid prescriptions from the retina department, the majority were for pars plana vitrectomy (136 prescriptions, 1.8% of pars plana vitrectomy procedures) (figure 1). Other retina procedures that had associated opioid prescriptions included tantalum marker ring placement (89, 26.1%) and scleral buckle (60, 7.3%). Other less common procedures associated with an opioid prescription included intravitreal injections (6), panretinal photocoagulation (4) and transscleral biopsy (2). Other opioid prescriptions for retina diagnoses without an associated procedure included panuveitis or scleritis (4), vitreous haemorrhage secondary to trauma (2) and retinal necrosis (1).

There were 127 opioid prescriptions following strabismus surgery (11.2% of all strabismus surgeries) (figure 1). 97 were following cyclophotocoagulation (9.6% of all cyclophotocoagulations). 37 opioid prescriptions were following open globe repairs (17% of all open globe repairs). 10 were following small incisional cataract surgery (0.1% of all cataract surgeries).

Opioid prescription patterns of ophthalmology prescribers and departments

Analysis of the prescription by individual prescriber revealed 97 unique prescribers, over half of which were trainees (25.8% residents and 27.8% fellows) (table 3). Analysis of the prescribers per individual prescription showed that 283 (17.1%) prescriptions written by residents versus 521 (31.5%) prescriptions were written by fellows (table 3).

When looking by department, the departments with the most unique prescribers were cornea (22; 22.7%) and retina (22; 22.7%) (table 3). This analysis excluded residents who are not assigned to a specific department, but overall had the highest percentage of individual prescribers (25; 25.8%). We also examined the total number of individual opioid prescriptions, since some providers will write more than one and a few patients received more than one prescription. For the total number of prescriptions, most were written by the cornea (32.8%) department, followed by the oculoplastics (22.2%) and retina departments (18.5%) (table 3).

DISCUSSION

Ophthalmologists, like other providers, must balance adequate management of acute post-operative pain with long-term risks of opioid dependence to help reduce opioid misuse.[6] This is especially true, since it was reported that about 10% of patients do not experience sufficient postoperative pain control.[19] Overall, ophthalmologists in the USA prescribe opioids less than some providers, accounting for an estimated 4–8% of the total ophthalmic prescriptions;[20] yet a recent study found a sustained increase in filled opioid prescriptions due to ocular surgeries between 2000 and 2016.[21] A large healthcare claims-based study found that 3.4% of opioid-naïve patients who received an initial opioid prescription at the time of incisional ophthalmic surgery had new, persistent opioid use after the perioperative period.[22] Therefore, ophthalmologists still play an important role in the opioid epidemic.[1 14 16 20 23–25]

Table 3 Unique opioid prescribers and individual opioid prescription patterns per ophthalmic department

	Number of unique opioid prescribers per department, N (% of total prescribers)				Number of individual opioid prescriptions written per department, N (% of total prescriptions)			
	Resident	Fellow	Attending	Department	Resident	Fellow	Attending	Department
Resident	25 (25.8)	--	--	25 (25.8)	283 (17.1)	--	--	283 (17.1)
Cornea	--	7 (7.2)	15 (15.5)	22 (22.7)	--	144 (8.7)	399 (24.1)	543 (32.8)
Oculoplastics	--	3 (3.1)	7 (7.2)	10 (10.3)	--	33 (2.0)	334 (20.2)	367 (22.2)
Retina	--	11 (11.3)	11 (11.3)	22 (22.7)	--	262 (15.8)	43 (2.6)	305 (18.4)
Strabismus	--	5 (5.2)	4 (4.1)	9 (9.3)	--	67 (4.0)	21 (1.3)	88 (5.3)
Glaucoma	--	1 (1.0)	4 (4.1)	5 (5.2)	--	15 (0.9)	40 (2.4)	55 (3.3)
Comprehensive	--	0 (0)	3 (3.1)	3 (3.1)	--	0 (0)	12 (0.7)	12 (0.7)
Uveitis	--	0 (0)	1 (1.0)	1 (1.0)	--	0 (0)	1 (0.1)	1 (0.1)
TOTAL	**25 (25.8)**	**27 (27.9)**	**45 (46.4)**	**97**	**283 (17.1)**	**521 (31.5)**	**850 (51.4)**	**1654**

In our study, the opioid prescriptions had a low MED with an average of 7.5. The opioid prescriptions also had a limited number of pills dispensed (12.4±6.75), and most were without refills (0.0±0.01, range 0–3). While the overall prescriptions were low and had a low MED in our study, patients who were prescribed opioids within 7 days of ambulatory surgery were reported to be 44% more likely to become long-term users.[26] Also, a short course of prescribed opioids after ophthalmic surgery was recently reported to significantly increase the rates of patient chronic opioid overdose, hospitalisations and mortality.[6] Importantly, a large study on opioid-naïve patients undergoing ophthalmic surgery suggested that 3.4% of patients continued to use opioids, despite low morphine equivalents.[22] These reports are notable when considering strategies to mitigate opioid abuse, since ophthalmologists are known to typically prescribe 5-day opioid supplies.[19] Approaches for reducing opioid prescriptions, while still effectively managing postoperative pain due to ophthalmic surgeries, have ranged from oral or intravenous non-narcotic alternatives including pregabalin, acetaminophen and ibuprofen, ketorolac, memantine and local anaesthetics (eg, bupivacaine, lidocaine, diluted proparacaine) that prevent pain development[27] to novel therapies, such as a tetracaine-eluting contact lens that provides sustained and controlled pain relief.[28]

Corneal injury represented an estimated 337 000 annual emergency department visits in the USA between 2010 and 2018,[29] and cornea specialists are some of the most frequent opioid prescribers as their patients are often predisposed to significant pain.[1 14 15] The cornea has more nerve endings than any other part of the body, and current pain control methods for the ocular surface are limited.[17] Topical anaesthetics are well known to cause ocular morbidities,[14] particularly corneal toxicity,[14] so systemic opioids may be prescribed for severe pain. Indeed, we found that most opioid prescriptions at our institution came from the cornea department. Similarly, a cohort study of patients undergoing cornea surgery found that 70% to 90% of patients received an opioid prescription, likely due to the high proportion undergoing surface ablative procedures.[18] Another more recent study reported a range of 77.2 to 83.9% of cornea physicians prescribing opioids.[1] Furthermore, we found that 2.2% of all ophthalmic procedures were associated with an opioid prescription. A similar rate of opioid prescriptions was reported by a large study on US insurer's claims database, which found that 1.9% of incisional ocular surgeries had an associated opioid prescription, but the rate increased to 6.1% for corneal surgeries alone.[16] The procedure with the highest associated opioid prescription was corneal crosslinking, where 52.3% of procedures received an associated opioid prescription. No previous study to our knowledge has reported on opioid prescription patterns associated with corneal crosslinking, despite it being well established that cornea specialists are frequent opioid prescribers.

Opioid prescriptions were also provided in the non-operative setting for ocular pain control. Within the cornea department, opioid prescriptions were provided for cornea diagnoses such as Acanthamoeba keratitis, oGVHD, recurrent corneal erosions, zoster ophthalmicus and corneal chemical injuries. Thus, ophthalmologists, and in particular cornea specialists who are prescribing opioids for pain management, should be aware of the potential need for additional pain control for their patients in the non-operative setting. This is of particular importance as there is strong evidence for only minimal short-term benefits to opioid prescribing, while research on the potential long-term benefits remains limited.[4]

This study also highlights the role of trainees, particularly fellows, in prescribing opioids postoperatively at our institution. Of the 97 unique providers who wrote opioid prescriptions, about half were trainees (25.8% residents, 27.8% fellows, 46.4% attendings). Of the total 1655 unique opioid prescriptions written, 17.0% were written by residents, 31.5% by fellows and 60.1% by attendings. While several studies have highlighted a lack of opioid training among surgical residents,[7–10] there are no surveys on opioid training among ophthalmology residents or fellows. It is possible that similar medical school curricula have left a gap in knowledge in this area. A small survey of general surgical residents found that the majority expressed a preference for more formal training or guidelines for opioid prescriptions for routine postoperative management.[30] There has been a recent call to standardise opioid prescriptions and create guidelines within ophthalmology,[11] and our study suggests that future guidelines should be distributed to trainees as well as faculty to reach the most common prescribers. For instance, a study evaluating the effect of state-level policies on opioid prescribing patterns showed that the enactment of the Michigan Opioid Laws in 2017 and 2018 led to a reduced number of opioid prescriptions for oculoplastic procedures.[25] Similarly, another more recent study including almost 20 000 ophthalmologists across the USA reported a significant annual reduction in prescribed opioids from 2016 to 2018 for the cornea, retina, glaucoma and comprehensive ophthalmology subspecialties.[1] However, these state-level policies are variable and may not uniformly impact trainees. This agrees with our findings, where although the cornea, oculoplastics and retina subspecialties consistently had the most opioid prescribers at our institute as across the USA, each one prescribed about three to four times less than the national average in 2018: cornea (77.2% vs 32.8%), oculoplastics (86% vs 22.2%) and retina (54.5% vs 18.5%).[1] Our findings further suggest a geographic disparity in opioid prescribing patterns, which was previously reported as well.[19] Additionally, the fact that trainees may train for residency in one state and undergo fellowship in another may additionally pose a challenge for trainees.

The strengths of this study include that it was performed at a large academic eye institute, with a wide range of

procedures performed and subspecialties surveyed. Moreover, we contributed data to the limited knowledge on opioid prescribing patterns regarding procedures and subspecialties previously not reported. This further included newly found differences in prescribing habits between trainee and non-trainee ophthalmologists. In terms of study limitations, the retrospective chart-based review prevents us from confirming whether the opioid prescriptions were actually filled or taken. However, this provides data on the ophthalmologists' perception of post-operative pain needs and is not necessarily representative of the patients' actual pain medication needs. Additionally, the results reflect the practice patterns of only a single institution and are extracted based on primary procedure codes. Therefore, the results may reflect individual or departmental practices rather than overall field trends and may not capture the full extent of the surgery if multiple procedures were performed. We also did not assess whether the patient was opioid-naïve, which may necessitate higher MED for equivalent pain control. Finally, another limitation is that an evaluation of the association between provider and patient characteristics to opioid prescribing was not performed.

The opioid epidemic in the USA has spurred significant changes in prescribing practices across medical specialties, including ophthalmology.[1] Regulatory frameworks, such as the Centers for Disease Control and Prevention opioid prescribing guidelines and Drug Enforcement Administration oversight, have tightened access to opioids, encouraging clinicians to seek non-opioid alternatives wherever possible.[4] Globally, approaches to corneal pain management and opioid prescribing vary widely, influenced by healthcare infrastructure, cultural attitudes and regulatory policies.[31 32] In high-resource settings such as Europe and Australia, opioid use is also limited, with greater emphasis on non-opioid therapies and multidisciplinary approaches.[31] In contrast, low-resource settings often face significant barriers to care, including limited access to advanced diagnostic tools and medications, resulting in a reliance on traditional remedies or over-the-counter analgesics.[32] Middle-income countries, such as India and Brazil, are navigating an intermediate landscape, with increasing access to advanced care but ongoing variability in provider training and opioid regulation.[32]

Furthermore, specialised pain clinics in many high-income countries serve as a structured and safer pathway for opioid access when necessary. These clinics, often led by anaesthesiologists with multidisciplinary teams, provide comprehensive pain management, integrating psychological support and non-opioid therapies alongside carefully monitored opioid prescriptions to minimise misuse risk.[33 34] Given their success in balancing pain relief with opioid stewardship, expanding access to specialised pain clinics in the USA may offer a safer, more controlled alternative to widespread opioid prescribing. The American Society of Interventional Pain Physicians (ASIPP) has published guidelines emphasising the importance of comprehensive assessment and monitoring in specialised settings to ensure safe opioid use within a structured framework.[35] This model could ensure that patients requiring opioids receive them within a multidisciplinary framework that prioritises both efficacy and safety.[4]

Research on practice-specific postoperative opioid prescribing for pain management in ophthalmology continues to be of importance. Addressing the opioid epidemic in the field of ophthalmology will require raised awareness and better understanding of the practice patterns of opioid prescriptions, both in the operative and non-operative setting. While opioid prescriptions are generally low for ophthalmic procedures across departments, this study highlights that cornea specialists accounted for nearly a third of opioid prescriptions. Further understanding of postprocedural corneal surface pain management, opioid tapering guidelines, geographic disparities and developing opioid-sparing pain therapies is needed.

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