Pharmaceutical Care of the Eye

Author
Dr E F Ruth Morrissey
Lead Pharmacist, Research & Clinical Trials
Western Health and Social Care Trust

Editor
Dr Fran Lloyd
Assistant Director for Distance Learning
Northern Ireland Centre for Pharmacy Learning and Development

Reviewer
Mrs Lucy Titcomb
Lead Ophthalmic Pharmacist
Birmingham and Midland Eye Centre

Design
www.darragheely.com

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Northern Ireland Centre for Pharmacy Learning and Development,
Queen's University Belfast, 97 Lisburn Road, Belfast BT9 7BL, Northern Ireland.
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Participants are reminded that information contained in this course is correct at the time of publication but it is their responsibility to keep up-to-date with any changes in practice.

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## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Acanthamoeba</strong></td>
<td>One of the most common protozoa found in soil, air and some water sources</td>
</tr>
<tr>
<td><strong>Anisocoria</strong></td>
<td>Inequality in diameter of the pupils</td>
</tr>
<tr>
<td><strong>Arcus cornea</strong></td>
<td>An opaque ring round the edge of the cornea, seen in older people</td>
</tr>
<tr>
<td><strong>Blepharitis</strong></td>
<td>Inflammation of the eyelids, particularly the edges</td>
</tr>
<tr>
<td><strong>Bowman's membrane</strong></td>
<td>A basement membrane in the eye located between the front epithelium and the stroma in the cornea</td>
</tr>
<tr>
<td><strong>Bruch's membrane</strong></td>
<td>The innermost layer of the choroid - also called the vitreous lamina</td>
</tr>
<tr>
<td><strong>Canaliculi</strong></td>
<td>Tube-like structures that carry tears from the eyes to the lacrimal sac, also known as lacrimal ducts</td>
</tr>
<tr>
<td><strong>Cataract</strong></td>
<td>An opacity of the crystalline lens of the eye or its capsule</td>
</tr>
<tr>
<td><strong>Chalazion</strong></td>
<td>A cyst on the edge of the eyelid from retained secretion of the meibomian glands (oil glands). Also known as a meibomian cyst</td>
</tr>
<tr>
<td><strong>Choriocapillaris</strong></td>
<td>Layer of the choroid adjacent to Bruch's membrane and consisting of a network of capillaries that supplies nutrients to the retina</td>
</tr>
<tr>
<td><strong>Choroiditis</strong></td>
<td>Inflammation of the choroid</td>
</tr>
<tr>
<td><strong>Drusen</strong></td>
<td>Tiny yellow or white accumulations of extracellular material that build up in Bruch's membrane of the eye; a common early sign of age-related macular degeneration</td>
</tr>
<tr>
<td><strong>Fovea</strong></td>
<td>A tiny pit located in the macula of the retina that provides the clearest and most distinct vision</td>
</tr>
<tr>
<td><strong>Goniotomy</strong></td>
<td>An operation, mainly for congenital glaucoma, involving incision through the anterior chamber angle to the canal of Schlemm</td>
</tr>
<tr>
<td><strong>Iridocyclitis</strong></td>
<td>Inflammation of the iris and ciliary body</td>
</tr>
<tr>
<td><strong>Iridectomy</strong></td>
<td>A surgical incision into the iris performed to treat angle closure glaucoma</td>
</tr>
<tr>
<td><strong>Iridotomy</strong></td>
<td>Laser treatment to treat angle closure glaucoma. Usually two small holes are made in the iris using a laser. The holes are almost unnoticeable to other people</td>
</tr>
<tr>
<td><strong>Iritis</strong></td>
<td>Inflammation of the iris</td>
</tr>
<tr>
<td><strong>Keratitis</strong></td>
<td>Inflammation of the cornea</td>
</tr>
<tr>
<td><strong>Lowe's syndrome</strong></td>
<td>A genetic disorder characterised by anomalies affecting the eye, the nervous system and the kidney</td>
</tr>
<tr>
<td><strong>Lysozyme</strong></td>
<td>An enzyme that acts as an antibacterial agent and is present in various body fluids such as tears and saliva</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<td>-------------------------</td>
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</tr>
<tr>
<td>Macula</td>
<td>An oval-shaped highly pigmented yellow spot near the centre of the retina of the human eye</td>
</tr>
<tr>
<td>Marfan’s syndrome</td>
<td>A genetic disorder of the connective tissue. People with Marfan’s are typically tall, with long limbs and long thin fingers</td>
</tr>
<tr>
<td>Mydriasis</td>
<td>Excessive dilation of the pupil due to disease, trauma or the use of drugs</td>
</tr>
<tr>
<td>Myopia</td>
<td>A refractive defect of the eye in which collimated light produces image focus in front of the retina when accommodation is relaxed. Also known as short sightedness</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>Is characterised by a rapid involuntary movement of the eyes, usually from side to side. The eye movement is not necessarily in a horizontal plane – it could be a vertical or circular movement</td>
</tr>
<tr>
<td>Ora serrata</td>
<td>The serrated junction between the retina and the ciliary body. This junction marks the transition from the simple non-photosensitive area of the retina to the complex, multi-layered photosensitive region</td>
</tr>
<tr>
<td>Photophobia</td>
<td>A symptom of excessive sensitivity to light and the aversion to sunlight or well-lit places</td>
</tr>
<tr>
<td>Presbyopia</td>
<td>An age-related condition in which the lens of the eye exhibits a progressively diminished ability to focus on near objects with age</td>
</tr>
<tr>
<td>Sclera</td>
<td>The white of the eye</td>
</tr>
<tr>
<td>Stye</td>
<td>An infection of the sebaceous glands of Zeis at the base of the eyelashes. An external stye may also be due to infection of the glands of Moll. Internal styes can also be caused by infection of meibomian glands</td>
</tr>
<tr>
<td>Trabeculectomy</td>
<td>A surgical procedure used in the treatment of glaucoma to relieve intraocular pressure by removing part of the eye’s trabecular meshwork and adjacent structures</td>
</tr>
<tr>
<td>Trabeculoplasty</td>
<td>A surgical treatment for glaucoma performed on the trabecula. Specifically, laser surgery is used to create small openings in the eye’s trabecular meshwork from which the aqueous humor can drain to reduce intraocular pressure caused by open-angle glaucoma</td>
</tr>
<tr>
<td>Uveitis</td>
<td>Inflammation of the uveal tract, the iris, ciliary body and choroid. It may be classified by the part of the uveal tract affected, e.g. anterior uveitis.</td>
</tr>
<tr>
<td>Xanthelasmata palpebrum</td>
<td>yellow flat plaques over the upper or lower eyelids, most often near the inner canthus. They represent areas of lipid-containing macrophages but the exact pathophysiology is not known</td>
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</table>
Introduction

Vision is predominant of all the senses; to touch and taste we have to be in contact with the object, to hear and smell we can be further away, yet with sight we can perceive objects up to millions of miles in the distance. The thought of losing this ability to see is a frightening prospect and one that ensures that most people will seek help with their eye symptoms. Eye conditions range from the trivial and self-limiting, which are of little consequence, to the severe with the prognosis that sight might be lost. In between these two extremes is a range of conditions that are often treated therapeutically and therefore may involve a range of healthcare professionals, including pharmacists. Therefore, this course aims to revise and update a pharmacist’s knowledge of the eye in terms of its actual structure and function, diseases and drugs that may affect the eye and how to keep eyes healthy.

In requesting this course you have already identified one or more specific personal learning needs. Before reading further, write down these learning needs and the method by which you identified these (reflection).

1.

2.

3.

4.

5.

These learning needs should be recorded appropriately in the reflection stage of your CPD cycles.

Having completed your study you should record what you learned and what you did not learn but had expected to learn (action).

In evaluating the outcome of your learning, you should indicate if your learning need has been met and if you have identified additional learning needs as a result of your study. You should also record how you have been able to translate your learning into practice (evaluation).
**Aim**
To provide pharmacists with an overview of the most common conditions that affect the human eye and to understand the principles behind the drug management of these conditions.

**Intended learning outcomes**
Having completed this course you should be able to:

- **Provide** a clinical understanding of the most common conditions that affect the human eye.
- **Outline** the drug therapy available to treat these conditions (POM and OTC) and indicate the principles of rational drug choice in individual patients.
- **Identify** the advice and information needs of patients with eye conditions that would enable them to manage their condition and use their medications more effectively.
- **Highlight** opportunities for greater partnership between pharmacists, GPs and optometrists in the patient management process.

**Signposts**
Throughout the course the following signs have been used to guide you accordingly.

- Intended learning outcomes that specify what you should know, or be able to do, as a result of your study.
- Exercises, as distinct from case studies, where you have to give a written response.
- Case studies that present patient-orientated challenges to which you have to offer written explanations or solutions.
- Summary points of important information that practitioners should take into consideration when managing patients.
Using the course to best effect

The course should take you about 8-10 hours to complete but is so designed to facilitate short periods of study. It is also self-contained in that all the basic material you need is provided. References have been included to allow you to undertake further study.

1. Plan to set aside specific times to work through the material, and discipline yourself to keep these appointments.

2. Make use of any occasional spare time you have to study (for example, less busy periods in your practice; during a train/bus journey to work).

3. Study in manageable and digestible ‘chunks.’ That is, don’t do too much during each study period, but rather intersperse study with practice, looking for opportunities in which to apply and/or test the knowledge you have gained.

4. Complete the exercises in each section as fully as possible before comparing your responses with the answers or comments that follow at the end of the section.

5. Discuss your responses to the exercises/case studies with a colleague whenever possible. This can be an extremely useful way of consolidating and extending your knowledge and expertise.

This course is divided into six sections. Section one deals with pharmaceutical care and how this is integrated into every day practice of the pharmacist. The second section is concerned with the structure and function of the eye, which will form the foundation of knowledge to assist you in understanding the contents of the subsequent sections; these deal with responding to eye symptoms, eye diseases and their treatment and drugs/diseases that can adversely affect the eye. The final section discusses how to keep the eyes healthy in terms of correct use of contact lenses, contact lens care products and eye drops/ointments.

Each section is self-contained and therefore it is not absolutely necessary for you to study the sections in their written order; however, it would be advisable to complete section two before moving to Sections 3-6. The answers to the exercises and case studies are given at the end of each section. The text is referenced throughout and you will find a list of references at the end of each section.

Evaluation

The self-assessment associated with this course can be accessed from www.nicpld.org. The assessment is a straightforward multiple-choice questionnaire with the stem of each question requiring a true or false answer. Answers should be submitted online at www.nicpld.org. We would strongly encourage you to complete the questionnaire as it forms an integral part of the course, particularly in allowing you to gauge the extent of your learning.
Introduction
Before looking specifically at eye disease and its treatment, it is important to consider the role of the pharmacist in the context of Pharmaceutical Care. Other health professionals have responsibility for eye care including GPs, ophthalmic medical practitioners (OMPs), community orthoptists, ophthalmic nurses and optometrists, and ophthalmologists; what is the role of a pharmacist? This section encourages you to look at the care you are already providing within the model known as Pharmaceutical Care.

Intended learning outcomes
Following completion of this part of the course, you should be able to:

List the three levels at which care for patients is provided within a pharmacy

Define the concept of pharmaceutical care

Describe interventions for eye care within the framework of pharmaceutical care.

Pharmaceutical care
Think about the recent contacts you have had with your patients or customers about any aspect of their eyes and eye care.

Exercise 1

List recent enquiries about eyes and eye care, with some detail about when the contact occurred and why they asked you for advice rather than another healthcare professional.

1.

2.

3.

Please compare your response to the comments made in the exercise review.
The public seeks the pharmacist’s help at three levels, which reflects their professional role in society:

**Level 1:** Keeping healthy people healthy

**Level 2:** Dealing with common symptoms

**Level 3:** Pharmaceutical care

These are now considered in more detail, particularly with respect to care of the eyes. As you read through the text, look back to your list of recent contacts with patients about their eyes and try to classify your list into the three levels.

**Level 1: Keeping healthy people healthy**

Health promotion is a key element in avoiding disease and one that local government has placed emphasis on through their Investing for Health Strategy. It might not be immediately apparent how health promotion and the role of the pharmacist fits into the avoidance of acute or chronic eye disease but consideration and promotion, for example, of health and safety procedures at work might ensure that acute eye damage is avoided. Also the maintenance of normal blood glucose concentration in patients with diabetes can help avoid the development of diabetic eye disease. This course includes a section that considers how pharmacists might be involved in keeping eyes healthy. The example of a sale of contact lens solutions is a Level 1 intervention.

**Level 2: Dealing with common symptoms**

The pharmacy is becoming increasingly recognised as a ‘first port of call’ for common ailments. For many, the pharmacy is the ‘gate’ to the Health Service and the pharmacist therefore is being seen as ‘the gatekeeper’. In the late 1990s community pharmacists were spending approximately 8% of their working day dealing with minor symptom consultations, but with the continuing reclassification of drugs from POM to P legal status and the advent of the community pharmacy Minor Ailment Scheme, the time spent dealing with OTC consultations is set to significantly increase. Within their protocols for dealing with symptoms and OTC sales, many pharmacists insist that all requests for eye conditions, and for the products sold to treat eye conditions, should be seen by the pharmacist. Section 3 looks at how pharmacists can respond to queries about eye symptoms. The examples of the painful eye and the child with red eye are instances of the role of the pharmacist as a ‘gatekeeper’ to differentiate minor symptoms that may be self-treated from major problems with serious consequences.
Level 3: Pharmaceutical care

By far the most important role pharmacists have in dealing with eye disease is in the dispensing and sale of eye drops and ointments for the management of chronic and acute eye conditions. This is covered throughout this course, but to set the context, it is important to discuss in detail what pharmaceutical care is and how it is relevant to the role of the pharmacist.

Possibly the earliest published use of the term pharmaceutical care was by Brodie in the context of thoughts about drug use control and medication-related services. The concept of pharmaceutical care was subsequently eloquently defined by Douglas Hepler and Linda Strand as ‘the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient’s quality of life’. The adoption of the concept and definition of pharmaceutical care by the pharmacy profession re-emphasized its recognition that the pharmacist’s primary responsibility is to the patient who has needs related to drug therapy; this has become a dominant form of practice for thousands of pharmacists throughout the world.

Essentially the definition of Pharmaceutical Care is in three parts. The first part, ‘the responsible provision of drug therapy’, refers to the need to choose the right medicine for the condition and also to stress that in some conditions perhaps it is not appropriate to recommend a medicine at all. In primary care, the choice of medicine is often the responsibility of the GP. However, where someone asks for advice on a minor eye complaint in the pharmacy, then the pharmacist must consider a suitable treatment. Therefore this part of the definition is concerned with rational drug selection.

The second part of the definition, ‘to achieve definite outcomes’, refers to making sure that the medicine has done what was intended. This may seem obvious but research has shown that very often patients are not getting the response expected by the prescriber. For example, it has been shown that up to 65% of patients who have been prescribed antihypertensive medication fail to get a fall in blood pressure sufficient to reduce the risk of a serious cardiovascular event. In glaucoma it has been estimated that failure to use medication properly is responsible for 10% of visual loss. Recent research also concluded that good adherence (greater than 90%) to treatment in glaucoma patients has demonstrated no further disease progression whereas poor adherence leads to increased intraocular pressure, glaucomatous damage and/or disease progression. Good patient education should lead to improved adherence and preservation of visual function. Although less information is available on deficiencies in the management of eye conditions, compared to other conditions, clearly the issue is the same and there needs to be greater assessment of how well patients are able to manage their eye disease.
This can be illustrated by considering two examples. The first is in patients with glaucoma who need to be assessed to find out how well their intraocular pressure is controlled. The pharmacist will not normally do this but patients must be followed up and intraocular pressure measured, an assessment of the optic disc undertaken and visual field assessed. The pharmacist could remind patients about this when dispensing a repeat prescription for eye drops. A second example is the patient with repeat prescriptions or OTC requests for antibacterial eye drops/ointment. He/she must be considered for referral as the underlying cause of the infection may be being ignored and therefore the treatment is not achieving its desired outcome of curing the infection.

The third part of the definition, ‘that improve a patient’s quality of life’, is a reflection of the fact that the patient’s overall well-being needs to be considered, for example, by attempting to minimise the development of adverse drug reactions. ADRs caused by the use of eye drops are common and many drugs taken to treat chronic conditions have the potential to cause adverse ocular events. This factor may not be so obvious to the GP and the pharmacist may need to refer the patient with an appropriate referral note.

Pharmaceutical care is not care by pharmacists, rather it is care by pharmaceutical agents, that is, medicines. In short it is a model that attempts to maximise the benefits from medicines while minimising their side-effects. It can be done by pharmacists, GPs, optometrists and nurses and it is likely that within a multidisciplinary team approach to patient care each healthcare professional will contribute to the pharmaceutical care of the patient and will complement the work of others. Up until 2004, the pharmacist’s role may have consisted of three parts: the supply of medicine, advising the patient and monitoring the outcome. With the introduction of pharmacist supplementary prescribing in 2003\(^1\) and further expansion to independent prescribing in 2006\(^2\), the pharmacist’s role may now also include prescribing.

**Supply**

The supply of medicines is essentially the dispensing role that community pharmacists are currently contracted to perform. In addition to ensuring that the patient gets the right medicine at the right dose, it also involves ensuring that patients or their representatives know what the medicine is for, how and how often to take or administer/use, if they will need more and if they must finish the course. For eye ointments and drops this information is very important.
Advice
The advice in the pharmaceutical care model refers to advice on the disease and the medicines used to control the disease. It has been shown that when patients understand the nature of their disease, they then appreciate the need to control the disease. As a result, there is likely to be greater concordance with the prescriber’s wishes and presumably a better outcome. It is therefore important that the patient fully understands all aspects of their therapy and how to use their medicines. Pharmacists therefore need to spend more time advising patients where the medicines have a difficult delivery form. For example, a patient with glaucoma, who understands the nature of their disease and treatment, (i.e. optic nerve head damage and visual field defects), is more likely to comply, leading to a greater likelihood of intraocular pressure reduction, with a reduced risk of blindness as a result of their disease. The NICE Glaucoma Quality Standards states that “People with COAG, suspected COAG or with OHT are given the opportunity to discuss their diagnosis, prognosis and management, and are provided with relevant and accessible information and advice at initial and subsequent visits in accordance with NICE guidance.”

Monitoring
The most challenging aspect of the pharmaceutical care model for pharmacists is monitoring, particularly in relation to eye disease. However, it could also provide the basis for the pharmacist’s full integration into the primary healthcare team. This is already happening for conditions such as asthma, diabetes and hypertension. With the use of analytical devices available to measure factors such as blood glucose, cholesterol, blood pressure and peak expiratory flow rate, the patient can perform these simple tests at home as well as in the pharmacy.

Pharmacists should also be aware of the monitoring requirements for certain eye diseases and could check patients are attending their review appointments when dispensing their treatment. For example, recent NICE guidelines have included the monitoring requirements for patients with Chronic Open Angle Glaucoma (COAG), with review required anything from two to 12 monthly dependent upon the severity of disease (see Table 1 opposite).

Prescribing
Pharmacists may be involved in prescribing medications for eye conditions. The National Prescribing Centre websites (www.npc.co.uk and www.npci.org.uk) offer resources to support non-medical supplementary and independent prescribers and share example of prescribers in practice.

Optometrists can now also qualify as independent prescribers; services being offered by appropriately qualified optometrists include one-stop optometry glaucoma assessment clinics. In April 2013, there were 171 optometrists on the independent prescribing register.
### Table 1: NICE guidelines for monitoring intervals for people with Chronic Open Angle Glaucoma (COAG).

<table>
<thead>
<tr>
<th>Clinical Assessment</th>
<th>Monitoring Intervals (Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intraocular Pressure (IOP) at Target&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
<td>Uncertain</td>
</tr>
<tr>
<td>No</td>
<td>No&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>No</td>
<td>Yes/Uncertain</td>
</tr>
</tbody>
</table>

<sup>a</sup> IOP at or below target.  <sup>b</sup> Progression = increased optic nerve damage and/or visual field change confirmed by repeated test where clinically appropriate.  <sup>c</sup> For change of treatment plan refer to treatment recommendations.  <sup>d</sup> For people started on treatment for the first time check IOP 1 to 4 months after start of medication.  <sup>e</sup> No = not detected or not assessed if IOP check only following treatment change.
Summary points

- The public seeks the pharmacist’s help at three levels: Level one involves keeping healthy people healthy, Level two relates to dealing with common symptoms and Level three encompasses pharmaceutical care.
- Pharmaceutical care is defined as ‘the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient’s quality of life’.
- When implementing pharmaceutical care, the patient’s overall well-being needs to be considered so as to maintain and improve their quality of life.
- The most challenging aspect of the Pharmaceutical Care model for pharmacists is the monitoring of patients.
- Pharmacists may now prescribe in any area in which they prove to be competent; this could include conditions affecting the eye.

Having completed your study of Pharmaceutical care of the eye, you should be able to:

**List** the three levels at which care for patients is provided within a pharmacy

**Define** the concept of pharmaceutical care

**Describe** interventions for eye care within the framework of pharmaceutical care

If you are not able to do all of these, go back and review this section again.
References


11. Supplementary prescribing by nurses and pharmacists within the HPSS in Northern Ireland - A guide for implementation. April 2004. DHSSPSNI.


Exercise and case study reviews

Exercise 1 review

Your answer may have included the following scenarios:

- Sale of contact lens solutions at a weekend. The patients usually got supplies from the optometrist but had run out.
- Advice on how to treat painful eye on a Sunday morning. The patient was not sure whether to go to casualty.
- Advice on use of prescribed eye drops, having difficulty with bottle – asked when getting repeat.
- Child with red eyes, their mother was not sure whether to send to school or didn’t want to bother the GP.
- Request for treatment of ‘gritty eyes’ on a Saturday afternoon.
Section Two

Structure and function of the eye
Introduction
When considering diseases that affect the eye and understanding the treatment of these, it is essential to have an underpinning knowledge of the structure and function of the eye. Much of this should be revision and although this course has been written to enable independent study of each part, it is recommended that you gain full understanding of this section before moving on to the remainder.

This section is designed to allow you to review the structural components of the human eye and to understand the way that these structures function to effect sight.

Intended learning outcomes
Following completion of this part of the course, you should be able to:

Review the structure of the human eye

Describe the process by which the vision is achieved

List the main neurological processes involved in vision.

Structure and function of the eye
Normal vision involves the eyes and brain working in harmony to transform light images into visual signals that the visual cortex can interpret. Correct functioning of the visual system involves an extremely complex array of cellular structures and biochemical processes.
Exercise 2

On the eye diagram below, label the following to indicate their correct location: iris, pupil, sclera and conjunctiva.

Please compare your response with the comments made in the exercise review.

It is essential to have good background knowledge in order to help patients understand their eye disease and its treatment. With the increasing availability of health information in the media and over the internet, there has been a change in the relationship between health professionals and the public. Health professionals no longer provide passive basic drug and disease information to their patients; they now respond to the wide breadth of health information available to patients and help them to understand what is meaningful and relevant. In other words, the health professional-patient relationship has shifted from being a professional-centered relationship to being a patient-centered interaction. It is therefore important to remember when counselling patients that they will have already received information from other sources including family, friends, other healthcare professionals, media publications and the internet. Always try to establish what knowledge the patient already has; clarify this and build upon it.
Structure of the Eye

As light enters the eye it is bent toward the optic axis to form a sharp inverted image upon the neurosensory retina. Many of the structures of the eyeball are designed to optimise this light passage. The cornea, aqueous, lens and vitreous humour are all involved in bending light rays as they enter. The natural curvature of the cornea, together with the lens, places the focused image onto the retina. This is the case where the eye is emmetropic, that is it does not need any spectacle correction to correct myopia (short sight), hyperopia (long sight) or astigmatism. The lens can be adjusted to alter focus between distant and near objects. Figure 1 is a diagram of a section through an eyeball showing the structures within the organ of the eye. Ophthalmologists traditionally divide the eye into the anterior segment, which deals with the anterior chamber and its associated structures, and the posterior segment, which deals largely with the vitreous body, retina and choroid. In addition to the intraocular structures, the eye also has several important extraocular tissues including muscle groups, eyelids and glands. The following text reviews the structure of the eye using these arbitrary groupings.

Figure 1: A schematic of a section through the eye
Anterior Segment

Cornea
The adult cornea is a highly sensitive avascular transparent structure, which covers approximately one-sixth of the eyeball (the remaining five-sixths being covered by the sclera). The cornea consists of three cell layers: the outer corneal epithelium, the stroma and the innermost corneal endothelium (see Figure 2). These offer a unique combination of rigidity and transparency while serving an important role in focusing light entering the eye. The epithelial layer rests on a basal lamina (Bowman’s membrane) and is continuous with the conjunctival epithelium (see Figure 3). The epithelial cells provide protection for the cornea, a role that is assisted by a renewable tear film, which is secreted largely by the lacrimal gland and is spread over the cell-layer by regular blinking. The tear film provides a smooth refractive surface on the cornea, acts as a lubricant, prevents dehydration and has inherent antibacterial properties. The corneal epithelium is highly dependent on the free supply of oxygen, which is mainly derived from atmospheric oxygen dissolving in the tear film.
A plexus of unmyelinated nerve axons, which penetrate the anterior stroma and epithelium as bare, highly sensitive, nerve endings, provides sensory innervation of the cornea. These nerve endings, which are directly derived from the branching of the ciliary nerve, are concentrated in the central cornea, tailing off towards the limbus. Sensitivity can be variable between individuals and generally reduces with ageing. The cornea is an extremely sensitive tissue with the nerve fibres showing exquisite sensitivity to mechanical stimulation.

Damage to the cell layers of the cornea can result in scarring of the cornea with subsequent reduction of visual acuity. While the corneal epithelium layer can repair itself after insult, Bowman’s membrane shows little regenerative capacity and may be subject to fibrous scar-formation if damaged. Damage to the endothelium results in corneal oedema with associated reduction in vision.

A whitish ring may appear around the periphery of the cornea; this is known as a corneal arcus (arcus corneae) and is due to phospholipid deposition in the peripheral cornea. This can be found in younger patients with dyslipidaemias (arcus lipoides), but is more often detected with increasing age (arcus senilis) and is found in virtually all individuals over the age of 80. It may be associated with familial and non-familial dyslipoproteinaemias, but may also occur without any predisposing factors. It is however harmless to the eye and does not affect vision.

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**Figure 3:** A diagram of the outer surface of the cornea showing the stroma and Bowman’s layer containing unmyelinated nerve axons.
Iris and Ciliary Body

The iris begins to form during the third month of gestation. The structure is complete by the eighth month of gestation, but pigmentation continues into the first year after birth. The iris forms from the ciliary body in front of the lens (see Figure 1). The anterior chamber lies between the anterior iris surface and the inner surface of the cornea, and the shallow posterior chamber between the iris's inner surface and the lens.

The pupil averages about 4mm in diameter and is regulated, by opposing influences of parasympathetic and sympathetic impulses on the sphincter and dilator muscles, according to the degree of illumination. The pupils are normally equal in size; indeed a difference in size (anisocoria) may be of pathological significance. Autonomic nervous control of pupil diameter starts at the retina where the photoreceptors initiate a response. Parasympathetic neurones derived from the third cranial nerve control smooth muscle contraction of the iris with stimulation resulting in constriction of the pupil (miosis). Conversely dilation of the pupil (mydriasis) results from stimulation of radially orientated iris dilator muscles under sympathetic nerve control. As in other parts of the body, sympathetic neurones use noradrenaline as a neurotransmitter stimulating alpha adrenoreceptors, which can be effectively blocked by alpha-adrenoreceptor antagonists (pupil constriction) or stimulated by agonists (pupil dilation). Interestingly, light-stimulated constriction of one pupil can cause a constriction in the other eye. This is known as the consensual pupil response. This reflex provides a useful diagnostic tool for assessing brain damage in comatose or unconscious patients.

The iris is composed of three layers, an inner pigment epithelium, a stromal layer and an outer endothelial layer, which is continuous with the corneal endothelium. The stromal layer is continuous with the choroid and contains a blood vessel network. The iris merges with the ciliary body although both structures have distinct and important roles. The key roles of the ciliary body in the eye are:

- the source of aqueous humour
- correct suspension of the lens
- contraction of the ciliary muscle, which allows changes in accommodation due to alteration in curvature of the lens.

Aqueous humour (also referred to as aqueous) is actively secreted from the non-pigmented epithelium of the ciliary body via several enzymatic systems (e.g. Na⁺/K⁺-ATPase pump) and accounts for about 80% of the aqueous fluid. The remainder is produced by ultrafiltration from the ciliary capillaries. Aqueous humour is essential to feed the transparent structures of the anterior chamber but the balance between inflow and outflow needs to be very finely integrated (see Section 4). The regulation of aqueous production remains ill-defined and may be under control of neuronal and humoral pathways. However, it is known that increased secretion of aqueous humour results from beta adrenoreceptor stimulation (see Table 2) while alpha adrenoreceptor stimulation may actively reduce inflow by constricting blood flow through the ciliary body.

The following table summarises the distribution and actions of the post-ganglionic parasympathetic and sympathetic receptors on the eye.
### Table 2: A summary of the distribution and actions of the post-ganglionic parasympathetic and sympathetic receptors on the eye

<table>
<thead>
<tr>
<th>Receptors</th>
<th>Distribution in the eye</th>
<th>Effect on aqueous dynamics</th>
<th>Action on other smooth muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parasympathetic/ cholinergic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscarinic</td>
<td>Ciliary muscle, Sphincter pupillae</td>
<td>Increase in aqueous outflow</td>
<td>Stimulation of sweat glands. Stimulation of salivary glands</td>
</tr>
<tr>
<td><strong>Sympathetic/ adrenergic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>α 1</td>
<td>Dilator muscle. Ciliary, retinal &amp; choroidal blood vessels.</td>
<td>Reduction in aqueous formation</td>
<td>Vasoconstriction → blood pressure rises. Inhibition of salivary glands</td>
</tr>
<tr>
<td>α 2</td>
<td>Non-pigmented ciliary epithelium. Ciliary muscle. (NB: α₂ receptors are on the pre-synaptic terminal. Stimulation inhibits release of neurotransmitter.)</td>
<td>Reduction in aqueous formation</td>
<td>Vasoconstriction → Inhibition of salivary glands. Centrally determined hypotension and sedation.</td>
</tr>
<tr>
<td>β 1</td>
<td>Ciliary, retinal &amp; choroidal blood vessels</td>
<td>Promotes aqueous secretion</td>
<td>Present on cardiac muscle → increase in heart rate (tachycardia).</td>
</tr>
</tbody>
</table>
The trabecular meshwork

Functionally the trabecular meshwork works intimately with the ciliary body to regulate production and outflow of aqueous humour and as a result, it controls intraocular pressure. Structurally, the trabeculum consists of a sieve-like meshwork and a central channel called Schlemm’s canal, which drains into the episcleral veins. Approximately 90% of the aqueous humour leaves the eye through the trabecular meshwork while the remainder flows out through a uveoscleral or iris route whereby it passes through the ciliary body (see Figure 4). In conditions where the aqueous humour outflow is abnormal, uveoscleral outflow may be increased by antimuscarinics (e.g. atropine) and decreased by miotics (e.g. pilocarpine). Alpha-2-adrenergic agonists (e.g. brominidine) and prostaglandin analogues (e.g. latanoprost) can be used to increase uveoscleral outflow.

Figure 4: Aqueous outflow routes in the adult eye
Lens

The lens is a thick refractile body bathed on one side by the aqueous humour and supported on the other side by the vitreous (see Figure 1). The entire structure is maintained within a lens capsule. Normally the lens is transparent and transmits light onto the photosensitive retina and can vary the focus of that light (or accommodate) by the action of ciliary muscle contraction or relaxation. The lens is suspended by suspensory ligaments anchored at the ciliary body. When the ciliary muscle relaxes, the ligaments are taut and stretch the lens into an ellipsoidal shape. Ciliary muscle contraction via parasympathetic stimulation causes relaxation of the suspensory ligaments and induces a more spherical shape of the lens and focuses near objects to the retina. The prolonged contraction of the ciliary muscles can cause fatigue and this can be illustrated by tiredness of eyes when reading or using computers for prolonged periods. 

As the lens increases in weight and thickness with age it becomes less elastic and this is accompanied by a loss of near vision (presbyopia). Also with ageing the crystallin proteins may form aggregates resulting in altered solubility of these proteins. This can result in formation of lens opacity or cataract. More information on cataracts and their treatment is provided in Section 4.
Posterior Segment

Vitreous Humour (vitreous)
Serving a structural, supportive role for the posterior eyeball and in particular the retina (see Figure 1), the vitreous humour consists of a hydrated gel matrix formed largely by a complex network of collagen fibrils and the water-retaining glycosaminoglycan, hyaluronan. This gel has excellent shock absorption properties while still maintaining optical transparency and many disorders of the vitreous manifest themselves by the presence of opacities. Vitreous abnormalities are often associated with age-related changes affecting the anatomy and physiochemistry of the gel or with secondary changes caused by trauma, inflammation or other ocular diseases. Structural changes to the vitreous such as liquefaction and posterior vitreal detachments are associated with ageing and often with the occurrence and onset of diabetic retinopathy.

Retina

![The cellular organisation of the retina](http://webvision.med.utah.edu/imageswv/schem.jpeg)

**Figure 5:** The cellular organisation of the retina. Figure adapted, with permission, from WebVision (http://webvision.med.utah.edu/imageswv/schem.jpeg)
Section Two

Structure and function of the eye

The retina forms the inner neuroepithelium layer of the posterior segment and is concerned with the reception of light images and transmission of a nervous impulse along the optic nerve. Structurally the retina has two main parts: the neural retina and the retinal pigment epithelium. While there is an intimate association between these two parts of the retina, there is not a strong attachment and this sub-retinal space has implications for retinal detachments. As a part of the brain, the neural retina has a very complex cellular structure which, in brief, consists of rod and cone photoreceptors, adjacent to the retinal pigment epithelium, which connect through a series of ganglion cells, finally ending as nerve fibres in the innermost layer of the retina (see Figure 5). These fibres sweep from all areas of the retina to the optic nerve head. There is a very wide and varied population of nerve cells in the retina, each responsible for a particular aspect of the transmission or co-ordination of the visual impulse.

The retina has one of the highest metabolic demands of anywhere in the body and it requires an extensive and efficient blood supply, which comes from two sources. The dense choroidal capillary network (known as the choriocapillaris) supplies the retinal pigment epithelium and outer half of the retina. The central retinal artery enters the eye through the optic nerve head and sub-divides into an extremely intricate end-artery system, which supplies the other half of the retina adjacent to the vitreous. Capillary density is highest around the macular region of the central retina, the area that has the highest concentration of cone photoreceptors. In the centre of the macula is the fovea which is a vascular free zone and has responsibility for detailed vision (see Figure 6).

The intraretinal vasculature is worthy of special mention since normal functioning of the retinal blood vessels is extremely important for retinal function. This can be demonstrated by the pathological consequences of retinal vascular dysfunction, which leads to widespread retinal oedema and ischaemia as observed in several important diseases such as diabetic retinopathy and Age-Related Macular Degeneration (see Section 4).
Photoreceptors represent a remarkable adaptation of basic cellular structure that is optimised for presentation of photopigment on membranous discs and transmission of the converted light stimulus to accessory neurones. Photopigments are coloured substances with an ability to absorb light of various wavelengths. Chemically, the photopigments consist of a combination of water-insoluble opsin protein linked with an aldehyde of Vitamin A that can undergo a chemical realignment after light-stimulation. This realignment is responsible for initiating an electrical potential change leading to a nervous impulse. Rods and cones differ in their function. Cones are concerned with an appreciation of form and colour and under conditions of bright illumination give very high visual acuity. Rods on the other hand are responsible for perception under dim illumination and cannot discern colour or fine detail. The highest density of cones is in the macular region where the ratio of cones to ganglion cells is greater than that of rods. Rods are present throughout the retina although they are dominant in the peripheral retina and absent from the fovea.

Figure 6: Healthy Retina (National Eye Institute, National Institutes of Health, USA)
Choroid
At the region of the ora serrata, the ciliary body gives way to the choroid, which is a pigmented vascular undercoat between the sclera and the retina. The principal function of the choroid is through its blood supply to nourish the outer retina and to provide a pathway for the vessels that nourish the anterior chamber. To this end, the choroid has an extremely rich vasculature, which is fed by short choroidal arteries that cluster into the eye around the optic nerve. The choroid inner surface, known as the choriocapillaris, has as its primary function the nourishment of the retina. However, this network also has an important function in maintenance of intraocular pressure. The choriocapillaris is separated from the retinal pigment epithelium by a thick basal lamina known as Bruch’s membrane. As the retina and choroid age, Bruch’s membrane undergoes a series of changes including an increased thickness and stratification. Amorphous granular material known as drusen are deposited beneath the retinal pigment epithelium with ageing. Drusen are now thought to play a causal role in a progressive condition known as Age-Related Macular Degeneration\textsuperscript{21,22} (see Section 4).

Optic nerve
At its entry into the retina, the optic nerve is referred to as the optic disc or optic nerve head. This is also the point of entry for the central retinal artery and vein, which form the retinal vasculature\textsuperscript{16}. Functionally, the optic nerve transmits the information gathered by the neurosensory retina to the brain along approximately 1.2 million axons. While most of the axons are concerned with vision, some provide a pathway for the pupillary light reflex while others relay general responses to light (e.g. blinking, eye movement, neck muscles). Eye reflexes are often used to assess patient condition. For example, pupillary reaction is observed by flashing light into the eye; this normally results in constriction of the pupil. An abnormal accommodation reflex of the pupil may be indicative of a pathological condition\textsuperscript{2}. One of the earliest recordings of linking abnormal pupillary response to disease was in the late 19th century when Douglas Argyll Robertson described patients whose small and irregular pupils reacted poorly to light with a normal near response. Physicians subsequently realised the aetiology of this pupillary anomaly was a manifestation of tertiary syphilis\textsuperscript{23}.
Extraocular structures

Eyelids and conjunctiva
The primary function of the eyelids is to protect the eyes whilst keeping the cornea moist and free of dust and microscopic debris. Structurally, the eyelids consist of modified folds of skin grouped into a posterior lamella (conjunctiva and tarsal plate, which determines the shape of the eyelid) and an anterior lamella (muscle and skin). The eyelids are complex tissues with protective and exocrine functions. For example, the secretion of the meibomian glands within the eyelids provides the important lipid component of tears.

The conjunctiva is essentially a mucous membrane that lines the under surface of each eyelid (palpebral conjunctiva) and covers the surface of the eyeball starting as far back as the upper fornix and ending at the margin of the cornea (bulbar conjunctiva) (see Figure 7). The entire conjunctiva is richly supplied by blood vessels. The conjunctiva has a role in protecting the sclera and providing lubrication for the eye through the secretion of mucin from the goblet cells, which then combines with lacrimal secretions to form tears. Although the larger proportion of secretions is lacrimal fluid (aqueous component of tears) from the lacrimal glands, the conjunctival secretions are an important component. The conjunctiva is a very important tissue for the continued well-being of the external eye. Unfortunately, there are many inflammatory conditions that can affect the conjunctiva.\textsuperscript{2,24}

Figure 7: A section through the eyelid showing associated structures.
Tear Film

The aqueous component of tears is largely produced by the lacrimal gland and drained by associated structures. The lacrimal gland resides in the upper orbit of the eyelid and consists of a superior and inferior lobe. Tears, which are produced in both parts of the lacrimal gland, are secreted into the upper fornix via ducts from the inferior lobe and thereby cover the whole eye (see Figure 8). In addition to a moisturising function, the tears contain antibacterial agents such as lysozyme, lactoferrin and immunoglobulins. The rate of production is low in new-born infants and also shows a reduction in old age. Complications arising from lack of tear production (e.g. dry eye) will be dealt with in Section 3. Sympathetic and parasympathetic systems contribute to innervation of the lacrimal gland. Normal tear production by the lacrimal gland is controlled by sympathetic innervation, which is intimately associated with the blood supply. It is generally thought that sympathetic stimulation regulates the gland’s blood flow in response to a dry atmosphere or irritation. Parasympathetic innervation is derived from branches of the VII cranial nerve in the form of the lacrimal nerve. Excessive tear production (lacrimation) during weeping, a uniquely human trait, is under parasympathetic control under the direction of many centres of the brain, including the frontal cortex, thalamus and hypothalamus. Tears drain by an active process along the lacrimal accessory structures consisting of superior and inferior openings (puncta), canaliculi and large ducts (see Figure 8). Drainage is achieved by a pump mechanism, which requires closure of the eyelids thereby producing a suction effect in the ducts that in turn forces the tears into the puncta and down the canaliculi. The tears are subsequently drained into the nasolacrimal ducts and into the nose.

Figure 8: Schematic showing structure associated with tear production and drainage
Communication skills
This section has provided a comprehensive overview of the structure and functions of the eye. Think about how this will be useful to you, for example, in helping patients at the three levels of care outlined in Section 1. For instance, in the sale of artificial tears it might be useful to explain some of the functions of tears within the eye.

Exercise 3

(a) Make a list of the circumstances in which this information would be useful

(b) How will you communicate this information to your patients?

Please compare your response to the comments made in the exercise review

It is important to use your judgment to decide what type of explanation is most appropriate according to the patient’s condition and their level of understanding.
Summary points

- The structure of the eye is usually divided into two parts; firstly the anterior segment, which deals with the anterior chamber and its associated structures (cornea, iris, ciliary body, trabecular meshwork and lens), and secondly the posterior segment, which largely deals with the vitreous body, retina and choroid.

- The cornea is made up of three cellular layers: the epithelium, the stroma and the endothelium.

- The iris forms from the ciliary body in front of the lens and is composed of three layers, an inner pigment epithelium, a stromal layer and an outer endothelial layer.

- The three key roles of the ciliary body are: the source of aqueous humour; correct suspension of the lens; and contraction of the ciliary muscles.

- The majority of aqueous humour leaves the eye through the trabecular meshwork. Where aqueous outflow is abnormal, uveoscleral outflow may be increased by antimuscarinics and may be decreased by miotics. Alpha-2-agonists and prostaglandin analogues can be used to increase uveoscleral outflow.

- Structural changes to vitreous humour are associated with ageing and often associated with diabetic retinopathy.

- The retina has one of the highest metabolic demands of the body and requires an extensive and efficient blood supply. Retinal vasculature dysfunction can be observed in diseases including diabetic retinopathy and age-related macular degeneration.

- The conjunctiva protects the sclera and is an important tissue for the maintenance of the well-being of the eye. It is, however, affected by many inflammatory conditions.

Having completed your study of the structure and function of the eye, you should be able to:

Review the structure of the human eye

Describe the process by which the vision is achieved

List the main neurological processes involved in vision

If you are not able to do all of these, go back and review this section again.
References

10. Dinslage S et al. The influence of Latanoprost 0.005% on aqueous humor flow and outflow facility in glaucoma patients: a double-masked placebo-controlled clinical study. Gr Arch Clin Exp Ophth 2004; 242(8); 654-60.
18. Spaide RF. Age-related choroidal atrophy Am J Ophthalmo 2009; 147: 801-10
Section Two

Structure and function of the eye

Exercise and case study reviews

Exercise 2 review
Labels should appear as below:

Exercise 3 review
(a) Some of the ways in which the information might help are:
  - In the sale of artificial tears, it could be useful to explain some of the functions of tears and how tear film deficiency can arise from conjunctival inflammation.
  - An understanding of age-related changes in the eye would be of value when advising the older population about cataract or age-related macular degeneration.
  - An understanding of changes in the eye leading to diseases such as diabetic retinopathy will help to re-emphasise the need for good compliance with diabetic medication and the need for regular checks of the eye (annual diabetic retinopathy screening is now routinely offered via GP practices in Northern Ireland as well as England, Scotland and Wales).

(b) Explanations can be classified into 2 stages:
1. A stage 1 explanation gives basic reasoning behind the need to follow a specific instruction, e.g. “it is important for the well-being of your eyes that you....”
2. A stage 2 explanation gives reasoning at a deeper level, e.g. “it is important that you use your lubricating eye drops because the conjunctiva has a role in protecting the sclera and providing moisture for the eye.” Generally, if someone is given a reason behind an instruction, they are more likely to adhere. However, it is important that you initially establish the patient’s current level of understanding so as not to burden them with unnecessary and confusing medical terminology and information.
Introduction

Patients are becoming increasingly involved in the self-diagnosis and treatment of minor ailments and, consequently, there is a greater awareness and encouragement of self-care. However, self-medication may not be appropriate for every patient in view of pre-existing medical conditions or because of interactions with prescription or other non-prescription medicines. This reinforces the importance of pharmacists taking a thorough medication history before recommending treatment. As more patients request advice and over-the-counter treatment from pharmacists in relation to eye complaints, it is important that pharmacists can advise appropriately.

The PSNI Code of Ethics, Professional Standards and Guidance states that pharmacists must ensure that procedures for sales of OTC medicines enable intervention and professional advice to be given whenever this can assist in the safe and effective use of medicines. Sufficient information must be obtained from the patient/carer to establish whether self-care is appropriate and whether suitable treatment can be recommended. In addition, all staff involved in the sale or supply of OTC medicines must be trained and aware of situations where referral to the pharmacist or other healthcare professional may be necessary².

In light of the introduction of the new Responsible Pharmacist regulations, which took effect on October 1st 2009, it is imperative that Standard Operating Procedures (SOP) for sale and supply of OTC medicines (P and GSL), and for the provision of medical treatment advice, are in place in individual pharmacies. These SOPs will govern and override any existing individual protocols put in place prior to the Responsible Pharmacist legislation. In the absence of the responsible pharmacist, and where no second pharmacist is present, the sale of GSL medicines by pharmacy staff may continue. Pharmacists must therefore now ensure that all pharmacy staff react appropriately to symptoms presented in the pharmacy and ensure that requests for all medications, including eye preparations and treatment are appropriately referred and dealt with³.

The purpose of this section is to outline a structured approach for dealing with eye complaints in community pharmacy and to describe the conditions most frequently presented together with details of how best to deal with these.
Intended learning outcomes
Following completion of this part of the course, you should be able to:

**Prepare** Standard Operating Procedures for safe and effective sale of OTC medicines and for provision of advice by pharmacy staff who are not pharmacists

**List** the questions you should ask anyone presenting with an eye condition

**Recognise** the main, commonly presented eye conditions

**Differentiate** minor eye conditions from more serious conditions that will require referral to the GP

**Manage** common eye conditions satisfactorily

**Understand** the Royal Pharmaceutical Society’s guidance for the sale of chloramphenicol 0.5% w/v eye drops and 1% eye ointment.

National Pharmacy Association Standard Operating Procedures
In response to the Responsible Pharmacist Regulations, the Royal Pharmaceutical Society of Great Britain (now called the Royal Pharmaceutical Society) and the Pharmaceutical Society of Northern Ireland issued advice on development of relevant SOPs within community and hospital pharmacy. For the purpose of demonstration of developing and writing a SOP for your practice, the National Pharmacy Association (NPA) model will be outlined overleaf.
Section Three

Responding to Eye Symptoms

The scope of the NPA SOP is to outline the general procedure to be followed when a sale of a medicinal product takes place. It is divided into five parts, as outlined below:

Table 3: Scope of the SOP for the safe and effective sale of medicines

<table>
<thead>
<tr>
<th></th>
<th>Pharmacy staff authorised to sell medicines</th>
<th>Medicines which CAN be sold when the pharmacist is PRESENT</th>
<th>Medicines which CAN be sold when the Responsible Pharmacist is absent and there is no second pharmacist present.</th>
<th>Products which ONLY the responsible pharmacist or second pharmacist should sell.</th>
<th>Sale of Medicines Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>For completion of this part, referral should also be made to the SOP Roles and Responsibility of Pharmacy Staff. This should help the pharmacist establish who is appropriately trained and authorised to sell a medicinal product (dependent upon parts 2-5)</td>
<td>This part should outline which members of the pharmacy staff are competent to sell GSL and P medicines. These medicines may only be sold in accordance with the procedure outlined in part 5 below. POM medicines cannot be sold, but can be dispensed.</td>
<td>This will contain a list of GSL medicines which may be sold with the Responsible Pharmacist’s prior permission. P medicines may not be sold and POM medicines may not be sold or dispensed. Again, these medicines may only be sold in accordance with the procedure outlined in part 5 below.</td>
<td>P medicines normally kept in the dispensary or recently reclassified POM to P products can be considered for inclusion in this list e.g. 400mcg tamsulosin capsules.</td>
<td>Before the sale of any medicine is made, appropriate questions must be asked or information provided to the customer to ensure the medicine is suitable and will be used safely. The NPA SOP uses the well-established WWHAM questions to form a basis for questioning of a patient/carer (See Table 4). This mnemonic is particularly useful for counter staff to use and ask relevant and appropriate questions. Note that all requests for chloramphenicol should be referred to the pharmacist.</td>
</tr>
</tbody>
</table>
### Table 4: WWHAM questions with reference to the eye

<table>
<thead>
<tr>
<th>Question</th>
<th>Refer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WHO is the medicine for?</strong></td>
<td>Older patients</td>
</tr>
<tr>
<td></td>
<td>Pregnant or breast-feeding women</td>
</tr>
<tr>
<td></td>
<td>Customers under 16 years (chloramphenicol can be sold &gt; 2yrs, many topical antihistamines are licensed for use in children)</td>
</tr>
<tr>
<td></td>
<td>Baby with 'sticky eyes' since birth</td>
</tr>
<tr>
<td></td>
<td>Patients wearing contact lenses</td>
</tr>
<tr>
<td></td>
<td>Patients who have been abroad recently</td>
</tr>
<tr>
<td></td>
<td>Patients who have undergone ophthalmic surgery or eye laser treatment</td>
</tr>
<tr>
<td></td>
<td>For chloramphenicol - personal or family history of bone marrow problems</td>
</tr>
<tr>
<td><strong>WHAT are the symptoms and signs of eye disease?</strong></td>
<td>Associated pain or swelling around the eye or face</td>
</tr>
<tr>
<td></td>
<td>Photophobia</td>
</tr>
<tr>
<td></td>
<td>Unusual appearance, e.g. cloudy cornea also a sign of AACG</td>
</tr>
<tr>
<td></td>
<td>Restricted eye movement</td>
</tr>
<tr>
<td></td>
<td>Copious yellow-green discharge</td>
</tr>
<tr>
<td></td>
<td>Patient feels unwell</td>
</tr>
<tr>
<td></td>
<td>Pain inside the eye</td>
</tr>
<tr>
<td></td>
<td>Bleeding from the eye</td>
</tr>
<tr>
<td></td>
<td>Visual disturbance</td>
</tr>
<tr>
<td></td>
<td>Foreign bodies in the eye</td>
</tr>
<tr>
<td></td>
<td>Reported trauma to the eye</td>
</tr>
<tr>
<td></td>
<td>Presence of accompanying systemic symptoms, e.g. headache</td>
</tr>
<tr>
<td></td>
<td>Unusual appearance of the eye, e.g. irregular shaped pupil – a feature of acute angle closure glaucoma</td>
</tr>
<tr>
<td><strong>HOW long have the symptoms been present?</strong></td>
<td>Any lasting a few days or longer</td>
</tr>
<tr>
<td></td>
<td>Recurring problems</td>
</tr>
<tr>
<td></td>
<td>Any occurring after trauma to the eye</td>
</tr>
<tr>
<td><strong>Has any ACTION been taken so far?</strong></td>
<td>If already seen doctor</td>
</tr>
<tr>
<td></td>
<td>If tried another remedy</td>
</tr>
<tr>
<td><strong>Are any other MEDICINES being used/taken?</strong></td>
<td>Customers taking/using/administering medicine of any kind.</td>
</tr>
</tbody>
</table>
Some pharmacists may prefer that all requests for advice on the treatment of eye conditions be referred immediately to them whilst others may feel their staff is suitably trained and competent. It is envisaged that the majority of eye conditions presented at a community pharmacy will be referred to the pharmacist. ASMETTHOD is a mnemonic, which a pharmacist might find useful in dealing with eye conditions. This acts as an aide-mémoire to help remember the range of issues on which information should be sought when an individual presents with symptoms. Obviously different situations will demand a different question mix and experience will guide the focus of the questions.

**Table 5: The ASMETTHOD mnemonic**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Age of the patient?</td>
</tr>
<tr>
<td>S</td>
<td>Self or someone else?</td>
</tr>
<tr>
<td>M</td>
<td>Medicines the patient is currently taking/using/administering, including OTC medicines</td>
</tr>
<tr>
<td>E</td>
<td>Exactly what does the patient experience?</td>
</tr>
<tr>
<td>T</td>
<td>Time, duration or change with time of symptoms?</td>
</tr>
<tr>
<td>T</td>
<td>Taken anything or help already solicited?</td>
</tr>
<tr>
<td>H</td>
<td>History of condition?</td>
</tr>
<tr>
<td>O</td>
<td>Other symptoms being suffered?</td>
</tr>
<tr>
<td>D</td>
<td>Doing anything to alleviate or worsen the condition?</td>
</tr>
</tbody>
</table>

Asking these questions should help you gain a more complete picture of the patient and their health problems.
Requests for advice on eye problems

Community pharmacists are regularly asked for advice on many minor ailments including eye problems; the majority of these requests are for minor eye complaints, which can be treated using the range of over-the-counter (OTC) products currently available, with the proviso that the patient should consult their general practitioner if the condition fails to resolve in a few days. In general, eye conditions presented to pharmacists can be considered under one of the following classifications:

- red eye
- disorders of the eyelid
- bacterial conjunctivitis
- tear disorders
- foreign bodies or trauma of the eye
- painful eye conditions
- eye conditions associated with systemic disease
- drug-induced eye conditions.

The first five categories are relatively easy to identify and can usually be treated or advised upon by the community pharmacist, at least initially. The last three categories will require referral by the pharmacist and patients should be advised to see a doctor urgently. The last two categories are the topic of Section 5 of this course.

Red Eye

The red eye is probably the most common ophthalmological problem that is presented to the pharmacist and general practitioner. Causes of red eye are multifactorial in nature and therefore the ophthalmologist must differentiate between a relatively trivial foreign body in the lower conjunctiva and a serious sight-threatening condition such as acute angle closure glaucoma. As a general rule of thumb, if a red eye presents with pain in association with visual loss, then the condition is likely to be serious though it should be noted that this is by no means a secure diagnosis. Redness of the conjunctiva is a generalised ocular response to injury or infection and it would be impossible to deal with all causes of red eye. Therefore in this section we will deal with only the major causative conditions leading to red eye.

Some possible causes of red eye are:

- Conjunctivitis, either Infective (bacterial, chlamydial, adenoviral) or allergic
- Subconjunctival haemorrhage
- ‘Inflamed’ eyes.
Conjunctivitis
This is a very common inflammation of the mucous membrane that lines the anterior sclera and the inside of the eyelids. There are four main common types of conjunctivitis: bacterial, adenoviral and chlamydial, which are all infective conjunctivitis, and allergic conjunctivitis\textsuperscript{11}.

Bacterial conjunctivitis
Bacterial conjunctivitis (see Figure 9) is usually self-limiting\textsuperscript{13, 34} and occurs more frequently in infants and children than in adults. In adults, over half of the cases of bacterial conjunctivitis are caused by the Gram positive bacteria Staphylococcus aureus. In children and infants, the most common bacteria causing bacterial conjunctivitis are Streptococcus pneumoniae, Moraxella catarrhalis and Haemophilus influenzae\textsuperscript{11}.

![Figure 9: Acute bacterial conjunctivitis. Reproduced with permission from Dr P. Marazzi, Science Photo Library.](image)

Adenoviral Conjunctivitis
This type of conjunctivitis is more common in adults and is usually diagnosed in combination with the presence of the common cold (rhinovirus)\textsuperscript{11}.

Chlamydial Conjunctivitis
This is the least common type of conjunctivitis encountered and is more common in younger adults than older people. If Chlamydial conjunctivitis (see Figure 10) is present, it is usually accompanied by a systemic infection; this diagnosis should always be ruled out in patients presenting with a red and infected eye as untreated, it can lead problems with vision due to conjunctival and corneal scarring\textsuperscript{11}. Chlamydial conjunctivitis is an increasingly common cause of neonatal conjunctivitis in the UK. It requires urgent referral.
Allergic conjunctivitis

The most common cause of allergic conjunctivitis is hay fever, often referred to as seasonal allergic conjunctivitis, where eye symptoms are usually accompanied by nasal symptoms such as congestion, sneezing and running nose. Allergic conjunctivitis can also be caused by cleansing products or make-up that have been applied to the face. It is worth noting that hypoallergenic products may still affect some patients and the condition may only resolve with total avoidance of cosmetics around the eye. Allergic conjunctivitis may also result from the use of medication, eye drops/ointment, e.g. chloramphenicol, neomycin, atropine or preservatives in multi-dose eye drops. Contact lens solutions may also cause allergic conjunctivitis in those who wear lenses. Another complication of soft contact lens wear, Giant Papillary Conjunctivitis, is similar to allergic conjunctivitis and results from an immune response to protein deposits on the lens.\textsuperscript{11,12}
Signs and Symptoms
Conjunctivitis usually affects both eyes, although one eye may be worse than the other. In all types of conjunctivitis, the white part of the eye (sclera) appears red because of vasodilation of blood vessels in the conjunctiva which overlays it, as is the inner surface of the eyelids (see Figure 11). If the lower lid of the eye is pulled down, a red conjunctiva will be visible rather than the usual pale pink colour seen in a normal eye. There is often a discharge from the affected eye(s); in bacterial conjunctivitis this discharge takes the form of pus, often collecting in the inner corner of the eye and preventing easy opening of the eyelids particularly on awakening. In allergic and viral conjunctivitis, the discharge differs in that it is usually clear and watery. The patient may also complain that the eye(s) feel itchy and gritty with soreness on the surface of the eye. Vision is not normally significantly affected because the conjunctiva does not cover the cornea or pupil, but the patient may report irritation caused by light (photophobia) and vision may be obscured by discharge covering the cornea; this clears with blinking. Smoke, dust and pollen may aggravate the symptoms further. The differentiating point is that conjunctivitis causes irritation but not pain.

Treatment
Allergic conjunctivitis should resolve itself within 7-10 days once exposure to the allergen has stopped. Adenoviral conjunctivitis takes considerably longer to resolve. The prognosis for bacterial conjunctivitis is excellent and even without treatment, the vast majority of instances resolve within 7-10 days. However, over-the-counter antibacterial preparations: propamidine isetionate eye drops, dibrompropamidine isetionate eye ointment and chloramphenicol eye drops and ointment may be used in the treatment of bacterial conjunctivitis. These also help to loosen any hardened discharge that is stuck to the eyelids.
Guidance for the sale of chloramphenicol eye drops and ointment

Chloramphenicol antibacterial drops were reclassified from POM to P in 2005. The Royal Pharmaceutical Society (www.rpharms.com/your-day-to-day-practice/reclassifications.asp) issued practice guidance to support pharmacists with the change and to ensure correct procedures are in place for the sale of this particular OTC medication13. Following on from the chloramphenicol eye drops switch, chloramphenicol 1% ointment was reclassified to P status in July 2007. The ointment has some benefits over the eye drops in that it is a stronger preparation and some patients find it easier to administer.

Chloramphenicol eye drops and ointment are indicated for the topical treatment of acute bacterial conjunctivitis in adults, older people and children aged two years and over. Pharmacists need to be satisfied when making a supply that it is not only in line with its marketing authorisation but it is clinically beneficial, given that acute bacterial conjunctivitis can be self-limiting and does not always require antibacterial therapy13, 34. The following points should be considered when recommending chloramphenicol to patients in the pharmacy:

• OTC chloramphenicol is an antibiotic indicated for the treatment of acute bacterial conjunctivitis in adults, older people and children 2 years and over.

• In general, if a patient with an eye problem presents with pain or visual impairment, then the condition is more likely to be serious and requires referral.

• Contact lens users should be referred to an optometrist, contact lens practitioner or doctor.

• Contact lenses should not be worn during treatment; soft contact lenses should not be replaced for 24 hours after completing the treatment.

• Apply one drop to the infected eye every 2 hours for the first 48 hours and 4 hourly thereafter (see administration of eye drops, Section 6). If using ointment, apply 3-4 times daily.

• To be used during waking hours only.

• The usual course of treatment is 5 days.

• Do not share bottles if more than one member of the family is affected.

• If a sale is made, advise the patient to consult a doctor if symptoms do not improve with 48 hours of treatment and patients should be advised to seek immediate medical advice at any time if symptoms worsen.

• Try not to touch the eye or lashes with the nozzle as this may contaminate the medicine.

• Conjunctivitis is contagious. Advise patients to wash their hands prior to and after touching the eyes and avoid sharing towels, faceclothes etc. and to dispose of any eye cosmetics that may be contaminated.

• Side-effects are usually minor such as a transient stinging or burning sensation in the eye. Transient blurring of vision can also occur with the drugs and patients should be warned not to drive or operate machinery unless their vision is clear.

• Chloramphenicol Eye drops should be stored in a refrigerator (2-8oC). Once opened, the eye drops should be discarded after 5 days.

• Chloramphenicol eye drops are contra-indicated in those who have a history of hypersensitivity to chloramphenicol or any other ingredient of the drops, myelosuppression during previous exposure to chloramphenicol and in patients with a history of blood dyscrasias.
Who to refer to the GP
Refer patients to their GP in the presence of any of the following:

- contact lens use (or refer to an optometrist or contact lens practitioner)
- patient is already using other eye drops or ointment
- eye injury or suspected foreign body in the eye
- associated pain or swelling around the eye or face
- photophobia
- vision is affected
- severe pain within the eye
- pupil looks unusual, i.e. torn, irregular, dilated or sluggish/non-reactive to light
- the cornea looks cloudy
- there is restriction of eye movement
- copious yellow-green purulent discharge that re-accumulates after being wiped away
- eye inflammation associated with a rash on the scalp or face (may be indicative of Herpes virus)
- patient feels unwell
- conjunctivitis in the recent past
- glaucoma
- dry eye syndrome (keratoconjunctivitis sicca)
- eye surgery or laser treatment in the last 6 months
- personal or family history of bone marrow problems
- pregnant or breast-feeding
- recently returned from abroad
- no improvement is seen after 48 hours treatment
- symptoms get worse despite using chloramphenicol eye drops.

Storage of chloramphenicol
In the pharmacy setting, chloramphenicol eye drops must be stored upright in a refrigerator, set between 2°C and 8°C. Pharmacists are reminded to have a system in place to ensure chloramphenicol eye drops are stored separately in the fridge from other medications (e.g. chloramphenicol ear preparations) in order to reduce the risk of picking errors. It is best practice to keep the eye drops in the refrigerator during use, but this may be impractical for patients instilling eye drops every 2 hours. The drops are stable for 4 months at a temperature not exceeding 25°C. Once opened, the refrigerated shelf-life is 28 days. However, the usual course of OTC treatment is 5 days and the OTC packs will be labelled “discard after five days”.

Antibiotic resistance

Following the re-classification of chloramphenicol eye drops and ointment, there has been a marked increase in OTC supply which has not been accompanied by a similar decrease in prescription supply. Overall 1.5 million extra packs of ophthalmic chloramphenicol were supplied in England and Wales in the first 40 months post re-classification. Research in 2009 comparing the relative impact of clinical trial evidence and a change to the OTC availability on community use of topical chloramphenicol concluded that pharmacists: need to remain fully informed on potential antibacterial resistance; have a duty to control the sale of chloramphenicol; and should provide appropriate counselling to patients requesting or being sold antibacterial treatment.

Chlamydial conjunctivitis

Chlamydial conjunctivitis (see Figure 10), which may occur in patients with a history of venereal disease, requires urgent referral for treatment with an oral macrolide or tetracycline. Chlamydial conjunctivitis can be acquired by a baby during passage through the birth canal with potentially serious implications for the immature conjunctiva and cornea.

Allergic conjunctivitis

In allergic conjunctivitis the avoidance or minimisation of exposure to the allergen is key. In the treatment of seasonal allergic conjunctivitis, most eye symptoms will be controlled by oral antihistamines. However, if eye symptoms are particularly severe or persistent or are the only symptoms of hayfever present, then an eye preparation may be desirable. Cold compresses can be suggested for soothing the eyes. Eye drops containing an antihistamine such as antazoline, together with a vasoconstrictor drug, such as the sympathomimetic drug xylometazoline, are useful for short-term or intermittent use to relieve the symptoms of all forms of allergic conjunctivitis. Xylometazoline is contra-indicated in narrow angle glaucoma, therefore the presence of this must be ruled out. Absorption via the ocular route of both antazoline and xylometazoline may result in systemic effects and the possibility of interaction with other drugs being taken by patients.

Preparations containing sodium cromoglicate are more suitable for longer-term use, for example in the treatment of perennial allergic conjunctivitis for which sodium cromoglicate is indicated as a P medicine. These products provide fast and effective relief and are safe to use for prolonged periods. For those patients intolerant of preservatives, there is a preservative-free sodium cromoglicate preparation available to buy OTC.

Lodoxamide 0.1% eye drops (Alomide® allergy) can be sold for the treatment of allergic conjunctivitis in adults and children over 4 years of age.

The use of steroid eye drops long-term should be avoided because this can result in adverse effects such as cataract, glaucoma or severe infection. Topical steroids should never be given for an undiagnosed red eye as it may be indicative of a more serious condition, e.g. viral keratitis.
Case study 1

Linda Jones is a 32-year-old solicitor. When she presents today, she tells you that both her eyes feel gritty and are burning. Both her eyes are red, but on observation, it is apparent that the left one is particularly red. She has had symptoms since the previous morning. Linda has heard that antibiotic eye drops are now available to buy from the pharmacy.

(a) Choose a mnemonic and outline the questions you would ask Linda.

(b) Is it appropriate to sell antibiotic eye drops to this patient?

(c) What advice would you give Linda?

Please compare your response to the comments made in the case study review.
Subconjunctival haemorrhage

In this condition, a part of the conjunctiva covering the white of the eye appears bright red as a result of a small vessel bursting (see Figure 12). Referral of the patient is required if this presentation is a recurrence (which may be indicative of hypertension), the patient is taking warfarin, in which case the INR should be checked, or if there is any other unexplained bruising on the skin (full blood count and clotting needs to be checked). Providing there are no other symptoms present and the haemorrhage was not caused by physical trauma, it can be considered as a harmless condition, which generally resolves spontaneously after several weeks. However, it can be very worrying for the patient and reassurance will be needed. Reassure patients that their condition is harmless and due to a small blood vessel bursting even though it may look dramatic and will take a minimum of seven to 14 days to clear. If the condition occurs again, they should go to their doctor.

Figure 12: Subconjunctival haemorrhage. Reproduced with permission from Dr P. Marazzi, Science Photo Library.

‘Inflamed eyes’

Patients often present complaining of tired or irritated eyes. This may occur as a result of over-exposure to a smoky or dusty atmosphere or through regular rubbing but patients will erroneously blame a lack of sleep. Overwork might be a cause especially where a VDU is used for a long period of time. Prolonged staring at VDU screens causes a reduction in blink frequency and hence poor corneal wetting. The eyes may appear red or bloodshot and the rims of the eyes may be red. If there are no specific symptoms present to suggest anything more sinister, eye lotions or drops containing astringents, such as witch hazel, or lubricants may be suggested as a short-term measure. These have a soothing effect and also probably work as a placebo. If the condition persists, patients should be advised to consult an optometrist as it may indicate a dry eye condition.
Disorders of the eyelid
Problems with the eyelids present as the next most frequent category of eye symptoms in the pharmacy. Three problems commonly present:

- styes
- chalazia
- blepharitis.

Patients with xanthelasmata may be observed in the pharmacy, though not necessarily requesting treatment. Xanthelasmata is defined as the appearance is of yellow flat plaques over the upper or lower eyelids, most often near the inner canthus. They represent areas of lipid-containing macrophages but the exact pathophysiology is not known. A recent report concluded that xanthelasmata predict risk of myocardial infarction, ischaemic heart disease, severe atherosclerosis, and death in the general population, independently of well known cardiovascular risk factors, including plasma cholesterol and triglyceride concentrations.

Styes
A stye (also known as a hordeolum) is an acute, localized abscess situated on the eyelid. It is usually caused by a staphylococcal infection. Two types of stye can be distinguished:

1. External stye (also known as an external hordeolum or a common stye). Appears along the edge of the eyelid. This is caused by infection of an eyelash follicle or associated gland [sebaceous (Zeis) or apocrine (Moll) gland].

2. Internal Stye (also known as an internal hordeolum) which occurs on the conjunctival surface of the eyelid and is caused by infection of a meibomian gland.

The main symptoms are pain, redness, swelling and irritation. Initially, the whole lid may be affected, then the swelling becomes localized and a yellow pustule may develop near the lid margin; this pustule may burst or simply shrink and resolve.

Figure 13: Stye. Reproduced with permission from Western Ophthalmic Hospital, Science Photo Library.
Chalazia (Meibomian Cysts)

A chalazion (see Figure 14) is a cyst of the Meibomian gland, which secretes fluid to stop the eyes sticking together. This may become infected or develop into a sterile chronic granuloma – a firm, painless lump that gradually enlarges. Initially it may resemble a stye, but it is not inflamed. Chalazia usually grow inwards toward the conjunctival surface, which may be slightly reddened or elevated.

Treatment

Although they generally do resolve spontaneously, to speed up the healing process, a stye can be drawn to a head by applying a hot compress to the closed lid for several minutes each day. A clean towel or flannel, which has been soaked in hot (but not boiling) water, is suitable for use as a compress. Topical antibiotics should not be used unless there is evidence of conjunctivitis. If the stye is causing pain, a simple analgesic (such as paracetamol or ibuprofen) may be recommended. If the stye has not resolved in seven days, the patient should be advised to consult the doctor. Those styes that do not resolve may require surgical treatment often involving removal of an eyelash.

In a similar way to styes, chalazia usually resolve spontaneously although they may take a few weeks to completely disappear. Infected cysts are treated in the same way as styes. Cysts that do not resolve may require surgery to drain the swelling.

Figure 14: Meibomian cyst on an eyelid. Reproduced with permission from Dr P. Marazzi, Science Photo Library.
Marginal Blepharitis
Blepharitis is inflammation of the margin of the eyelid. It is usually a chronic condition that is typically bilateral. Blepharitis usually causes redness and irritation of one or both eyelid margins, and often dandruff-like scales, which are either dry or greasy in nature, can be seen sticking to the base of the eyelashes (see Figure 15). It is commonly seen in individuals with seborrhoeic dermatitis or acne rosacea. Some eyelashes may be either missing or distorted so that they point inwards and irritate the surface of the eye. Patients often complain of irritation and itching of the lid margins. Blepharitis is often associated with dry eyes.10,22

Figure 15: Blepharitis. Reproduced with permission from Dr P. Marazzi, Science Photo Library.

Treatment of blepharitis
People with blepharitis should be informed about the following:
- blepharitis is a chronic condition
- symptoms can frequently be improved, but the condition may not be cured permanently
- compliance with the recommended treatment is important, particularly lid hygiene
- sight is rarely affected
- contact lenses should not be worn during any eye infection
- eyelid hygiene – priority in management.
Eyelid hygiene

Eyelid hygiene is the first-line treatment and alone is often adequate treatment for uncomplicated seborrhoeic blepharitis. Warm compresses to the eyelids and eye margins loosen the collarettes and crusts, making cleaning more effective and comfortable. Cloths warmed with hot water should be applied to the closed eyelids for 5-10 minutes.

Massage the eyelids – gently roll your first finger on the eyelids. This helps to push out any oily fluid from the tiny eyelid glands. Cleansing of the eyelids is usually carried out with a mixture of 2 parts of baby shampoo diluted with 10 parts of warm water, which is applied with a clean cloth or cotton bud and rubbed along the lid margins. Alternatively lid wipes can be purchased over the counter. Cleansing of the eyelids should be done twice daily for several weeks. Once symptoms have improved this can be reduced to once daily. Daily cleansing should be continued indefinitely in order to reduce the likelihood of recurrence. Eye make-up, especially eye liner, may contribute to blepharitis. Advise avoidance or use of an eye-liner that washes off easily.

If symptoms have not resolved within seven days, patients should be advised to speak to their GP. Bacterial blepharitis is treated by application of an antibacterial eye ointment to the conjunctival sac or to the lid margins. Chloramphenicol eye ointment can be rubbed into the eyelashes and at the base of the lashes two to three times daily for seven days. It should be noted that OTC chloramphenicol is not licensed for the treatment of blepharitis. An alternative is to use fusidic acid viscous drops which is active against Gram positive bacteria including Staphylococcus aureus and Staphylococcus epidermidis. Systemic treatment may occasionally be required and is usually undertaken after culturing organisms from the lid margins and determining their antibiotic sensitivity. Oral antibiotics such as tetracyclines given for three months or longer may be required.
Tear Disorders

Two tear disorders occur:
- watering eyes
- dry eyes.

The consequences of both can be related to the structure and function of the normal eye and tears (see Section 2).

Watering Eyes

Discharge from the eyes may be caused by conjunctivitis as previously discussed. However, excessive lacrimation, when there are no other symptoms to suggest the presence of this condition, may be associated with interrupted drainage of the tear film often as a result of blockage of the nasolacrimal duct. Twenty per cent of infants develop the symptoms of congenital lacrimal obstruction during their first month of life. Twenty per cent of infants develop the symptoms of congenital lacrimal obstruction during their first month of life. Watering eyes can also be a symptom of dry eyes as the inflammatory process that results from dry eyes can cause watering.

Watering eyes may also occur as a result of either ectropion or entropion conditions, which occur particularly in older people. In these conditions, spasm or atony of the orbital muscles causes the eyelids to either invert (entropion) or evert (ectropion). Both can occur in such a way that the punctal openings on the eyelid margin are not in contact with the ocular surface. Tears can also overflow if the margins of the eyelids do not meet when the eyes are closed. Both conditions lead to an overflow of tears.

Treatment

In infants with nasolacrimal duct blockage, spontaneous resolution is the commonest outcome; without treatment only 0.7% of infants will still be affected by their first birthday. After considering the differential diagnosis, general practitioners can manage the condition until infants are 12 months old. An attempt may be made by the GP to resolve the problem by applying pressure with one finger to the lacrimal sac at the internal corner of the eye and lightly massaging the duct beneath. If fluid is not released, pressure should not be increased. This approach is not normally effective in adults.

In the case of either ectropion or entropion, referral is necessary since a minor surgical procedure can correct the problem.
Case study 2

Mrs Wright comes into your pharmacy with her three week old son, James. He has had slightly sticky eyes since he was born and she has been advised by the midwife to bathe his eyes gently with sterile water. She has been doing this but feels that his eyes are not improving. She asks if you can recommend some drops to help.

(a) What is/are likely cause(s) of James’s condition?

(b) What advice would you offer?

(c) What do you have to consider when asked for a ‘second opinion’ in this case?

Please compare your response to the comments made in the case study review.
Section Three

Responding to Eye Symptoms

Dry Eyes (keratoconjunctivitis sicca)

Dry eye is a multifactorial disease of the tears and the ocular surface. It is a common chronic eye disorder especially among the older population (tear production decreases with age); the condition is commonest amongst post-menopausal women and may be induced by HRT. It is also sometimes associated with connective tissue disease such as rheumatoid arthritis and Sjögren’s syndrome. It causes distress through its uncomfortable symptoms and has the potential for vision-threatening complications since, if left untreated, it may lead to corneal ulceration. In terms of symptoms, the eyes often feel gritty or burning and there may be discharge and an increased awareness of lid movement. There may be no visible reduction in tear volume since a deficiency in any of the tear components (aqueous, mucoid or lipid) may interfere with the wetting properties of tear fluid. Although there may be some discharge present on wakening, the other symptoms of dry eye tend to increase in severity as the day goes on and are exacerbated by dry atmospheres or air conditioning. Dry eye patients are particularly susceptible to external ocular infections and the condition may cause serious corneal problems, e.g. corneal scarring or thinning.

Some wearers of contact lenses may be more susceptible to dry eye since contact lenses interfere with the normal lubricating action of eyelids distributing tears across the ocular surface in a blink reflex. The marginal dry eye observed in contact lens wearers differs from the true dry eye patient both in subjective complaints and in physical findings. Most often the contact lens patient neither complains of ocular dryness nor exhibits clinical signs of dry eye when not wearing their lenses. Instead, they find that symptoms of dryness limit their ability to comfortably wear lenses.

Treatment

The condition may usually be regarded as chronic since, once the ability to produce tears is lost, it is rarely, if ever, regained and therefore treatment is expected to be life-long. However, dry eye, when associated with infection, can be acute and temporary. It is best to refer patients presenting with dry eye in order to eliminate associated problems such as corneal ulceration. The theory behind the treatment of dry eye is to initially provide sufficient lubrication to enable the chronic inflammation of the eye surface to subside and thereafter to maintain the eye in a well-lubricated state so that the patient is symptom-free. Tear substitutes are generally recommended for the treatment of this condition. Eye ointments such as Simple Eye Ointment BP, VitA-POS® or Lacrilube® can be used and have a prolonged retention time. However, they are greasy and produce unpleasant stickiness and blurring of vision. They are sometimes used as adjunctive treatment at night. Eye drops such as Hypromellose Drops BP are more commonly used. These are usually viscous in nature to increase retention time and the lubricating effect in the eye. In general, the greater the concentration of viscous agent in the preparation, the more prolonged the retention time. However, the more viscous preparations also tend to be less acceptable to patients as they often cause increased symptoms of blurring of vision and may crystallise on the lids and lashes, causing irritation. Patients therefore generally start treatment with one of the less viscous agents, e.g. Hypromellose drops 0.3%. Carbomers, e.g. Viscotears®, Liposic®, are more gel-like in nature and can cling to the eye surface. This may help reduce the frequency of application to four times daily. Anyone needing to use ocular lubricants six times a day or more should use preservative-free eye drops to reduce the damage by benzalkonium chloride which disrupts the tear film. These eye drops may be single dose units or multi-dose preservative-free devices such as Vismed Multi, Hyabak and the Hylo range.
Trauma or Foreign bodies

Foreign bodies fall into two categories.
1. **Superficial foreign bodies**: these stick to the front of the eye or get trapped under one of the eyelids, but do not enter the eye.
2. **Penetrating foreign bodies**: these penetrate the outer layer of the eye (cornea or sclera) and enter the eye. These objects are usually travelling at high speed and are commonly made of metal.\(^2\)

All eye injuries are potentially serious and even superficial grazes (abrasion) can lead to scarring of the cornea, or infection, with possible deterioration of eyesight and even permanent blindness. The eye can be cut or bruised by direct blows, broken glasses, or sharp chipped fragments of metallic materials (see Figure 16), grit or glass, which fly into it. However, particles of dust or grit or loose eyelashes are the most common foreign bodies found in the eyes. They stick to the inner surface of the eyelid, normally the upper lid, causing considerable discomfort and inflammation. In most cases, these can be easily removed.\(^2\)

![Figure 16: Foreign body (centre) on the cornea. Reproduced with permission from Dr P. Marazzi, Science Photo Library.](image)
Removing foreign bodies from the eye

Before attempting to remove the object, the patient should be asked to sit down in a chair facing the light and lean back. You should wash your hands, then stand behind the person, with their head resting against you. Using the index finger and the thumb of one hand to separate the affected lid, ask them to look up, down, right and left so that all parts of the affected eye can be seen. If the foreign body can be seen, an attempt should be made to remove this using sterile saline. If this is unsuccessful and the foreign body is not sticking to the eye, the foreign body should be lifted off using a moistened swab or the damp corner of a clean paper tissue or cotton bud. If the foreign body cannot be removed, cover the affected eye with an eye pad or a piece of gauze wrapped around a soft pad of cotton wool. This should be lightly secured in position and medical aid sought. If the foreign body is on the pupil or iris, or embedded in the eyeball, no attempt should be made to remove it and instead medical attention should be sought. Similarly, any obvious signs of trauma to the eye such as bleeding should be referred immediately. If a patient presents with any eye symptoms, it should be ascertained if there has been a trauma to the eye that might be responsible for the problems.

Case study 3

First Aid in the Pharmacy

A man in his mid-thirties comes into your pharmacy at lunchtime, holding a tissue to his left eye. He tells you that he was on his way to buy a sandwich and was passing a building when he felt something go into his eye. He has no idea what it was but says his eye feels very sore. Can you help him?

(a) What steps would you take?

(b) What are the legal implications of providing first aid in the pharmacy?

Please compare your response to the comments made in the case study review
Painful eye conditions

Patients presenting with minor eye conditions may complain of some pain on the surface of the eye. This should be distinguished from a deep-seated pain, which comes from inside the eye and is suggestive of a more serious underlying cause. A severe pain inside the eye suggests the presence of conditions such as:

- acute closed angle glaucoma (will be covered in Section 4)
- iritis
- corneal ulceration.

Iritis (anterior uveitis), iridocyclitis and choroiditis (posterior uveitis)

This is an inflammation of the iris and surrounding structures such as the ciliary body (see Figure 17). Iritis and anterior uveitis are synonymous terms, which refer to inflammatory conditions of the anterior uveal tract. Indeed, iridocyclitis also refers to inflammation of the ciliary body and is therefore also an iritis. Posterior uveitis refers to inflammation of the choroid and is often referred to as choroiditis.

It usually affects only one eye. Iritis can begin as an acute pain at the front of the eye accompanied by blurred vision, redness of the conjunctiva, and perhaps photophobia. The affected eye is red and there is no discharge. As the condition continues to develop, iritis causes the inflammed pupil to become ‘sticky’ and form attachments called synechiae to the lens; this can cause the pupil to appear small, irregular in shape and show poor light reactivity.

Its cause is not identified in the majority of cases but it may be the result of systemic disease such as connective tissue disorders. Iritis itself can be caused by infection by agents such as syphilis, herpes or tuberculosis. There is also a strong genetic influence on the patients who are at risk from iritis, such as those who are HLA-B27 positive with sero-negative arthropathy or children who have sero-negative arthritis. Iritis is a relatively infrequent cause of red eye but nonetheless it should always be considered since it can have serious implications for the well-being of the eye.
Section Three
Responding to Eye Symptoms

Exercise 4
Using your BNF, state which of the following are classified as steroid eye drops:

Exocin® eye drops

Voltarol® ophtha eye drops

Betnesol® drops

Please compare your response to the comments made in the exercise review.

Figure 17: Inflamed iris. Reproduced with permission from Dr P. Marazzi, Science Photo Library.

Treatment
Iritis may progress to cause cataracts if the lens is involved, or glaucoma if the drainage angle for aqueous humour is affected. Referral is essential for treatment with steroids to reduce the inflammation and topical mydriatics to prevent adherence of the iris and lens. If treatment is not sought at an early stage, there is a danger of permanent visual loss.
**Corneal Ulceration (keratitis)**

This may be caused by infection (bacterial, viral and fungal) or injury, or rarely in association with systemic diseases such as collagen vascular disorders, e.g. rheumatoid arthritis and systemic lupus erythematosus. Inflammatory conditions of the cornea can often occur due to a compromise in corneal epithelial integrity, perhaps due to an abrasion, contact lens wear or even the use of topical steroids. Infection or injury can cause corneal ulceration. It is characterised by photophobia, either dryness or lacrimation, and pain, although this is not always present. If pain is present, this will often be extreme, due to the exquisite sensitivity of the corneal nerve endings. If there is severe corneal ulceration, the patient will have experienced a noticeable decline in visual acuity.

Having established the presence of a corneal epithelial lesion using fluorescein drops, the ophthalmologist will seek to establish the absence or presence of a conjunctival foreign body. If signs of infection are present, swabs will be taken to establish the nature of the infection. Ulceration of the cornea is a serious condition and requires intensive treatment with an appropriate antimicrobial agent. Subconjunctival injection of antibiotics can be used to concentrate the antibiotic in the anterior segment. If inflammation is severe, topical steroids can be administered under strict supervision. Fungal infections of the cornea are often a result of an agricultural injury and may take comparatively longer to become established.

Anyone with a painful eye will require referral by the pharmacist to a doctor and it should be stressed to the patient that they should see the doctor reasonably urgently. The warning signs for immediate referral are:

- pain inside the eye, as distinct from superficial soreness, grittiness or itchiness
- redness localised in one area of the eye
- disturbance of vision; blurred/double/loss of vision
- pupils abnormal shape or uneven
- pupils reacting unevenly to light
- recurrent sub-conjunctival haemorrhage
- dry eyes
- trauma to the eye
- a red painful eye that is associated with vomiting and headache, potentially a case of angle-closure glaucoma.
Summary points

- It is the pharmacist’s responsibility to ensure that protocols and SOPs are in place for the safe supply of all OTC medicines including eye preparations.
- Red eye is generally the most common ophthalmological complaint presented to pharmacists and GPs with causes including conjunctivitis, subconjunctival haemorrhage and ‘inflamed eyes’.
- There are four main types of conjunctivitis – bacterial, adenoviral, chlamydial and allergic with chloramphenicol 0.5% eye drops and 1% eye ointment, propamidine isetionate and dibrompropamidine being available OTC for the treatment of bacterial conjunctivitis. For allergic conjunctivitis, lodoxamide, sodium cromoglicate and Otrivine Antistin (xylometazoline hydrochloride, antazoline sulphate) preparations are available.
- Full guidance is available from the Royal Pharmaceutical Society (www.rpharms.com) for the sale of chloramphenicol 0.5% eye drops.
- Disorders of the eyelid include styes (infection of the hair follicle gland at the base of an eyelash), chalazia (Meibomian gland cysts) and marginal blepharitis.
- Tear disorders (watering eyes and occasional stickiness) occur in one-fifth of new-born babies within the first month of life. This is usually caused by nasolacrimal obstruction and usually resolves within 12 months.
- Tear production decreases with age leading to dry eye syndrome, which is most commonly observed in post-menopausal women.
- Severe pain in the eye can be indicative of acute closed angle glaucoma, iritis or corneal ulceration.

Having completed your study of responding to eye symptoms, you should now be able to:

- Prepare Standard Operating Procedures for safe and effective sale of OTC medicines and for provision of advice by pharmacy staff who are not pharmacists
- List the questions you should ask anyone presenting with an eye condition
- Recognise the main, commonly presented eye conditions
- Differentiate minor eye conditions from more serious conditions that will require referral to the GP
- Manage common eye conditions satisfactorily
- Understand the Royal Pharmaceutical Society’s guidance for the sale of chloramphenicol 0.5% w/v eye drops.

If you are not able to do all of these, go back and review this section again.
References


Exercise and case study reviews

Case study 1 review
(a) Questions that may be asked include further investigation of the discharge from the eyes; if the patient’s eyelashes were stuck together with a yellow discharge when she woke up, which had to be wiped away, it is likely that the patient has bacterial conjunctivitis. It is important to ask about other symptoms including: photophobia (not normally present); blurring of vision (which may occur but clears with blinking); contact lens use; previous medication tried or other eye drops being used; recent overseas travel; recent eye laser or surgery; pregnant or breastfeeding; history of foreign body entry.

(b) Firstly, it is important to state that acute bacterial conjunctivitis can be self-limiting and does not always require antibacterial therapy\textsuperscript{13, 34}. If antibacterial therapy is chosen then chloramphencicol is the first-line choice for acute bacterial conjunctivitis but it may be clinically difficult to distinguish bacterial from viral conjunctivitis. In the pharmacy setting, it may be appropriate to treat any superficial infective conjunctivitis with chloramphenicol as long as there is no reason to refer the patient to their GP. Immediate use of chloramphenicol eye drops in all cases of infective conjunctivitis (bacterial and viral in origin) has the following advantages: increased rate of resolution of bacterial infection reduces the risk of transmission, prevention of secondary bacterial infection with viral conjunctivitis (unlicensed indication), possible reduction of the (slight) risk of complications. Before diagnosing infective conjunctivitis, it is essential to exclude serious causes of red eye that can lead to permanent impairment of vision and to distinguish it from allergic and irritant causes (see who to refer to the doctor – RPS guidance\textsuperscript{13}).

(c) Infective conjunctivitis is contagious so advice should be given about washing hands regularly after touching infected secretions and to avoid sharing pillows, towels and utensils. If Linda had been a contact lens wearer, she would have been referred to her GP who would have advised her not to wear her lenses until all signs and symptoms of the infection had completely resolved. Linda should also be advised on the correct way to administer eye drops and that if symptoms do not improve within 48 hours, she should consult her GP.

Exercise 4 review

Exocin\textsuperscript{®} eye drops (ofloxacin 0.3%) – Antibacterial
Voltarol\textsuperscript{®} ophtha eye drops (diclofenac sodium 0.1%) - non-steroidal anti-inflammatory
Betnesol\textsuperscript{®} drops (betamethasone sodium phosphate 0.1%) - Corticosteroid

A full list of current corticosteroid eye drops available can be found in section 11.4.1 of the BNF, see www.bnf.org
Section Three
Responding to Eye Symptoms

Case study 2 review
(a) James may be suffering from conjunctivitis although other factors are likely to be important in this particular case. Small children may be susceptible to infective conjunctivitis and they may develop severe forms of the condition due to their poor immune defences at this stage in their development; this is particularly so in babies. This particular type of conjunctivitis (ophthalmia neonatorum) may be due to an infection that has been contracted during the passage through the birth canal and may include gonococcal or chlamydia infection; swabs should therefore always be taken to determine appropriate treatment.

Alternatively, the stickiness may be as a result of the punctal openings of the eye not being fully formed. This is quite common in newborn infants and results in incomplete drainage of tears leading to watering eyes and occasional stickiness. As the infant gets older, this opening will form properly and the condition usually spontaneously resolves.

(b) In this case, it is inappropriate to sell an OTC eye product as the use of an antibacterial agent will interfere with any swabs taken by the GP. Also chloramphenicol is only licensed for children over two years old. Mrs Roberts should be advised to take James to see his GP in the near future to ensure that there is no infection present. In the meantime, she should continue to bathe his eyes, as advised by the midwife.

(c) In most aspects of healthcare, there will be more than one professional involved. This is particularly so in the case of newly born babies. The mother will have had advice before the birth in her antenatal clinic; she will have seen a midwife in hospital, a community midwife at home, the health visitor at home and in postnatal classes, and possibly the GP. She probably also has well meaning friends and relatives giving her advice. When advice is conflicting or contrary to her own views, she may turn to the pharmacist for an accessible available form of ‘second opinion.’

To handle such cases, you should first ascertain what other advice she has already received and perhaps find out what her own health beliefs are. You must be careful not to undermine her confidence in other professionals, and yet you must give the advice you feel is most appropriate. It is important that you are up-to-date with current trends in the advice being provided by others so that you can support the advice already received. If possible, try to attend multidisciplinary meetings or if that is not feasible, make a point of using your personal contacts with other health professionals to keep up-to-date and aware of trends.

Case study 3 review
(a) It may be better if you have a look in his eye to ascertain what the particle is and how it should best be dealt with, rather than have him delay removal until he gets back to his workplace. Sit him down facing the light and ask him to tilt his head back to allow you to view his eye. The advice given in this section should then be followed and the patient referred if appropriate. As mentioned in this section, all eye injuries are potentially serious. If power tools were being used on the building site, without adequate screening, the particle may have hit this patient’s eye at high impact. You may choose to refer the patient to the local A&E; if you do, you could contact them by phone to alert them to your referral.

(b) You must be aware of your legal liability; you must be able to demonstrate competency in your actions if any claim is made against you. If you are going to do any first aid in the pharmacy, ensure it is done well and recommended procedures are followed.
Introduction
There are many diseases affecting the eye; these may be systemic diseases with ocular symptoms, e.g. rheumatoid arthritis, or they may be specific to the eye, e.g. cataract. Certain conditions may only be treated by surgical intervention and those patients will usually present to pharmacists post-operatively, whilst other conditions will require topical and/or systemic treatment, e.g. glaucoma. Pharmacists need to understand these diseases and be able to advise and inform patients appropriately so as to improve adherence and outcomes. It is not always obvious that a counselling session is directly affecting the health of the eye. For example, whilst counselling a patient on the need for compliance when taking multiple cardiovasular (BP and lipid-lowering) and diabetic medications, the counsellor contributes to the prevention of eye conditions such as retinal detachment and diabetic retinopathy.

Having looked at the structure and function of the eye in Section 2, this Section now details common diseases of the eye, their pathology, aetiology and treatment.

Intended learning outcomes
Following completion of this part of the course, you should be able to:

- **Describe** the classification and causes of cataracts
- **Differentiate** the types of glaucoma and describe the treatments for glaucoma
- **Explain** the importance of glucose monitoring in the prevention of diabetic retinopathy
- **Describe** the background to Age-Related Macular Degeneration
Cataract
Cataract is defined as any opacity (or loss of transparency) of the lens (see Figure 18). The term cataract is derived from the Latin word cataracta and the Greek word katarrakt-es, meaning white water falling. Symptoms suffered will include one or more of the following:

- cloudy, fuzzy or blurry vision
- need for brighter lights whilst reading
- changes in the way colours are perceived
- problems with glare - usually manifested as difficulty in night driving due to car headlamps
- frequent changes of glasses prescription
- double vision
- double vision that is still present on covering one eye.

Figure 18: Male patient with mature cataract. Reproduced with permission from Sue Ford, Science Photo Library.
Section Four
Common diseases of the eye

While these rough indicators may suggest a cataract, they may also be signs of other eye problems. It should also be noted that such symptoms depend on whether the cataract is unilateral or bilateral and the degree and position of the opacity.

Evidence of how a cataract can change the perception of colour can be seen in Monet's famous paintings of waterlilies in the garden at Giverny. He was first diagnosed with cataracts in 1912 at the age of 72, but because of fear, he did not have surgery until 1923. During that time his vision became less clear and as the lens become progressively yellow, he viewed things as though through a yellow filter. Pictures painted before removal of his cataracts are predominantly in tones of browns and reds, whilst those after removal of the cataract are in more vivid hues of blues and purple.

Development of a cataract is the only response by the lens to injury or insult and while opacities can occur in the newborn and children, they are more frequent in older people. Moreover, the cataract can occur within the nucleus, cortex, and capsular or subcapsular regions of the lens. For an overview of the many different forms and causes of cataracts see Table 6.

Cataracts and their treatment can be classified into three main groups:
1. congenital cataracts
2. senile cataracts
3. secondary cataracts.

**Congenital Cataracts**

The aetiology of congenital cataracts remains largely unknown. It has been established, however, that several forms have a strong hereditary background while others can occur as a result of intrauterine infection (e.g. rubella), metabolic disturbance (e.g. galactosaemia) or drugs taken during pregnancy. Unilateral cataracts are usually isolated sporadic incidents and can be associated with ocular abnormalities, trauma, or intrauterine infection, particularly rubella. Bilateral cataracts are often inherited and associated with other diseases therefore the affected child requires a full metabolic, infectious, systemic, and genetic investigation.

Approximately 40% of congenital cataracts are lamellar (also called zonular) in nature with the opacity in a zone in the lens nucleus. Other congenital cataracts may take on the form of opacities confined within the lens nucleus or to the anterior or posterior poles of the lens.

A sub-class of congenital cataracts can occur as a developmental ‘defect’ in a relatively large proportion of the population and are somewhat different from the other forms in that they are idiopathic and generally do not affect vision appreciably. They may develop as a result of hereditary, toxic or nutritional influences. Developmental cataracts, as they are sometimes called, occur as small focal opacities, which have a cortical orientation.
Senile Cataracts

Senile cataracts refer to the class of lens opacities that occur spontaneously in the absence of any congenital disorder, systemic disease, ocular trauma or ocular disease. These cataracts frequently occur in people over the age of 65 although they can sometimes occur in younger individuals where they are termed pre-senile such as in Werner’s syndrome, which is a heterofamilial condition. Generally, there are three types of senile cataract with each having a different prognosis and speed of development.

Nuclear sclerosis

Nuclear cataracts consist of a central opacification or coloration that interferes with visual function. There are different types of nuclear cataracts, accompanied by either brunescence, opalescence, or both. Nuclear cataracts tend to progress slowly and render the patient more myopic; patients who have needed reading glasses for many years to clearly read small print then also struggle with their distance vision. In advanced cases, the lens becomes brown and opaque.

Cortical cataract

These are radial, spoke-like opacities, which appear in the lens fibres in the anterior and posterior cortex. They gradually extend to the central area of the lens and increasingly interfere with normal vision at a slow, yet progressive, rate. Patients with this type of cataract complain of glare.

Posterior subcapsular cataract

Posterior subcapsular (PSC) cataracts can cause significant visual impairment if they affect the axial region of the lens. Posterior subcapsular cataracts are found more often in younger patients than are nuclear or cortical cataracts. Patients often have glare and poor vision with bright lighting, and their near vision is typically more affected than distance vision. Two population-based studies found that of the three types, PSC cataracts are associated with the greatest rate of cataract surgery. In an older population (mean age 79 years) undergoing cataract surgery, however, nuclear cataracts were most frequently encountered.
Secondary Cataracts

These cataracts occur through the lens’s response to an insult whether as a result of systemic disease, an eye-related complication or intraocular trauma. Perhaps unsurprisingly, there are many insults that can cause secondary cataracts. A few examples are outlined below:

Diabetes mellitus
Diabetes mellitus has been reported as the most critical factor causing visual loss. Among the various complications of diabetes mellitus in the eyes, diabetic retinopathy has been regarded as the most common cause of visual loss. Diabetes mellitus is also known as an important risk factor for cataracts with a senile-type cataract occurring more frequently, and at an earlier age, in diabetic patients. In epidemiologic studies, factors such as a long duration of diabetic disease, advanced age at the time of clinical diagnosis, advanced retinopathy, treatment with diuretics, and poor control of blood sugar level are reported as risk factors for cataract in patients with diabetes.

Traumatic cataract
Traumatic cataracts occur secondary to blunt or penetrating ocular trauma or intraocular surgery. Infrared energy (glass-blower’s cataract), electric shock, and ionizing radiation are other rare causes of traumatic cataracts. Cataracts caused by blunt trauma classically form stellate- or rosette-shaped posterior axial opacities that may be stable or progressive, whereas penetrating trauma with disruption of the lens capsule forms cortical changes that may remain focal if small or may progress rapidly to total cortical opacification.

Toxic cataract
Drugs, e.g. corticosteroids in high doses and other toxic substances, may cause toxic cataract. This generalised lens response to toxic insult can also occur when metals are absorbed due to chronic exposure in industrial situations or after administration for therapeutic reasons. The toxic effects of tobacco smoking also carries an increased risk of cataract formation.

Radiation cataract
All forms of ionising radiation can have serious consequences for the lens. Prolonged exposure to light in the infrared region of the spectrum has been shown to be a clear cataract risk factor, best demonstrated by the high incidence of posterior cortical cataract among glass blowers. The action of UV (B) light is also an increasingly recognised risk factor for cataract formation and necessitates eye protection on prolonged exposure to sunlight.
Treatment of cataracts

Early cataracts cause a myopic shift in spectacle prescription therefore patients with early cataracts are advised to see their optometrists, as a change in glasses prescription will often improve vision. In cases where the ophthalmologist has deemed it necessary for cataracts to be removed, there are two surgical procedures available: the extracapsular extraction (very rarely used) and phacoemulsification methods. Phacoemulsification is the most common method of cataract removal nowadays and involves emulsification and aspiration of the lens contents, whilst leaving the capsule intact, and substituting a clear plastic artificial lens. The modern refinements of this operative procedure allows rapid recovery and good visual rehabilitation.

Table 6: Causes of lens opacities and associated pathologies

<table>
<thead>
<tr>
<th>Disease/Condition</th>
<th>Associated Lens Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital infant/adult</td>
<td>Many forms: lamellar, punctate etc.</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>Increased incidence &amp; more rapid maturation of senile cataract</td>
</tr>
<tr>
<td>Lowe's syndrome</td>
<td>Congenital cataract, posterior capsule adherent to vitreous humour</td>
</tr>
<tr>
<td>Marfan's syndrome</td>
<td>Cataract and lens subluxation</td>
</tr>
<tr>
<td>Down's syndrome</td>
<td>Cataract development after first decade, congenital lens opacities often present</td>
</tr>
<tr>
<td>Rubella Syndrome</td>
<td>Advanced cataract and association with other conditions, e.g. glaucoma</td>
</tr>
<tr>
<td>Cataract associated with isolated ocular defects, e.g.</td>
<td>Variable</td>
</tr>
<tr>
<td>retinitis pigmentosa, retinal detachment, absolute</td>
<td></td>
</tr>
<tr>
<td>glaucoma, intraocular inflammation</td>
<td></td>
</tr>
<tr>
<td>Traumatic cataract</td>
<td>Ruptured capsule due to penetrating injury – may induce subcapsular opacity</td>
</tr>
<tr>
<td>Toxic cataract</td>
<td>Systemic or topical corticosteroid for long periods may cause subcapsular cataract</td>
</tr>
<tr>
<td>Radiation</td>
<td>Smoking also increases risk of cataract, various cataract types according to nature of</td>
</tr>
<tr>
<td></td>
<td>radiation, notable association of UV radiation with onset of senile cataract.</td>
</tr>
</tbody>
</table>
Glaucoma

Glaucoma is currently defined as a disturbance of the structural or functional integrity of the optic nerve that causes characteristic atrophic changes in the optic nerve, which may also lead to specific visual field defects over time. The generic term glaucoma should only be used in reference to the entire group of glaucomatous disorders as a whole because multiple subsets of glaucomatous disease exist. A more precise term should be used to describe the glaucoma, if the specific diagnosis is known. Due to the silent nature of glaucoma, patients will not usually present with any symptoms or visual complaints until late in the disease course, particularly with open angle glaucoma. However, in the case of angle closure glaucoma definite symptoms such as pain in the eye or blurring of vision will occur.

The pathophysiology and clinical presentation of glaucoma is multifactorial and variable, which makes it difficult to define the condition. However, in general terms, glaucoma involves one or more of the following conditions:

- rise in intraocular pressure
- abnormalities in aqueous drainage and trabeculum function
- damage to the optic disc
- loss of visual fields.

In the following overview of glaucoma and the relevant therapeutic intervention of the condition we will define each of the three primary types of glaucoma, followed by secondary glaucoma, which occurs as a result of another eye complication or systemic disease:

Angle closure glaucoma | Open-angle glaucoma | Congenital glaucoma | Secondary glaucoma
Angle-closure glaucoma (Acute glaucoma)

Angle-closure glaucoma is a condition in which the iris is apposed to the trabecular meshwork at the angle of the anterior chamber of the eye (see Figure 19). When the iris is pushed or pulled anteriorly to block the trabecular meshwork, the outflow of aqueous humour from the eye is blocked, which causes a rise in intraocular pressure (IOP). In comparison, chronic open-angle glaucoma is more common in patients who are long-sighted (since their anterior chambers are slightly more shallow) and older people (when the lens is larger). Such an ‘angle-closure’ prevents the outflow of aqueous humour, which results in a rapid rise in intraocular pressure (IOP) with the eye also becoming red and painful; the patient may also feel nauseous. Signs of angle-closure glaucoma include an eye that is tender, and a semi-dilated pupil, that is fixed to light. The cornea may also be hazy because of stromal oedema. The incidence of acute glaucoma is three times higher in women than in men.

![Diagrammatic representation of angle-closure glaucoma](image)

Figure 19: Diagrammatic representation of angle-closure glaucoma. Reproduced from the National Eye Institute, USA.

Treatment

Acute glaucoma is a medical emergency and immediate treatment is needed in order to prevent damage to the optic nerve and permanent loss of sight in the affected eye. This condition requires surgical treatment (laser iridotomy or peripheral iridectomy) but it is treated medically initially with acetazolamide (Diamox) 500 mg (i.v.) to reduce aqueous inflow or an infusion of mannitol to produce an osmotic diuresis and, as the intraocular pressure falls, with topical pilocarpine 1 or 2% to constrict the pupil and open the drainage angle. Other ocular hypotensives, e.g. beta-blockers, sympathomimetics and prostaglandin analogues are also used and corticosteroids to reduce the inflammation. It is important to note that the other (unaffected) eye should also be treated as a prophylactic measure.23, 59, 60
Open-angle glaucoma (chronic simple glaucoma)

Open-angle glaucoma, also referred to as chronic simple glaucoma, is the most common glaucoma type accounting for about 10% of blindness registrations in the United Kingdom. Open-angle glaucoma may be reported to be symptomless in the early stages because stereoscopic vision compensates for minor defects in the visual field. This condition is bilateral in nature and occurs in 2% of people aged over 40 peaking at prevalence levels of approximately 10% in those aged over 75 years\(^24\). It also has a strong hereditary aetiology with a ten-fold increase in risk of developing chronic glaucoma for first degree relatives of affected individuals. Open-angle glaucoma also occurs with greater frequency in diabetic patients\(^25\).

Open-angle glaucoma is characterised by damage to the retinal ganglion cells and optic nerve leading to gradual loss of visual fields. Frequently there is a gradual increase in resistance to outflow through the trabecular meshwork with subsequent damage to the optic nerve head. However, a rise in intraocular pressure is not always detected in this glaucoma (although there may be fluctuations) and it has recently been suggested that vascular dysfunction in the retina and/or optic nerve head may itself lead to loss of retinal function and damage to the optic nerve. Nonetheless, open-angle glaucoma invariably leads to gradual loss of visual fields, which can be correlated with optic disc changes such as increased cupping of the disc (see Figure 20). The gradual nature of this glaucoma renders it virtually symptomless in the early stages and it is usually first detected through routine examination by an optometrist\(^26\).

Figure 20: Ophthalmoscopy of disc cupping in glaucoma patient. Reproduced with permission from Sue Ford, Science Photo Library.
Treatment

Early diagnosis of this condition is essential for effective treatment. The goal of treatment is to reduce intraocular pressure by 20-40% and to prevent further optic nerve and visual field damage. Initial treatment of open-angle glaucoma is with a prostaglandin analogue, e.g. latanoprost or prostamide. If ineffective, contra-indicated or not tolerated, a beta-blocker is an alternative first line agent. NICE guidance acknowledged that long-term lowering of intraocular pressure remains the only strategy known to be effective against sight loss. The majority of Randomised Controlled Trials available to the researchers were of relatively short duration, thereby presenting a challenge in how to extrapolate the effects of recommended treatments and strategies for a disease, which is long-term and progressive. The guidance, however, concluded that newly diagnosed people with early or moderate chronic open-angle glaucoma (COAG), and at risk of significant visual loss in their lifetime, should be offered treatment with a prostaglandin analogue. Those at risk of progressing to sight loss despite treatment should be offered surgery (laser trabeculoplasty or trabeculectomy) with pharmacological augmentation (5-fluorouracil or mitomycin C).

Sympathomimetics and carbonic anhydrase inhibitors are second line therapies, used when prostaglandin analogues/prostamides and beta-blockers are contra-indicated, not tolerated or insufficiently effective. Combination preparations can sometimes help with compliance, especially in older patients, by reducing the frequency of administration of drops and by preventing ‘washout’ and reducing the amount of preservative instilled.

Miotics are very effective as anti-glaucoma agents; however, they are generally not used initially in the condition because of their ocular side-effects, which include burning, itching and blurred vision.

See Table 7 overleaf for an overview of the common pharmacological agents used in the treatment of glaucoma.
Parasympathomimetic drops (miotics)

Pilocarpine (1-4%) eye drops. These constrict the pupil and exert a ‘pull’ on the trabecular meshwork thereby increasing outflow of aqueous humour from the anterior chamber. They may cause blurred vision (due to loss of accommodatory change) especially in younger patients. Pilocarpine should not be used if inflammation is present in the eye.

Sympathomimetic drops

Brimonidine tartrate drops (selective alpha-2-adrenoceptor agonist) can be used as a monotherapy alternative to beta-blockers in patients who are at risk of pulmonary complications. They may be effective in reducing intraocular pressure alone or as adjunctive therapy with beta-blockers.

Beta blocker drops

Betaxolol; carteolol; levobunolol; timolol. Topical application of these drugs reduces secretion of aqueous humour. Contra-indications to their use include a history of pulmonary or heart disease since topical drops may cause a systemic beta-blockade. The use of punctal occlusion or simply shutting eyes for several minutes after application of drops can reduce drug entry into the lacrimal ducts and subsequently to the systemic circulation.

Prostaglandin analogues and prostamides

Includes latanoprost; travoprost; tafluprost; bimatoprost (a synthetic prostamide). Increase uveoscleral flow and subsequently reduce intraocular pressure. Indicated and recommended first line for open-angle glaucoma and ocular hypertension. All have the advantage of once daily administration. Patients should be warned that they might increase the brown pigment in the iris.

Carbonic anhydrase inhibitors

There are two topical carbonic anhydrase inhibitors, dorzolamide and brinzolamide. The latter is more comfortable for patients to use because of its neutral pH. Acetazolamide tablets (250mg - 1g/day) and SR capsules (250-500mg/day) - now rarely prescribed, these serve to reduce secretion of aqueous humour and can quickly reduce intraocular pressure. They can induce several side-effects including nausea, lassitude, and development of renal stones, hence need to be used with caution.

Screening

Screening for glaucoma is not generally recommended, although certain at-risk patients, e.g. patients with diabetes, are screened as part of the diabetic retinopathy screening programme. Although people over 40 years old are encouraged to attend their optometrist for a check-up and first degree relatives of glaucoma patients are eligible for free eye tests, this system is not policed and a national screening programme has not been introduced.
Congenital Glaucoma (Buphthalmos)

By definition, primary congenital glaucoma is present at birth; however, its manifestations may not be recognised until infancy or early childhood. It is characterised by improper development of the eye’s aqueous outflow system, leading to increased intraocular pressure, with consequent damage to ocular structures, resulting in loss of vision. Often the condition is characterised by a complete absence of the angle recess and the iris is inserted directly onto the trabeculum. Intraocular pressure rises can be experienced in utero, prior to the third birthday or up to 16 years old. Although the disease is relatively rare, the impact on visual development can be extreme. Early recognition and appropriate therapy of the glaucoma can significantly improve the child’s visual future.

The condition takes its name from the enlargements of the eyes giving an impression of cattle eyes (ox eye = buphthalmos). In addition to enlargement of the eyes, congenital glaucoma can be recognised by a watering of the eye, often in combination with photophobia and perhaps a clouding of the cornea.

Treatment

Treatment of congenital glaucoma is always surgical, by preparing a space in the angle of the anterior chamber (goniotomy) or by preparing an outflow channel for excess aqueous humour (trabeculectomy). Continuing assessment of intraocular pressure is also required post-operatively.

Exercise 5

(a) Which of the following groups would you consider to be at increased risk of developing glaucoma?

- children
- patients with a family history of glaucoma
- patients with hypertension
- patients who are non-smokers
- patients who are white.

(b) Having considered the risk factors for glaucoma, how do you think a pharmacist could contribute to the early detection of glaucoma? Please compare your response to the comments made in the exercise review.
Secondary Glaucomas

A rise in intraocular pressure is a relatively frequent complication of other eye conditions. Some of the more frequent conditions that can lead to secondary glaucoma are:

- inflammation of the iris
- steroid-induced glaucoma
- injury
- neovascularisation of the iris.

Inflammation

Inflammation in the form of iritis (see Figure 17, Section 3) can cause focal adhesions of the iris and lens (a condition known as posterior synechiae) and blocks the flow of aqueous humour between the two eye chambers. Similarly adhesions between the iris and the cornea can cause angle closure. The chronic infiltration of pro-inflammatory leucocytes or exudates from an inflamed iris into the trabecular meshwork can lead to its mechanical blockage\(^36\). All three mechanisms can occur simultaneously or separately to produce a rise in intraocular pressure.

Steroid-induced glaucoma

Prolonged use of inhaled, nasal, dermatological or topical ocular as well as systemic steroids produces a type of glaucoma very similar to chronic simple glaucoma. The elevated intraocular pressure is reversible, whereas the glaucomatous cupping and the field defects are irreversible\(^37\). Around 30% of the population can respond to such treatment with an ‘open-angle-type’ glaucoma and it has been speculated that this steroid-susceptibility to secondary glaucoma is genetically determined\(^38, 62\). Systemic steroids have a lesser effect on intraocular pressure, presumably because they do not reach such high concentrations at the trabecular meshwork as topical applications.

Injury

Intraocular trauma or injury can induce glaucoma by direct damage to the angle or even obstruction with blood cells. Cataract-like changes after penetrative injury may cause lens swelling and a partial obstruction of the anterior chamber.

Neovascularisation

Neovascularisation (the growth of new blood vessels) onto the iris (iridis rubeosis) can cause fibrosis and tractional closure of the angle. New vessels and associated membranous structures can also block the trabecular meshwork directly if they grow into the anterior angle. Such neovascular responses are usually a result of retinal ischaemia secondary to retinal diseases such as proliferative diabetic retinopathy (see below) or central retinal vein occlusion\(^39\).

Treatment

As with all glaucomas there is an urgent need to treat a rise in intraocular pressure even if it happens to be secondary to other ocular conditions. If this is high, then such treatment often takes priority over the management of other complications.
Exercise 6

Trials looking at the treatment of patients with ‘medically refractory glaucoma’ have shown that more careful supervision of eye drop administration and thus increased adherence is of value. How can you contribute to enhance patient adherence? Can you use your PMRs to compare the frequency with which they obtain their drops?

Please compare your response to the comments made in the exercise review.
Diabetic retinopathy

Diabetes is a common disease that has a profound influence on the well-being of the eye. People with diabetes are more prone to cataract formation and retinal detachments but retinopathy is by far the most important and sight-threatening ocular problem encountered. While there are many vascular complications of diabetes that can have implications for kidney function, peripheral circulation and the progression of atherosclerosis, diabetic retinopathy is the most common and widespread. People with type 1 insulin–dependent diabetes are susceptible to diabetic retinopathy. The risk increases with duration of disease (usually evident within 5 years of onset) and poor glycaemic control of diabetes. Diabetic retinopathy is less frequent in type 2 diabetes, which is accounted for, at least in part, by the much later onset of this form of the disease. Nonetheless, diabetic retinopathy remains the leading cause of blindness in the working age group in the United Kingdom.

Diabetic retinopathy has four stages:

1. **Mild Nonproliferative Retinopathy** - at this earliest stage, microaneurysms occur (see Figures 21 & 22). They are small areas of balloon-like swelling in the retina's tiny blood vessels.

2. **Moderate Nonproliferative Retinopathy** - as the disease progresses, some blood vessels that nourish the retina are blocked.

3. **Severe Nonproliferative Retinopathy** - many more blood vessels are blocked, depriving several areas of the retina with their blood supply. These areas of the retina send signals to the body to grow new blood vessels for nourishment.

4. **Proliferative Retinopathy** - at this advanced stage, the signals sent by the retina for nourishment trigger the growth of new blood vessels. This condition is called proliferative retinopathy. These new blood vessels are abnormal and fragile. They grow along the retina and along the surface of the clear vitreous gel that fills the inside of the eye. By themselves, these blood vessels do not cause symptoms or vision loss. However, they have thin, fragile walls. If they leak blood, severe vision loss and even blindness can result.

Blood vessels damaged from diabetic retinopathy can cause vision loss in two ways:

1. Fragile, abnormal blood vessels can develop and leak blood into the center of the eye, blurring vision. This is proliferative retinopathy and is the fourth and most advanced stage of the disease.

2. Fluid can leak into the center of the macula, the part of the eye where sharp, straight-ahead vision occurs. The fluid makes the macula swell, blurring vision. This condition is called macular oedema. It can occur at any stage of diabetic retinopathy, although it is more likely to occur as the disease progresses. About half of the people with proliferative retinopathy also have macular oedema.
The pathogenesis of diabetic retinopathy is complex and likely to be multifactorial in nature, but the Diabetes Control and Complications Trial (DCCT) points to the pivotal importance of prolonged high blood glucose levels and the need to keep such hyperglycaemia under strict control\textsuperscript{41,42}. The ability to measure glycated haemoglobin (HbA1c) gives a consistent measure of blood glucose management in individual patients over a period of about 8-12 weeks.

The United Kingdom Prospective Diabetes Study (UKPDS) recruited 5,102 patients with newly diagnosed type 2 diabetes in 23 centres within the U.K. between 1977 and 1991. Patients were followed for an average of 10 years to determine amongst many other investigations, the impact of tight blood pressure control in hypertensive patients also diagnosed with type 2 diabetes; this tight BP control (mean ‘tight’ BP =144/82 vs ‘less tight’ BP = 154/87) led to a one third reduction in retinopathy progression compared to conventionally treated patients\textsuperscript{45}. More recently the ACCORD study group reported intensive glycaemic control and intensive combination treatment of dyslipidaemia (statin plus fibrate), but not intensive blood-pressure control, reduced the rate of progression of diabetic retinopathy\textsuperscript{46}.

Treatment

During the first three stages of diabetic retinopathy, no treatment is needed, unless there is macular oedema. Proliferative retinopathy is treated with laser surgery. This procedure is called scatter laser treatment. Scatter laser treatment helps to shrink the abnormal blood vessels. Because a high number of laser burns are necessary, two or more sessions usually are required to complete treatment. Although there may be some loss of side vision, scatter laser treatment can save the rest of the sight. It might slightly reduce color and night vision\textsuperscript{44}. Scatter laser treatment works better before the fragile, new blood vessels have started to bleed. That is why it is important to have regular, comprehensive dilated eye exams. Even if bleeding has started, scatter laser treatment may still be possible, depending on the amount of bleeding. If the bleeding is severe, a surgical procedure called a vitrectomy may be required. During a vitrectomy, blood is removed from the center of the eye\textsuperscript{44}.

Macular oedema is treated with focal laser treatment. Several hundred small laser burns are placed in the areas of retinal leakage surrounding the macula. These burns slow the leakage of fluid and reduce the amount of fluid in the retina. A patient may need focal laser surgery more than once to control the leaking fluid. Focal laser treatment stabilises vision and can reduce the risk of vision loss by 50 percent. In a small number of cases, if vision is lost, it can be improved. Recent research has found that prompt treatment of macular oedema with the drug ranibizumab, with or without laser treatment, resulted in better vision than laser treatment alone or steroid injections\textsuperscript{44}. Diabetic macular oedema is now included in the NICE approved indication for ranibizumab\textsuperscript{62}.

**Figure 22:** Photograph of the blood vessels of the retina showing changes caused by diabetic retinopathy (microaneurysms and exudates)
Age-related macular degeneration

There are several important degenerative diseases of the macula, the region of the retina with the highest concentration of cone photoreceptors and involved in high visual acuity. Of all the macular degenerative conditions, age-related macular degeneration (ARMD) is perhaps the most important. The United Kingdom is predicted to have about 16 million people over the age of 60 by 2040. One major implication of this demographic change is the emergence of conditions that are directly related to ageing. Age-related macular degeneration is already the leading cause of blindness in the Western world. According to the World Health Organisation, 8 million people have severe blindness due to age-related macular degeneration, excluding the countries where data are scarce. In a systematic review it was estimated that somewhere between 182,000 and 300,000 people in the United Kingdom are blind or partially sighted as a result of age-related macular degeneration (see Figure 23).

Important symptoms of this condition may include:
- blurring of central vision
- distortion of straight lines
- change in the relative size of perceived objects
- gradual loss of central vision.

ARMD is typified by one or more of the following phenomena:
- macular atrophy - i.e. degenerative loss of the photoreceptor cells
- hard exudates at the retinochoroidal interface
- abnormal pigmentation at the retinochoroidal interface
- intra-retinal haemorrhage.

Two main clinical types of ARMD exist, referred to as the ‘dry form’ and the ‘wet form’; it is generally characterised by the presence of acellular hyaline deposits of drusen between the retinal pigment epithelium (RPE) and the Bruch’s membrane. Drusen are familiar to ophthalmologists as localised yellow deposits of lipid material, which occur in two distinct forms.

(1) Hard (nodular) drusen appear as granular masses and contain vesicles and collagenous deposits. Hard drusen are usually associated with dry ARMD and generally reflect a localised disorder of the RPE in which there is an accumulation of membranous material from dead and dying cells. There may be associated atrophy of the RPE and outer neural retina. Amongst eyes with severe visual loss, 20% of cases are due to dry ARMD.

(2) Soft drusen are represented by large diffuse deposits that can readily become confluent, resembling serous detachments of the RPE. Indeed soft drusen can be representative of diffuse RPE dysfunction. Soft drusen formation is associated with wet ARMD, which is typified by proliferation of blood vessels in the sub-retinal space (between photoreceptors and RPE), which can cause haemorrhage and formation of a disciform scar in the macula consisting of proliferative fibrous tissue.
Section Four

Common diseases of the eye

Treatement

At present the dry changes associated with ARMD cannot be treated whilst wet ARMD requires urgent referral and assessment. The ophthalmologist will resort to photodynamic therapy, or laser photocoagulation of the sub-retinal neovascular membranes with limited results. The preferred option now is intravitreal injections of antivascular endothelial growth factors (anti-VEGF). The agents currently being investigated and used are: ranibizumab (Lucentis®), which has a licensed indication for this use; bevacizumab (Avastin®), which presently has a licence for metastatic bowel cancer, but not for ARMD, and is being administered unlicensed; and pegatanib (Macugen®), which does not have the support of NICE guidelines.

Further guidelines and summaries of research on treatment and management of ARMD has also been published by The Royal College of Ophthalmologists.

It has been proposed that antioxidant therapy may prevent cellular damage in the retina by mopping up free radicals produced in the process of light absorption. Antioxidant vitamin and mineral supplements are increasingly being marketed for use in age-related eye disease, including ARMD. However, currently available trial data, examined by the Cochrane Centre Oxford, has not found evidence that people with ARMD should take antioxidant and mineral supplements to halt progression of the disease. However, studies do not distinguish the stage at which antioxidant vitamins and minerals may be important. People with ARMD and their families may like to consider that a healthy diet with a variety of fresh fruit and leafy green vegetables may have benefits in reducing the incidence of ARMD, will not do any harm, and will be a good source of the antioxidant vitamins and minerals, the lack of which has been implicated, but not fully proven, in the aetiology of ARMD.
Case study 4

You have just issued a prescription for an antidepressant to 68 year-old Mrs Chesney, which she is receiving for the first time; on counselling her about her new medication, you notice she is having difficulty reading the small print on the label and accompanying patient information leaflet. “Just wait till you’re old” she says, “failing sight is something you’ll have to accept”. You begin to wonder whether she should have to accept her visual impairment and whether anything can be done to improve things. You check her PMR and note that a few months back the community nurse had prescribed dressings for application to a leg wound.

(a) List the possible reasons for Mrs Chesney’s poor vision?

(b) Do you see any possible link with past and current therapy and her poor vision?

(c) How do you think the adverse effects of poor vision might be picked up in the pharmacy?

(d) What advice would you give to Mrs Chesney’s daughter when she asks whether the new vitamins she read about in a women’s magazine would help her mother’s eyesight?

(e) How do you help people assess the evidence that is available to them?

Please compare your response to the comments made in the case study review.
Summary points

- There are three main groups of cataracts – congenital, senile and secondary.
- Senile cataracts are sub-divided into three groups – nuclear sclerosis, cortical cataract and posterior subcapsular cataracts.
- Secondary cataracts are caused by an ‘insult’ to the eye as a result of systemic disease, an eye-related complication or an intraocular trauma.
- Cataracts are treated by surgical intervention.
- Glaucoma symptoms normally present after the disease has significantly progressed.
- Acute angle-closure glaucoma is three times more common in women and is a medical emergency.
- Open-angle (chronic simple) glaucoma is the most common type of glaucoma accounting for 10% of blindness registration in the UK.
- The primary goal of treatment of Open-angle (chronic simple) glaucoma is to reduce intraocular pressure, with prostaglandin analogues or prostanides considered the first line treatment.
- Treatment of congenital glaucoma always involves surgical intervention.
- Diabetes mellitus has been implicated in many eye disorders including cataract, glaucoma, retinal detachment and the progressive disease diabetic retinopathy.
- Tight blood pressure control, glycaemic control and intensive lipid-lowering treatment have all been demonstrated to help significantly reduce diabetic retinopathy progression in type 2 diabetic patients.
- Age-related macular degeneration is the leading cause of blindness in the Western world.
- It is advisable that patients with ARMD have a healthy dietary intake of vitamins and minerals.
- Intravitreal injections of anti-VEGFs are the preferred treatment of wet ARMD.
Having completed your study of Common diseases of the eye, you should be able to:

- **Describe** the classification and causes of cataracts
- **Differentiate** the types of glaucoma and describe the treatments for glaucoma
- **Explain** the importance of glucose monitoring in the prevention of diabetic retinopathy
- **Describe** the background to Age-Related Macular Degeneration

If you are not able to do all of these, go back and review the section again.
References


58. The Royal College of Ophthalmologists Focus Summer. 2010. Dietary supplements in age-related macular degeneration. Available at http://www.rcophth.ac.uk/


Exercise and case study reviews

Exercise 5 review

(a) Risk groups for developing glaucoma include:

- Older Patients. Older patients are most at risk[24].
- Family History. There is a 10-20% increase in risk in individuals with a family history of open-angle glaucoma[30].
- Myopia. Individuals with a high degree of myopia are at increased risk[29]. Such myopia is characterised by unaided vision of 3/60 or worse.
- Hypertension. Systemic vasoregulatory disorders such as hypertension or hypotension increase risk of open-angle glaucoma[30].
- Smoking. This is a common risk factor in many eye disorders including cataracts and age-related macular degeneration[21]. It has been hypothesised that smoking leads to an increased risk of glaucoma; however, research has been inconclusive[21,32,33].
- Race. Black individuals of African origin have a four-times higher risk than their white counterparts. In addition, the course of the condition can be more aggressive in these patients[24].

(b) Some of the ways in which a pharmacist could contribute include:

- reminding older people to get their free sight tests
- informing patients that they qualify for free sight tests when over the age of 40 years if their mother, father, brother, sister, son or daughter has been diagnosed with glaucoma
- encourage patients with hypertension, particularly if the patient is Afro-Caribbean, to have regular check-ups when dispensing repeat medications
- liaising with the local optometrist to develop referral criteria
- participating in health promotional activities, e.g. National Glaucoma Awareness week; displaying leaflets for International Glaucoma Association; signposting for local help groups, see http://www.glaucoma-association.com

Exercise 6 review

PMRs may be useful to gauge adherence to treatment regimes with most medications, but for eye drops with their 28 day expiry, it is difficult to use them for this purpose. If there is evidence that more drops are being used than you would have expected, this could be due to poorly co-ordinated administration, with drops missing the eye and having to be re-administered. Perhaps the drops are being used too frequently and therefore increasing the risk of side-effects. Alternatively, perhaps fewer drops are being used than you would expect indicating non-adherence or disregard for the expiry date. More discussion on aiding adherence with eye drops is included in section 6.
Case study 4 review

(a) Mrs Chesney’s poor vision could be due to presbyopia, macular degeneration, cataracts, retinopathy or glaucoma.

(b) A variety of adverse factors have been reported in association with visual impairment including reduced functional status, social interaction and quality of life, depression and falls. Perhaps not being able to carry out previously enjoyed tasks such as reading or needlework is contributing to the factors necessitating a prescription for an antidepressant. Her leg injury could have been due to a fall as a result of not seeing obstacles in her path. Two prescribers, the GP and the nurse, have been caring for Mrs Chesney recently. With comprehensive PMRs you may be able to pick up links between prescribing and other aspects of the patient’s condition that they had not realised. A multidimensional assessment of older people should look at all aspects of the person’s medical, social, psychological and functional problems.

(c) Mrs Chesney’s poor vision presented in your pharmacy as difficulty in reading the patient information leaflet. You might also be able to see people peering at the labels of OTC medications or asking for help in locating a product. You could ask her if she has recently had her eyes tested and remind her that eye tests are now available free of charge for men and women of 60 years and over. She shouldn’t just accept failing sight as an inevitable and acceptable consequence of ageing when often there could be potential for improvement.

(d) Recent research (the Age related eye disease study (AREDS)) showed that patients with moderate or advanced macular degeneration can benefit from vitamin supplementation. A further study is currently being conducted (AREDS 2), but results will not be known for a number of years. However, a good diet with plenty of fruit and vegetables will be high in these antioxidant substances and will benefit her mother in many other respects.

Some products may be recommended and include VisionACE, Ocuvite Lutein/Ocuvite Preservision and iCAPS. iCAPS is a dietary supplement containing a range of vitamins and minerals (including lutein and zeaxanthin), which has been promoted for use in Age-related macular degeneration (ARMD). However, current evidence does not support the use of products like iCAPS. Whilst zinc and antioxidants have been shown to statistically reduce the odds of development of ARMD, the effect of substituting other antioxidants such as lutein and zeaxanthin cannot be determined and their clinical value remains uncertain. iCAPS is not licensed as a medicinal product. The results from the AREDS will help to establish what combination of antioxidants and minerals actually does help ARMD, therefore enabling the formulation of a suitable supplement (results available mid-2013). Useful information leaflets on Macular disease are available to download from: http://www.maculardisease.org/page.asp?section=189&sectionTitle=Information+Sheets

(e) Evidence on health-related matters is available to the public from a variety of sources. Some articles in magazines may be advertisements presented as factual articles (advertorials). It is the responsibility of the pharmacist as a health professional to help people sort through the information that is provided to them and point patients to reliable sources of information, e.g. macular disease society website.
Section Five

Drug and disease related eye problems
Section Five

Drug and disease related eye problems

Introduction

This section looks at some of the eye problems that can be related to drugs and disease. Many drugs being taken for diseases including cardiovascular, respiratory and infective conditions may cause ocular irritations and side-effects and awareness of these particular medications is important. Alternatively, a patient may be suffering from a disease that has ocular symptoms; awareness of which may help to identify what is due to an existing disease state and what is actually presenting for the first time.

Many ophthalmic preparations used to treat eye conditions may also cause other problems with the eyes; this may range from transient stinging to topical corticosteroid-induced glaucoma or cataract; when prescribing these the practitioner must weigh up the risks and benefits in these cases, for example a topical steroid may be necessary post-operatively to reduce inflammation.

This section is in three parts:
1. drug-induced eye problems
2. side-effects caused by ocular products
3. eye conditions associated with systemic disease.

An awareness of the associations between drugs, other diseases and eye problems is of particular importance when responding to symptoms in the pharmacy.

Intended learning outcomes

Following completion of this part of the course, you should be able to:

- **Detect** drug-induced eye problems
- **Identify** side-effects caused by products used in the eye
- **Link** common eye conditions with systemic disease

Drug-Induced Eye Problems

This section considers the ocular effects that have been reported for a number of drugs. The majority of drugs, which are absorbed systemically, have the potential to cause side-effects of varying degrees of severity. Many drugs have been reported to show adverse ocular reactions, but the incidence of these side-effects is very low and they usually only occur after the drugs have been taken over a long period of time. The occurrence of ocular side-effects does not necessarily lead to the withdrawal of the drug concerned, since the drug may be essential to the well-being of the patient and the advantages of continuing treatment may outweigh the ocular side-effects. However, if it is suspected that a drug taken by the patient is causing an eye problem, then the patient should be referred to his/her doctor. A major component of pharmaceutical care is ensuring that drug side-effects are minimised and where possible, removed.
A whole range of eye structures may be affected by drugs including the conjunctiva, cornea, sclera, lens, retina, optic nerve and extraocular muscles and glands. The effects, observable as a result of this damage, include functional disturbance of accommodation, raised intraocular pressures, retinal damage and optic nerve damage. Several drugs, which caused severe eye problems, were subsequently withdrawn from the market in the 1970s including practolol, which was used in the treatment of hypertension and angina, and benoxaprofen, a non-steroidal anti-inflammatory drug.

Throughout this section drugs which dilate the pupil are only of concern if patients have a shallow anterior chamber and narrow angle which is occludable. If this has been diagnosed the patient will be listed for an iridotomy and then the problem will be resolved and the contra-indication no longer applies. Although there may be patients out there with potentially occludable angles, the pharmacist cannot diagnose this. If this is a concern, the patient should consult an optometrist who will do a van Herick test to determine whether such a contra-indication exists.

The following drugs are the most frequently cited drugs that have the potential to cause ocular damage; they are listed in alphabetical order rather than order of importance.

**Amiodarone**

Ocular side-effects related to amiodarone were first reported in the 1960s with lens opacities and corneal microdeposits being most frequently reported. Reported visual defects reported by patients have included blurred vision, dry eyes, glare and irritation of the eyelid skin. Optic neuropathy/neuritis is a very rare side-effect which may progress to blindness.

**Antimuscarinics**

These include drugs such as hyoscine found in motion sickness tablets; the older antihistamines, e.g. chlorphenamine; and treatments for overactive bladder, e.g. solifenacin. They cause mild pupillary dilatation with the attendant risk of inducing angle-closure glaucoma in susceptible individuals.

**Antiparkinsonian agents**

Trihexyphenidyl may precipitate glaucoma in susceptible patients and should be used with caution in patients already suffering from glaucoma. It may also cause blurring of vision as a side-effect. Levodopa is contra-indicated in angle-closure glaucoma. It may be used in open-angle glaucoma provided that the intraocular pressure is controlled. The antimuscarinic drugs orphenadrine, procyclidine, and trihexyphenidyl should be used with caution in those susceptible to glaucoma.

**Beta-blockers**

All beta-blockers can cause dry eyes. Both propranolol and atenolol have been reported to sometimes cause visual disturbances. There have been isolated cases of metoprolol causing eye irritation and oxprenolol has been reported to cause visual disturbances and keratoconjunctivitis.
Section Five

Drug and disease related eye problems

Cancer chemotherapeutic agents
During treatment with vincristine, it is important that there is no accidental contact with the eyes as it is highly irritant and can cause corneal ulceration. Fluorouracil has been associated with a condition known as punctal-canalicular stenosis, which can cause a watering eye.

Carbamazepine
There have been occasional reports of this drug causing double vision or blurred vision and rare reports of nystagmus and oculogyric crisis. Indeed many other antiepileptic drugs have been associated with ocular problems including vigabatrin (a twice-yearly eye examination is advised) and topiramate (acute myopia and secondary angle closure glaucoma, typically within the first month of treatment). Patients taking these drugs and complaining of visual blurring or ocular pain should be referred to an ophthalmologist.

Chloramphenicol
Optic neuritis, resulting in blurred vision or temporary loss of vision, has been reported very rarely following long-term oral administration.

Chloroquine
Prolonged therapy with high doses may lead to occasional development of irreversible retinal damage. Therefore, patients receiving the drug continuously at higher dose levels for periods longer than 12 months should undergo ophthalmic examination before re-issuing treatment and at regular intervals thereafter. This also applies to patients receiving therapy at weekly intervals for a period of three years or longer. Defects in visual accommodation may occur on first taking chloroquine and patients should be warned regarding driving or operating machinery. Side-effects reported after taking chloroquine include difficulty in accommodation, blurring of vision, corneal opacities and pigmentary retinopathy.

Corticosteroids
Systemic or topical corticosteroids such as prednisolone may cause side-effects such as increased intraocular pressure, cataracts, corneal or scleral thinning and exacerbation of ophthalmic viral or fungal disease. Glaucoma may occur in up to 30% of patients on long-term corticosteroid therapy. The risk of steroid cataract is very high (75%) if more than 15 mg of prednisolone or equivalent is given daily for several years. The longer the duration, the greater the risk. Recent research concluded that, among older people, even low doses of inhaled corticosteroids are associated with a small but significant excess risk of cataracts requiring extraction. Such an excess risk was not observed with nasal corticosteroids. This risk appears to be dependent on the dose and the length of treatment and may be genetically determined.

Digoxin
Ocular side-effects caused by digoxin are mainly associated with overdosage but may occur from a temporarily high serum concentration due to digoxin’s narrow therapeutic index. The main problem is visual disturbances including photophobia, colour vision abnormalities and blurred vision. Such symptoms should prompt determination of digoxin blood levels.
Ethambutol
The main side-effects of this drug are ocular and related to optic neuritis. It can cause loss of visual acuity, colour blindness (impairment of red-green colour perception), loss of central vision and restriction of visual fields. The condition is usually bilateral. These effects are more common where excessive dosage is used or the patient’s renal function is impaired, in which case it should be avoided. Patients should be advised to discontinue therapy immediately if they develop deterioration in vision and seek medical advice since early discontinuation of the drug is almost always followed by recovery of eyesight. An ophthalmic examination should be performed before, and at intervals during, treatment. The drug is contra-indicated in patients with optic neuritis and poor vision.

Hydroxychloroquine
Retinopathy with changes in pigmentation and visual field defects can occur but appear to be uncommon if the recommended dose is not exceeded. In its early form, it appears to be reversible on discontinuation of the drug. If allowed to develop, there may be a risk of progression even after treatment withdrawal. Corneal changes including oedema and opacities have been reported. They are either symptomless or may cause disturbances such as haloes, blurring of vision or photophobia. They may be transient and are reversible on stopping treatment. Blurring of vision due to a disturbance of accommodation, which is dose-dependent and reversible, may also occur. A review group convened by the Royal College of Ophthalmologists has updated guidelines for screening to prevent ocular toxicity on long-term treatment with chloroquine, hydroxychloroquine, and mepacrine. The following recommendations relate to hydroxychloroquine, which is only rarely associated with toxicity.

Before treatment:
- Ask patient about visual impairment (not corrected by glasses). If impairment or eye disease present, assessment by an optometrist is advised and any abnormality should be referred to an ophthalmologist
- Record near visual acuity of each eye (with glasses where appropriate) using a standard reading chart
- Initiate hydroxychloroquine treatment if no abnormality detected (at a dose not exceeding hydroxychloroquine sulphate 6.5 mg/kg daily)

During treatment:
- Ask patient about visual symptoms and monitor visual acuity annually using the standard reading chart
- Refer to ophthalmologist if visual acuity changes or if vision blurred and warn patient to stop treatment and seek prescribing doctor’s advice
- A child treated for juvenile idiopathic arthritis should receive slit-lamp examination routinely to check for uveitis
- If long-term treatment is required (more than 5 years), individual arrangement should be agreed with the local ophthalmologist
Isotretinoin
Dryness of the conjunctiva has been reported, following oral administration, and may lead to mild to moderate conjunctivitis, which may be alleviated by the use of ocular lubricants. It is recommended that patients, particularly those with dry eye syndrome, should be monitored for the development of keratitis.

Phenothiazine Tranquillisers
Antimuscarinic side-effects such as blurred vision can occur. With prolonged high dosage, drugs such as chlorpromazine may cause retinotoxicity, corneal and lens opacities, and development of a metallic greyish-mauve pigmentation of the cornea, conjunctiva and retina. Thioridazine can cause reduced visual acuity and poor dark adaptation. Phenothiazines should be used with caution in patients with narrow angle glaucoma since they may lead to raised intraocular pressure.

Phenytoin sodium
This may cause upbeat nystagmus, particularly at higher doses and in fact, this is one of the initial symptoms of overdosage.

Quinine
Visual disturbances including temporary blindness may occur. This is usually related to high plasma levels of the drug, often following high dosage and especially overdosage. Recovery of central vision may occur but gross restriction of visual fields is inevitable.

Quinolone antibiotics
Blurred vision, disturbed vision (e.g. change in colour perception and over-brightness of lights), decreased visual acuity, double vision, toxic optic neuropathy and eye pain have all been reported in patients taking ciprofloxacin. In patients taking nalidixic acid, reversible subjective visual disturbances without clinical findings sometimes occur with each dose during the first few days of treatment. These reactions include over-brightness of lights, change in ocular perception, difficulty in focusing, decrease in visual acuity and double vision. They usually disappear promptly when dosage is reduced or therapy is discontinued. Ofloxacin has been reported to cause transient visual disturbances and changes in visual acuity or colour perception in 1-3% of patients taking the drug. Photophobia has also been reported, although in less than 1% of the population.

Rifampicin
There have been reports of this causing loss of visual acuity and colour blindness. It will produce a reddish discoloration of the tears, which can cause permanent staining of soft contact lenses, as this is a route by which the drug is excreted.

Tamoxifen
Although ocular complications are uncommon, retinotoxicity may develop in some patients on high doses. There may also be a reduction in visual acuity due to accumulation of superficial yellow crystalline deposits at the macula and associated cystoid macular oedema. Following discontinuation of tamoxifen, vision usually improves but the retinal changes remain.

Tamsulosin (and other alpha blockers)
Alpha blockers such as terazosin, doxazosin, alfuzosin and in particular tamsulosin can cause floppy iris syndrome which can lead to complications during cataract surgery.
Tricyclic antidepressants
These may cause blurred vision, disturbance of accommodation, mydriasis and increased intraocular pressure due to their antimuscarinic properties. They should be used with caution in patients with a history of angle-closure glaucoma or increased intraocular pressure. Even average doses may precipitate an attack of glaucoma.

All patient information leaflets are available at the website www.emc.medicines.org.uk. Look at this site, in particular the PILs for the drugs mentioned in this section.

Exercise 7
The ocular side-effects of vigabatrin (Sabril®) require patient screening. Visit the Royal College of Ophthalmologists’ website and view information and guidance on vigabatrin (http://www.rcophth.ac.uk/docs/publications/published-guidelines/Vigabatrin_Guidelines_March_2008.pdf) and answer the following:

(a) What are the ocular side-effects of vigabatrin?

(b) Who is most at risk of the side-effects of vigabatrin?

(c) How would these side-effects affect the patient?

(d) In reference to eyes, what information should be given to a patient receiving vigabatrin?

Please compare your response to the comments made in the exercise review.
Side-effects caused by ocular products

When medicated eye drops are administered, the drugs contained in them usually penetrate the globe, predominantly through the cornea. Either local or systemic side-effects may occur following the administration of eye drops or ointments. Typical local side-effects experienced include transient stinging, burning, itching or irritation. Allergic reactions can be caused by many ophthalmic preparations and the preservatives used in them, e.g. benzalkonium chloride. Typically, the patient presents with irritation and redness of the eye being treated and this can progress to swelling around the eye and sometimes a skin rash under the eye due to the allergen running down in the tears. In most cases it is advisable simply to discontinue the drops or ointment and wait for the allergic reaction to settle. However, this can take several weeks and in severe cases topical preservative-free steroid preparations may be needed to accelerate recovery. Therefore, patients in this situation should be referred back to the prescriber.

The following is a list of ophthalmic drugs that have been reported to cause either local or systemic side-effects.

**Antibacterials**

Ocular use of chloramphenicol has been rarely associated with bone marrow hypoplasia, including aplastic anaemia. Although there have been some calls for a restriction on the use of this product, the British National Formulary recommends chloramphenicol as the drug of choice in the treatment of superficial eye infections and apparently has no plans to change this recommendation. It is not possible to identify who might be at risk, other than those with a history of aplastic anaemia. The risk of aplastic anaemia from chloramphenicol eye drops is probably 1 in 100,000 patient prescription events, with some investigators concluding that data provides no support to the claim that chloramphenicol eye drops increase the risk of aplastic anaemia.

The commonest adverse reaction to the use of topical antibacterial eye preparations is the development of an allergic reaction. Allergies are most likely to be encountered with the aminoglycoside, neomycin. It causes characteristic lesions of the corneal epithelium in the form of tiny snowflakes in those affected. These lesions may persist for weeks after application of neomycin to the eye is discontinued and they are usually associated with a sensation of irritation. Patients reactive to neomycin may show cross-reactivity with other aminoglycosides. Neomycin is found in combination preparations with corticosteroids and is sometimes used in the treatment of inflammatory eye conditions where it may in reality perpetuate the inflammation. Local irritation, including photophobia, has been reported with many antibacterial eye drops as have numbness, nausea and headache.
Anti-inflammatory eye preparations

Otrivine-Antistin®️️ eye drops, used in the treatment of allergic conjunctivitis, contain antazoline sulphate and xylometazoline hydrochloride, a sympathomimetic. Caution should be exercised if used in patients receiving medication for hypertension, cardiac irregularities, hyperthyroidism or diabetes mellitus. Side-effects, which have been reported rarely, include blurred vision, transient stinging, headache and drowsiness. Rebound congestion may also occur after continued use. Lodoxamide has been reported to cause mild transient burning, stinging, itching and lacrimation. Sodium cromoglicate, also used in allergic conjunctivitis, has been reported to cause transient stinging and burning after application. Due to the passage of eye drops through the nasal passage to the mouth/throat, patients often report a distinctive taste with many eye drops including those containing: the antihistamines, sodium cromoglicate, azelastine and nedocromil.

Beta-blockers

Since there may be some systemic absorption of topical beta-blockers, the side-effects experienced from systemic beta-blocker therapy may potentially occur. Similarly, eye drops containing beta-blockers are contra-indicated in patients with bradycardia, heart block and heart failure. The Committee on Safety of Medicines (CSM) warning to avoid beta-blockers in patients with asthma applies equally to ophthalmic preparations.

Corticosteroids

If corticosteroid drops are used for a prolonged period of time, they can lead to a rise in intraocular pressure. As a result, if they are used in patients predisposed to chronic simple glaucoma, a ‘steroid glaucoma’ may be produced after a few weeks treatment with a corticosteroid eye preparation. Typically, this type of glaucoma is poorly responsive to standard antiglaucoma treatment, although in most cases intraocular pressure subsides on discontinuation of the corticosteroid. If the problem is not detected in time, there may be a loss of vision. Cataracts may also occur following prolonged use of corticosteroid drops or ointments, usually after many months or years of daily application for chronic conditions. In some cases, these cataracts have arrested upon stopping treatment and some have regressed. However, some progress to interfere with vision and require surgery. If corticosteroid drops or ointments are used inappropriately, for example where herpes simplex virus is present, they may worsen the condition, potentially leading to irreversible corneal ulceration and scarring that may cause loss of vision or even loss of the eye. All long-term use of topical corticosteroid eye drops should be questioned and such patients should be under the care of an ophthalmologist.

Lubricating agents

These are generally used for the treatment of tear deficiency. The most common side-effects resulting from usage are local and include blurred vision. If too much product is used or the product is used too frequently, a mild transient burning sensation after application and sticky eyelids is often noted. Ingredients of the products, such as preservatives, may also cause an allergic reaction. Patients should be advised not to drive or operate machinery if their vision is affected and to consult their doctors if symptoms persist.
**Miotics**
These can be used in the treatment of glaucoma (not first line) and the mechanism of action of the drugs leads to the side-effect of a small pupil. This often leads to reduced visual acuity especially in poor illumination. There may be ciliary spasm and accommodation spasm, potentially resulting in blurring of vision and brow ache; this is more troublesome in younger patients in whom the ciliary muscle is more active, but does reduce with chronic use. Increased pupillary block, retinal detachment and vitreous haemorrhages also occur. Systemic reactions rarely occur at normal doses, but caution is still advised in patients with acute heart failure, bronchial asthma, peptic ulceration, hypertension, urinary tract obstruction and Parkinson’s disease.

**Mydriatics and Cycloplegics**
Mydriatics are used to dilate the pupil and cycloplegics are used to paralyse the ciliary muscle. The antimuscarinic drugs, e.g. atropine, cyclopentolate, are both mydriatic and cycloplegic while the sympathomimetics, e.g. phenylephrine, are mydriatic but not cycloplegic. Contact dermatitis is quite common with mydriatics such as atropine. Atropine and cyclopentolate may cause toxic systemic reactions in the very young and very old. Mydriasis may precipitate acute angle closure glaucoma in a very few patients, usually aged over 60 years and long-sighted.

**Eye conditions associated with systemic disease**
Some systemic diseases can lead to the development of a range of eye problems. It is useful to bear these in mind in patients presenting with recurrent eye conditions. Many of these have been mentioned in the preceding sections. This list summarises some of the main associations.

**Atopic eczema**
Chronic blepharitis caused by staphylococci and chronic conjunctivitis are common with this condition. Keratitis may also occur as can corneal scarring.

**Diabetes mellitus**
This may eventually lead to diabetic retinopathy (overall prevalence is about 25%), cataracts, ocular motor nerve palsies, abnormal pupillary reactions or changes in refraction.

**Hypertension**
The main ocular complications of hypertension are hypertensive retinopathy, retinal vein occlusion, retinal artery problems and ocular motor nerve palsy.
Hyperthyroidism
If the cause of hyperthyroidism is Graves’ disease, eye symptoms include puffiness around the eyes, increased tear formation, irritation, and unusual sensitivity to light. Two distinctive additional symptoms may occur: bulging eyes (exophthalmos) and double vision (diplopia). The eyelids may not close completely, exposing the eyes to injury from foreign particles and dryness.

Inflammatory bowel diseases
About 6% of patients with Crohn’s disease have a variety of inflammatory eye conditions, the most common of these include conjunctivitis and uveitis. More uncommon problems include scleritis, keratitis and optic neuritis. The most common complication of ulcerative colitis is uveitis.

Migraine
A classic migraine attack is often preceded by a visual aura lasting between 15 and 45 minutes; this often consists of optical features such as bright or dark spots, tunnel vision and heat haze distortions.

Multiple sclerosis
Approximately 70% of established cases of MS show evidence of optic neuritis. The main symptoms of this include impairment of visual acuity, impairment of colour vision and reduction of light brightness appreciation.

Rheumatological disorders
Rheumatoid arthritis may lead to the development of eye conditions such as keratitis and scleritis. Ankylosing spondylitis may cause recurrent acute iritis. Psoriatic arthritis may cause conjunctivitis and uveitis.

Rosacea
Ocular rosacea often accompanies facial acne rosacea and manifests as some combination of blepharitis, conjunctivitis, iritis, scleritis, and keratitis, causing itching, foreign body sensation, erythema, and oedema of the eye.

Sexually transmitted diseases
Acquired Immune Deficiency Syndrome (AIDS)
Ocular complications eventually affect about 75% of patients with AIDS. The most common complications are Kaposi’s sarcoma of the conjunctiva and eyelids, Herpes zoster, Herpes simplex, Candida, cytomegalovirus (CMV) retinitis and ocular toxoplasmosis.

Syphilis
Ocular involvement with syphilis usually only occurs during the secondary or tertiary stages. The most common symptoms include scleritis, keratitis, uveitis and neuroretinitis, where the retina and optic nerve become damaged.

Gonorrhoea
This is sometimes associated with conjunctivitis.
Stevens-Johnson syndrome
The main ocular feature is conjunctivitis. Complications of the condition may lead to symptoms such as scarring of the eyelids and cornea. Stevens-Johnson syndrome may be precipitated by the systematic administration of sulphonamides and related drugs such as acetazolamide.

Systemic lupus erythematosus
This may lead to the development of retinopathy and optic (autoimmune) neuropathy.

OTC drugs contra-indicated in eye disease
When purchasing an over-the-counter medicine, customers may not mention eye disorders when they are asked if they are taking any other medicines. The pharmacist should be aware of regular customers who have glaucoma and should also be aware of the potential problems for patients with glaucoma when counter-prescribing certain products.

Antimuscarinic travel sickness preparations
The most commonly used anticholinergic (antimuscarinic) for travel sickness is hyoscine hydrobromide. Although anticholinergic drugs can precipitate angle-closure glaucoma by pupillary block, they are not contra-indicated in open-angle glaucoma or in angle-closure glaucoma that occurred as a single acute event and/or has already been treated by laser iridotomy. Preparations containing cyclizine or meclozine should be used with the same caution because of their potential for antimuscarinic side-effects.

Antihistamines
Some patients with narrow-angle glaucoma should avoid the older antihistamines, such as diphenhydramine and promethazine. This is because of their antimuscarinic activity which induces angle-closure glaucoma, again by inducing pupillary mydriasis, in patients who are predisposed, i.e. those with a shallow anterior chamber and narrow angle. This is also more likely in those patients aged over 50 years and in certain races, e.g. Inuits, but is unlikely in younger Caucasian patients. Chlorphenamine has less antimuscarinic effect but should still be avoided by this group of patients. The newer antihistamines such as cetirizine are basically free from antimuscarinic effects and could used if necessary.

Hyoscine butylbromide
Even though this drug is poorly absorbed, it should be avoided in patients with angle-closure glaucoma since it causes mydriasis, which can precipitate Acute Closed Angle Glaucoma.

Vasoconstrictor-containing eye-drops
Patients with angle-closure glaucoma should not use eye-drops that contain vasoconstrictors such as naphazoline and xylometazoline as these drugs can dilate the pupil when applied topically and as a result, precipitate angle closure. However, the clinical relevance of this contra-indication has been questioned.
Summary points

- Many drugs have been reported to cause ocular side-effects, but the incidence is low and usually occurs after extended periods of treatment.
- Cardiovascular drugs that may cause ocular problems include beta-blockers, digoxin and amiodarone.
- Drugs with anticholinergic side-effects should be avoided in patients with a history of angle-closure glaucoma. These drugs may be available over-the-counter, e.g. hyoscine, or on prescription, e.g. solifenacin.
- Chloramphenicol eye drops and ointment are now available OTC.
- Both topical and systemic beta-blockers are contra-indicated in patients with bradycardia, heart failure, asthma and heart block.
- Long-term use of oral, nasal, dermatological, inhaled or topical ocular steroids has been linked to development of glaucoma and cataracts.
- Many systemic diseases including diabetes, hyperthyroidism, Multiple Sclerosis, Rheumatoid Arthritis and AIDS can lead to the development of eye problems.

Having completed your study of drug and disease related eye problems, you should be able to:

- Detect drug-induced eye problems
- Identify side-effects caused by products used in the eye
- Link common eye conditions with systemic disease

If you are not able to do all of these, go back and review this section again.
Section Five

Drug and disease related eye problems

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Exercise and case study reviews

Exercise 7 review

(a) Symptomatic visual field constriction, referred to as Visual Field Constriction attributable to Vigabatrin (VAVFC):
- bilateral, concentric, predominantly nasal constriction of the visual field
- Retinal Nerve Fibre Layer (RNFL) atrophy
- Optic nerve head pallor

(b) Males on vigabatrin have an increased risk of developing VAVFC of approximately 2-fold compared with females. This appears to be independent of any differences in dose duration or cumulative dose of vigabatrin.

(c) Symptomatic patients complain of blurred vision, oscillopsia (a visual disturbance in which objects in the visual field appear to oscillate), tunnel vision and difficulty in navigation. Patients do not always associate these problems with visual reduction and may attribute them to clumsiness or drowsiness. In a minority of patients VAVFC has been so severe that it limits their ability to perform a variety of activities of daily living. Patients may also not have a satisfactory driving visual field.

(d) You should inform the patient of the potential for the side-effects affecting the eye and to be aware of how this would affect their daily lives, e.g. be aware of unexplained clumsiness or difficulty when driving.

Vigabatrin should be initiated only under the care of an epilepsy specialist who should ensure that the patient has a baseline visual field obtained before starting treatment. You should explain that this will be done at least every six months for the first five years of treatment. If no defect is apparent, this eye test can be extended to annual review.

Advise the patient to tell their optometrist they are taking this particular drug and make sure they attend all planned eye appointments especially in light of the fact that patients with perimetric loss due to vigabatrin exhibit normal visual acuity and are usually asymptomatic of the field loss unless the defect encroaches within the central field. Hence, regular eye examinations will allow for detection and discontinuation of the drug before the patient experiences symptoms.

If the patient is under 9 years of age, it is more difficult to do reliable visual field testing and the risks/benefits will be weighed up before treatment is commenced. Parents should still be reminded that children should attend the recommended regular eye examination.
Introduction
The pharmacist is ideally placed to advise patients on correct use of their ophthalmological products. These preparations may have been prescribed for ocular conditions, e.g. glaucoma, or they might be requested over-the-counter by patients. It is essential that the patient understands how to use these products in order to optimise adherence in patients where failure of treatment could have devastating consequences for their health.

In the case of contact lens wearers, many purchase their solutions from pharmacies and it is important they understand the need for a good contact lens care routine in order to prevent irritations or even infection of the eye.

Patients may present with ocular symptoms caused by the treatments they are using topically or taking systemically. It is essential that the pharmacist can identify these problems or side-effects and take appropriate action, such as providing advice, counter-prescribing or referral to a GP or optometrist.

In this section we look at the role that pharmacists have in keeping eyes healthy. The section is in four parts: Patient adherence and pharmaceutical care | Recommended frequency of eye testing | Contact lens care | Interprofessional issues

Intended learning outcomes
Following completion of this part of the course, you should be able to:

- **Support** patients in the correct use of their eye drops
- **Advise** on current contact lens care
- **Advise** patients on frequency of eye testing
- **Outline** the role of different health professionals in eye care
Patient adherence and pharmaceutical care

Non-adherence is a potential problem with all medication regimens and it is recognised as being an important area in the use of ophthalmic products. The reasons for non-adherence with any medical regimen are complex and varied and include both intentional and unintentional factors. Non-adherence can take many forms, including overdosing, underdosing, incorrect usage/technique and inappropriate discontinuation of medication. These all apply to ophthalmic products as to other treatments. Non-adherence is a particular problem with asymptomatic conditions and in glaucoma it has been estimated that failure to use medication properly is responsible for 10% of visual loss. One method of improving patient adherence, which is particularly useful in asymptomatic conditions, is educating the patient properly on the reasons for using their medication and the correct method and timing of administration. This has been shown to be successful in improving adherence rates for patients with glaucoma.

Ophthalmic medicines differ from most other medications in that a certain level of psychomotor skill is necessary to successfully administer eye drops or ointments. If this is lacking, unintentional non-adherence may result. This may be a problem with administration of eye drops at all ages, but it is particularly true in older patients. Most long-term eye drop users are older people and the sensory and physical changes that accompany old age will contribute to the patient’s difficulties in manipulating a dropper bottle to instil the eye drops.

How to administer eye drops

Various studies have shown that high percentages of older patients experience difficulty with administration of eye drops. Although many of these patients do have some assistance at home, e.g. home helps, carers, health visitors, it is unlikely that these people will be able to pay as many visits as are required to assist with the administration of a full day’s dosage. This means that patients must find other ways of instilling their drops or go without. Problems commonly encountered with eye drop administration include difficulty aiming the bottle, shaky hands and reflex blinking. There is a risk of either squeezing out too many drops or the drop missing the eye and running down the cheek.

The patient should tilt their head back slightly. The lower lid should be pulled down gently and a drop instilled into the temporal corner (the corner of the eye farthest from the nose) of the lower conjunctival sac. The patient should look towards their nose so that they cannot see the drop descending. If the drop runs down the face another drop should be instilled.

Patients sometimes get a taste of eye drops in the mouth or a feeling that drops are running down the throat. Pressing a finger against the inner corner of the eye (by the nose) for about a minute after using the drops may help to stop the drops draining into the nose and throat. If the patient has no-one to help and is likely to have difficulty with administration, aids for instilling drops such as Opticare® (see Figure 24) are available. It is good practice for the person instilling eye drops to wash and dry their hands before and after administration.
Eye drop dispensers
The Opticare® Universal is a hand-held reusable plastic dispenser. The eye drop bottle fits into the dispenser and it is suitable for most plastic eye drop bottles. It fits over the eye and has a finger space for pulling down the lower lid. It allows more accurate positioning of the bottle over the eye and squeezing the dispenser only requires 25% of the force required to squeeze the bottle. The Arthro models have been specifically designed to help people who suffer from severe arthritis or limited hand or shoulder movement. The extended arms lead to a rotating eye piece, which allows the user to instill their eye drops in the most manageable and comfortable position for them. Disadvantages of the products are that they can be difficult to load and are quite expensive. ComplEye® has recently been launched to fit all Hylo eye drop bottles. It is especially suitable for people with weak hands or who suffer from arthritis. Devices can be purchased from pharmacies and are also available on prescription in the UK\textsuperscript{7,8}.

Pharmacists also have a role to play in providing advice on both acute and chronic ophthalmic products available on prescription. General advice, which may be provided with ophthalmic prescriptions, includes:
- the reason for using the product
- instructions on how to maintain the cleanliness of the eye drops or ointment during use
- the importance of following the dosage instructions
- the importance of using the product for as long as the GP/ophthalmologist/ optometrist has stated and a demonstration of the correct administration technique for the particular product dispensed
- advice on the order of use of each product if more than one
- the expiry date and/or in-use shelf life (expiry date after opening) of the product
- advice on reducing systemic absorption of eye drops
- advice on storage.
Exercise 8

For each of the headings below what advice would you give?

The reason for using the product

Instructions on how to maintain the cleanliness of the drops during use

The importance of following the dosage instructions

The importance of using the product for as long as the GP/ophthalmologist/optometrist has stated

Details, and preferably a demonstration, of the correct administration technique for the particular product dispensed

Advice on the order of use of products if more than one

The expiry date of the product

Advice on reducing systemic absorption of eye drops

Advice on storage

Please compare your response to the comments made in the exercise review
Frequency of eye examinations

In recognition of the fact that every patient has different clinical needs, the College of Optometrists, in consultation with other optometric bodies, has drawn up the guidance that follows in respect of appropriate intervals between eye examinations. The guidance indicates a series of minimum re-examination intervals that are considered good practice for defined categories of patients. It also provides a list of specific circumstances where departures from those intervals may be considered clinically necessary.

The guidance is broken into two categories: regular recall intervals and patient-initiated re-examination. Contact lens wearers may need more frequent appointments (for aftercare) than at intervals stated in the guidance below.

Recommended Minimum Re-examination Intervals

Unless deemed clinically necessary, patients should not be recalled more frequently than the following intervals outlined in the table below.

Table 8: Minimum eye re-examination intervals

<table>
<thead>
<tr>
<th>[A] Age at time of examination of patients who do not fall into categories of [B] (see below)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 16 years, in the absence of any binocular vision anomaly or manifest refractive error.</td>
<td>1 year</td>
</tr>
<tr>
<td>Under 7 years with binocular vision anomaly or corrected refractive error</td>
<td>6 months</td>
</tr>
<tr>
<td>7 years and over, and under 16 with binocular vision anomaly or rapidly progressing myopia</td>
<td>6 months</td>
</tr>
<tr>
<td>16 years and over</td>
<td>2 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>[B] Patients with relevant medical and ocular conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients over 40 with a family history of glaucoma or with ocular hypertension who are not part of a monitoring scheme</td>
<td>1 year</td>
</tr>
<tr>
<td>Patients with diabetes who are not part of a diabetic retinopathy monitoring scheme</td>
<td>1 year</td>
</tr>
</tbody>
</table>
Clinical reasons for earlier recall
Clinical circumstances may justify recalling a patient earlier than at the intervals set out in the table. Examples include patients:

- at any age with refractory error that is changing rapidly or who are at risk of such changes, for example, patients with newly diagnosed diabetes
- managed by the optometrist under the General Optical Council (GOC) referral rules, for example, suspect visual field on one visit, which is not confirmed on repeat, or abnormal IOP with no other significant signs of glaucoma
- identified in protocols as needing to be seen more frequently than above because of risk factors
- with pathology likely to worsen, for example ARMD, cataract, corneal dystrophy, or congenital anomalies.
- who are older may need to be examined more often. Practitioners should ensure the reason is clearly recorded.

Patient initiated re-examination
There will be patients who may present at intervals earlier than those recommended, for example, patients:

- referred by a GMP
- presenting with symptoms or concerns that can only be resolved by an eye examination
- who may be considered as being in a high risk group because of high myopia or aphakia (for instance those requiring complex lenses or with corrected vision of less than 6/60 in one eye).

Research into older patients who have suffered falls has highlighted the importance of eye examinations\(^2\). It is recognised that there will be cases when patients present with symptoms, for example headaches, where after examination no ocular cause can be found. The situation where a patient has broken spectacles does not by itself constitute a clinical reason for re-examination.

Contact lens care
According to the Association of Contact Lens Manufacturers (ACLM), approximately 3.7 million in the UK wear contact lenses\(^1\). Contact lenses have been available for over 100 years, although the modern range of lenses has only been available since the 1970s. Hard lenses were one of the first types of lenses available but their use now is almost obsolete, therefore there are two main types of contact lenses in current use:

- rigid gas-permeable lenses
- soft contact lenses
Section Six
Keeping eyes healthy

Rigid gas-permeable lenses (RGP)
RGP contact lenses have been available for longer than soft contact lenses, although many improvements have been made over this time to allow more oxygen to pass through the material. These lenses are smaller than soft lenses and usually rest within the corneal area. RGP lenses represented only five per cent of contact lens market in 2011. This is probably because they take a little longer to get used to than soft lenses, although regular wearers find them comfortable. RGP lenses come in an extensive range of materials, fittings, power and designs. Despite a decline in the use of rigid lenses, some contact lens practitioners believe RGP lenses provide a healthier option for long-term, full-time wear than soft contact lenses. They are thought to be better at correcting irregularly shaped eyes than soft lenses and are also more durable so are usually replaced every six or 12 months, making them a very cost-effective option.

Soft contact lenses
These lenses, as their name suggests, have a soft structure – a bit like a piece of thick clingfilm, making them very comfortable to wear. Soft lenses are larger in diameter (about 14mm) than RGP lenses and completely cover the cornea so the lens can be seen on the sclera of the eye. This is the most common type of contact lenses fitted today. Soft lenses are often described by their replacement frequency or wearing schedule. Replacement may be daily, two-weekly, monthly, or in some cases three-monthly, six-monthly or less often. The lenses may be used on a daily-wear basis or sometimes for up to 30 days of extended (or ‘continuous’) wear. The most commonly fitted soft lenses in the UK are daily wear, monthly replacement lenses, followed by daily disposable single-use lenses, worn for a day then thrown away.

Soft contact lenses come in a wide variety of materials, fittings, powers and designs to correct almost all types of vision. Soft lenses incorporate water, much like a sponge, and must be kept in contact lens solution to prevent them from drying out. Advances in materials have led to a new generation of soft contact lenses called silicone hydrogels which allow much more oxygen to pass through to the cornea, making them healthier for the eye. Originally intended for extended wear, these materials are now used for all types of soft lenses.

In 2011 the approximate proportion of soft contact lenses used was as follows: daily disposable lenses 5%, soft frequent replacement lenses 8%, silicone hydrogels 28% and soft traditional lenses 2%.
Problems associated with contact lenses

Whilst there are both cosmetic and therapeutic benefits associated with wearing contact lenses, there are also risks associated. Complications associated with wearing contact lenses include:

Inappropriate fit, prescription or extended wear
All of these may cause discomfort and infection. Patients should be advised to visit their optometrist regularly for a lens check-up.\(^{12}\)

‘Aged’ contact lenses
As lenses age, they may cause increasing discomfort to the wearer because of lens damage and accumulation of protein deposits and ‘Aged’ contact lenses are more likely to harbour pathogenic organisms. Wearers should be advised to consult their optometrist every 12 months or more frequently for a contact lens check.

Inherent patient problems with tear film, lids or lashes
These may be caused or worsened by the lenses and may necessitate discontinuing wear of the lenses, at least on a temporary basis. Patients should be advised to see their optometrist every 12 months.

Immunological factors
These include allergic reactions to lens material or cleaning solutions and can often be resolved by changing the solutions used. The College of Optometrists advises that the public do not switch their solution unless advised by their optometrist.\(^{11}\) Infection often results from patient non-compliance with cleaning regimens. This represents one of the biggest potential problems with contact lenses and usually arises if lenses are not maintained properly. It can lead to infections of the eye and ultimately microbial keratitis. There are various potential sources of the contamination including contact with contaminated fingers, inadequately cleaned lens cases and expired contact lens solutions.

The problem is a self-perpetuating one. If bacteria adhere to contact lenses, they can form a biofilm, which in turn makes them more resistant to chemical disinfection. Due to the nature of the lens material, the risks are increased if extended wear soft contact lenses are worn overnight.\(^{11,14}\)
Microbial keratitis
Microbial keratitis is inflammation of the cornea and is the worst complication associated with contact lens wear. As well as improper contact lens care, overnight wearing of contact lenses is a major risk. This can be caused by a range of organisms, of which two are of particular importance.

Pseudomonas aeruginosa
This can cause ulcerative bacterial keratitis and it is one of the most severe complications of contact lens wear. Approximately two-thirds of all cases of the condition are contact lens associated. Both gas-permeable and soft contact lenses are associated with this, although soft lenses are the more problematic of the two. If the bacteria become established on the cornea, the condition may become sight-threatening. Patients diagnosed with this are admitted to hospital for hourly administration of antibiotic eye drops. Chloramphenicol is ineffective against this infection and aminoglycoside or certain quinolone eye drops are usually prescribed. Pseudomonas aeruginosa can sometimes be isolated from saliva and it is important to discourage the use of saliva as an alternative to wetting solutions.

Acanthamoeba
One of the main causes of microbial keratitis is Acanthamoeba. It is more difficult to eliminate than Pseudomonas aeruginosa and consequently, the efficacy of contact lens solutions tends to be measured in terms of activity against Acanthamoeba. It is a free-living protozoan found in soil, air, some water sources including occasionally tap water, and swimming pools. Infection may produce intense pain, tearing and corneal staining. Treatment of the infection again requires admission to hospital where hourly drops of Polyhexamethylene biguanide (PHMB) 0.02% eye drops are instilled. Chlorhexidine 0.02% eye drops and propamidine can also be used with the PHMB. Treatment is generally unsatisfactory and severe vision loss may occur. Consequently, prevention of infection is very important. Contact lens wearers should not wear their lenses in the shower or swimming pool. Swimming whilst wearing swimming goggles over the contact lenses may be acceptable, but ideally the patient should invest in prescription swimming goggles so as to eliminate the risk of acanthamoeba infection.
Care of soft contact lenses

Wearers of soft traditional contact lenses need to look after both their lenses and storage case. In general, the care systems involve cleaning, rinsing, disinfecting and protein removal. Wearers have the option of either using a range of solutions to perform these tasks or a single multi-purpose solution. The multi-purpose solutions are useful in patients where compliance with cleaning may be lax.

Daily cleaning

Lenses must be cleaned thoroughly after each wear. This involves the use of a daily surfactant, which removes components such as mucins, lipids, eye cosmetics and dirt from the lens.

Disinfection

After daily cleaning, the lenses must be disinfected so that potentially pathogenic microbes are removed from the lenses. This process usually occurs in the storage case, which should also be cleaned and disinfected. The traditional methods of disinfection are either heat or cold chemical disinfection, with the latter now being more widely used. Although less popular, heat disinfection is successful for lenses that can withstand temperatures of 70°C. Provided that this temperature is maintained for at least one minute, it seems to be effective in killing Acanthamoeba. For cold chemical disinfection, a number of different compounds are available commercially. They tend to contain one or more of the following:

Chlorhexidine

This is a biguanide disinfectant used for soft and rigid lenses. It appears to have a variable effect on Acanthamoeba with recent research demonstrating its inability to effectively disinfect against acanthamoeba.

Polyhexamethylene biguanide (Polyhexanide/PHMB)

This has shown to be effective against Acanthamoeba at a concentration of 0.02%.

Hydrogen Peroxide

This is one of the more commonly used cold chemical disinfectants and hydrogen peroxide is generally included at a concentration of 3%. It has been found to be slightly more effective in killing Acanthamoeba than other commercially available contact lens disinfection solutions. However, one disadvantage of hydrogen peroxide is that it irritates the eye, so that the residual chemical requires neutralisation subsequent to disinfection. This means that the system is quite complex and prone to patients forgetting the neutralisation step. Oxysept 1 step® offers a one step peroxide disinfection and neutralising for all soft contact lenses. This is achieved by utilising a delayed release neutralising tablet. After 6hrs in the special lens case, lenses are ready to use. Current thinking is that the hydrogen peroxide system is the most efficacious of all currently available lens disinfecting solutions because of its reliable and consistent effects against Acanthamoeba.

Chlorine-based systems

This has been shown to be less than reliable against Acanthamoeba with use of this system by patients decreasing.
Protein Removal
An enzymatic cleaner is used, usually once a week, to remove tear proteins. These are more tightly bound to the lens surface than other deposits and are not removed during the daily cleaning process. Amiclair® tablets have a triple enzyme action plus a calcium deposit preventer to ensure contact lenses (all types) are clean and comfortable.

Saline Solutions
These can either be preserved or unpreserved, buffered or unbuffered. They are sometimes used for rinsing lenses or as a medium for the protein-removing tablet.

Lubricants/comfort drops
These make the lenses more comfortable for the wearer.

Multi-purpose solutions
The more traditional contact lens cleaning solutions tend to have a poor level of compliance associated with them. This has been attributed to factors such as the complexity of the regimen, the time required for proper disinfection and lack of comprehension of the instructions by the wearer. In an attempt to overcome this, multi-purpose solutions have been developed. These combine the major functions of cleaning, rinsing and disinfection. Most of the commercially available solutions use polyhexanide as the disinfecting agent. This has a broad spectrum of activity against Gram-positive and Gram-negative bacteria although it is less active against fungi. It does seem to be effective against Acanthamoeba although less so against its cysts and is low in toxicity. Other ingredients, such as chelating agents, are usually present in these solutions. At present, these solutions present a balance between the benefits obtained from increasing user compliance and the microbiological limitations associated with using alternatives to 3% hydrogen peroxide, which is regarded as the “gold standard”.

Care of hard contact lenses
There may still be a few patients who are using hard contact lenses and they must also carry out a careful daily routine of cleansing, disinfecting and protein removal. Hard lenses also require the use of wetting solutions.

Wetting solutions
Since hard lenses have hydrophobic surfaces, wetting solutions are needed to ensure that the lenses come into complete contact with the tear film. In general, wetting solutions improve comfort on insertion, provide a buffer between lens and finger during insertion and prevent contamination, and facilitate the even spread of tears over the lens surface. Usually, the same solution is used for soaking and wetting.

Lubricants/comfort drops
These make the lenses more comfortable for the wearer.

Multi-purpose solutions
These are specifically formulated for cleaning, storing, disinfecting and wetting and may be useful to improve wearer compliance. The choice between an abrasive and a non-abrasive system will depend upon any film coatings put on the lenses.
Care of rigid gas permeable lenses
The deposits that build up on gas-permeable lenses can be slightly more difficult to remove than from hard lenses. For this reason, the care regimen for gas-permeable lenses is the same as for hard lenses, with the additional step of protein removal being required.

Care of daily, two-weekly and monthly disposable lenses
These are essentially soft contact lenses. Obviously, daily disposable contact lenses do not require any maintenance as they are discarded at the end of each wear. Weekly, fortnightly and monthly lenses do require some care. As they are soft lenses, they therefore require daily cleaning and disinfection; soft contact lens solutions can be used. More often, multi-purpose solutions are used. Frequent replacement contact lenses do not usually require protein removal since there is not the same potential for protein build-up. However, wearers of these contact lenses should be urged to dispose of the lenses after the recommended wearing period has elapsed, i.e. one day, a week, a fortnight or a month.

There are now some solution systems available that can be used with all contact lenses. The systems generally consist of two stages: cleaning and soaking/disinfecting.

Care of contact lens cases
Currently, lens cases are reusable and as such, susceptible to contamination if they are not maintained very carefully. All lens cases should be kept dry when not in use. They should not be rinsed in tap water but rather they should be frequently cleaned and disinfected using contact lens solutions. Lens cases should also be replaced at regular intervals. It has been suggested that disposable cases should be made available to reduce the incidence of contamination of the lens by microbes. Indeed many 3 month solution packs include a free lens case to encourage frequent replacement.

Care of contact lens solutions
These should not be used if the original pack’s expiry date has passed. Additionally, most solutions have a recommendation to discard the product a certain length of time after initial opening. A note should be made of this date and the product disposed of accordingly. The nozzle or tip of a solution container should not be immersed in fluid held in a lens container to prevent contamination of the solution. It is important to note that the correct solution is used for the particular lens type; solutions for RGP lenses should not be used with soft contact lenses.
Section Six
Keeping eyes healthy

Counter prescribing for contact lens wearers
Patients are unlikely to disclose voluntarily that they wear contact lenses during counter-prescribing and so the possibility of this should be borne in mind especially when patients request products such as chloramphenicol eye drops.

Use of topical ophthalmic preparations
Hard and gas-permeable contact lens wearers can safely use all OTC eye preparations, although the need for eye drops could indicate problems with their lenses, e.g. users may develop sore red eyes following a reaction to their solutions or inadequate cleaning.

Soft contact lens wearers need to be more careful when using eye drops since they are hydrophilic and have the potential to absorb components of the drops. This is particularly so with benzalkonium chloride, a preservative contained in many eye drops. Soft contact lenses should not be worn whilst using any eye preparations containing this as a preservative since it is absorbed into soft contact lenses and released onto the cornea during wear causing inflammation and irritation. Eye drops containing chlorhexidine are suitable to use. If patients with soft contact lenses have to use eye drops preserved with benzalkonium chloride, lenses should remain out of the eye for at least 15 minutes after using the drops.

Soft contact lens wearers who present with red eyes may be suffering from oxygen starvation of the conjunctiva caused by prolonged wear, dry eye or an infection. The best advice is to leave the contact lenses out until the redness subsides. The patient should be advised to consult their optometrist.

Over-the-counter medications
Antihistamines and antimuscarinic drugs, when taken systemically, have been reported to decrease tear volume and blink rate in some people and could potentially lead to irritation in soft, hard and RGP lens wearers either because of reduced lens hydration or corneal drying. Some drugs are excreted into tears after oral administration and may be absorbed by soft lenses. Salicylic acid, which is present in tears after taking aspirin, has been reported to cause unexplained ocular irritation in lens wearers.

Use of Prescription Only Medicines in contact lens wearers
Drug treatments, and indeed the underlying medical condition requiring the treatment, can lead to changes in lens comfort. This may be the result of lens discoloration, changes in tear flow and eye lubrication and alteration in eyeball shape.
Reduction in tear flow
This can cause lens discomfort and can follow treatment with drugs with antimuscarinic side-effects, e.g. antihistamines, antispasmodics, tricyclic and related antidepressants and neuroleptics. Other drugs that can cause conjunctival dryness include isotretinoin, beta-blockers and diuretics. If drug administration is essential, lubricating eye drops may help to alleviate the problem\(^{13}\).

Lens intolerance
This can be caused by hormone preparations such as oral contraceptives and hormone replacement therapy. The effects these drugs can have on the eye include steepening of corneal curvature caused by corneal oedema, decreased tear production and increased mucus and protein production\(^{23}\).

Lens discolouration
This is known to occur following oral administration of beta-blockers, nitrofurantoin, phenolphthalein, rifampicin, sulfasalazine and tetracyclines. It also occurs following topical administration of diagnostic agents such as fluorescein\(^{23}\).

Effects of disease on contact lenses
Some disease states can make contact lens wear very uncomfortable and indeed, it may be advisable in some cases to avoid the use of lenses altogether. Problems can occur for some patients with rheumatoid arthritis or diabetes\(^{24}\). As discussed earlier, some disease states are associated with increased levels of certain eye conditions and as such, may lead to problems with contact lens wear.

Problems such as dry eyes and blurred vision can also occur as a result of the hormonal changes associated with the menstrual cycle, menopause and pregnancy. These are thought to be due to deficiencies in the lipid component of the tear film, resulting in increased tear evaporation, and also to a reduction in the aqueous and mucin layers. During pregnancy, a reduction in tear flow (particularly in the third trimester), increased corneal thickness and changes in the curvature of the eye have been reported\(^{25}\).

Patients with cold sores should be advised not to wear their lens during infection to reduce the chance of spread to the eye. Similarly, patients with any eye infection should be advised to discontinue wearing the lenses until all signs of infection have gone and consult their optometrist.
Interprofessional issues

Currently, the optometrist in general practice has some links with other healthcare professionals, namely GPs and community pharmacists. The link with GPs comes about mainly through their role in detecting conditions such as glaucoma and diabetic and hypertensive retinopathy. Following diagnosis or suspicion of the existence of a medical condition, the optometrist will refer the patient to their GP for treatment. Direct referrals from optometrists are also in place in some areas of the UK. Similarly, patients visiting their GP who are suspected to be suffering from eye-strain or long- or short-sightedness will most probably be referred to the optometrist. The links with community pharmacists follow a similar pattern, with pharmacists referring patients to the optometrist whom they suspect to be suffering from eye-strain, long or short-sightedness or regarding diagnosis of eye conditions.

Over recent years, there have been a number of changes in the list of medicinal products that optometrists may sell or supply. It is important that a pharmacist is aware of these in order to facilitate inter-professional working relationships; these are summarised below.

In May 2004, proposals suggesting changes to the products that optometrists could administer, sell or supply were put out for consultation by the Medicine and Healthcare products Regulatory Agency (MHRA). After the consultation, the agreed changes were embodied in three statutory instruments. From 7th April 2005, provided it is in the course of their professional practice, all optometrists registered with the General Optical Council (GOC) may sell or supply all GSL products and all P medicines to a patient\(^\text{26}\). In addition, provided it is in the course of their professional practice and in an emergency, registered optometrists may sell or supply POMs that are not for parenteral administration and that are:

(a) are eye drops and contain not more than 0.5 per cent chloramphenicol or
(b) are eye ointments and contain not more than 1 per cent chloramphenicol
(c) contain the following substances:
Cyclopentolate hydrochloride, Fusidic Acid, Tropicamide

The POMs to which this exemption applies may also be sold or supplied by a person lawfully conducting a retail pharmacy business on the presentation of an order signed by a registered ophthalmic optician.
In addition, a registered optometrist may obtain the following medicinal products by way of wholesale dealing:

- P medicines for administration, sale or supply in the course of his or her business
- POMs for administration containing tetracaine (amethocaine) hydrochloride, lidocaine (lignocaine) hydrochloride, oxybuprocaine hydrochloride or proxymetacaine hydrochloride.

Further information on this and wholesale to additional supply optometrists can be found on the MHRA website under Exemptions from Medicines Act Restrictions [http://www.mhra.gov.uk](http://www.mhra.gov.uk)/27.

**Additional supply optometrists**
From 30th June 2005, optometrists who have undergone additional training and accreditation and qualified as additional supply optometrists have access to an extended range of POMs. The list of medicines available to them can be found on the MHRA website under Exemptions from Medicines Act Restrictions [http://www.mhra.gov.uk](http://www.mhra.gov.uk)/27.

**Supplementary prescribing optometrists**
From 30th June 2005, a registered optometrist has been added to the list of people who are eligible to train as supplementary prescribers. The legislation relating to this is laid out in Statutory Instrument 2005 1507 and further information is available on [www.dh.gov.uk](http://www.dh.gov.uk).

**Independent prescribing optometrists**
From June 2008, Optometrists who have undergone the appropriate training can qualify as Independent Prescribers; they can prescribe any licensed medicine for ocular conditions affecting the eye and surrounding tissue, but cannot prescribe any controlled drug independently.

The General Optical Council defines an Optometrist independent prescriber as:
An independent prescriber is a practitioner who is ‘responsible and accountable for the assessment of patients with undiagnosed or diagnosed conditions and for decisions about the clinical management required, including prescribing [of medicines]’.

The first independent prescribing optometrists qualified in 2009, therefore it is likely that the pharmacist will now encounter prescriptions issued by these healthcare practitioners.
Summary points

- Non-adherence is a problem with all medications, but seems to be particularly so with ophthalmological products.
- The reasons for non-compliance with eye drops/ointments in older people range from difficulty in administration to forgetting timing of the dosage schedule.
- The pharmacist plays a key role in ensuring patients adhere to using their ophthalmological preparations particularly for conditions with serious consequences if treatment fails, e.g. glaucoma. The pharmacist can advise on correct use or supply appropriate compliance aids.
- The majority of contact lens wearers use soft contact lenses, which allow good permeation of oxygen into the eye, preventing hypoxia and keeping the eye healthy.
- Multipurpose contact lens solutions, which can cleanse and disinfect, are the solutions of choice where patients are liable to be lax about a good contact lens care regime, e.g. teenagers.
- Products containing the preservative benzalkonium chloride should not be used by soft contact lens wearers whilst concomitantly wearing their lenses.
- Pseudomonas aeruginosa and Acanthamoeba are the most frequent infective causes of microbial keratitis in contact lens wearers.
- Since 2005 optometrists can qualify as supplementary prescribers and since 2008 they can do further training to become registered independent prescribers.

Having completed your study of Keeping eyes healthy you should now be able to:

Support patients in the correct use of their eye drops

Advise on current contact lens care

Advise patients on frequency of eye testing

Outline the role of different health professionals in eye care

If you are not able to do all of these, go back and review this section again.
References


**Professional Organisations**

**Association of Optometrists**
2 Woodbridge Street, LondonEC1R 0DG
Tel: 020 7549 2000F: 020 7251 8315E: mailto:postbox@aop.org.uk

**British & Irish Orthoptic Society**
62 Wilson Street, London EC2A 2BU
Tel: +44(0)1353 66 55 41

**College of Optometrists**, 42 Craven Street, London WC2N 5NG.
Tel: 02078396000 Fax: 02073896800 E-mail: optometry@college-optometrists.org
Section Six
Keeping eyes healthy

Federation of Ophthalmic and Dispensing Opticians, 199 Gloucester Terrace, London W2 6LD. Tel: 02072895151 Fax: 02072895111 E-mail: mailto:optics@fodo.com

General Optical Council, 41 Harley Street, London W1G 8DJ. Tel: 02075803898 Fax: 02074363525 goc@optical.org

UK Ophthalmic Pharmacy Group. Contact through RPS website: http://www.rpharms.com/networking/about-partner-groups.asp

Royal College of Ophthalmologists, 17 Cornwall Terrace, London NW1 4QW. Tel: 02079350702 Fax: 020 7935 9838 Contact: kathy.evans@rcophth.ac.uk

Self-Help Organisations
Association of Blind Asians, Room 16, Zenith House, 210 Church Road, Leyton. E10 7JQ. Tel: 020 8558 6972 Fax: 02073882666 E-mail: info@aba-uk.org

The Eyecare Trust, Box 804 Aylesbury, Buckinghamshire HP20 9DF Tel: 0845 1295001 Fax: 0845 1295002 E-mail: info@eyecaretrust.org.uk

Guide Dogs for the Blind Association, Hilfields, Burghfield, Reading RG7 3YG Tel: 0118 983 5555 E-mail: guidedogs@guidedogs.org.uk www.guidedogs.org.uk

Henshaw’s Society for Blind People, John Derby House, 88-92 Talbot Road, Old Trafford, Manchester M16 0GS Tel: 01618721234 Fax: 01618489889 E-mail: info@hshp.co.uk

International Glaucoma Association (IGA), Woodcote house, 15 Highpoint Business Village, Henwood, Ashford, Kent TN24 8DH. Tel: +44 (0) 1233 648170. Email: info@iga.org.uk

The Macular Society. PO Box 1870,Andover SP10 9AD Helpline: 0300 3030 111 Email: iinfo@macularsociety.org http://www.maculardisease.org.

National Federation of the Blind of the UK, Sir John Wilson House, 215 Kirkgate, Wakefield, WF1 1JG. Tel: 01924291313 Fax: 01924200244 E-mail: nfbuk@nfbuk.org

National League of the Blind and Disabled, Swinton House, 324 Grays Inn Road, London WC1X 8DD. Tel: 02078376103 Fax: 02072780436

Royal National Institute of Blind People, 105 Judd Street, London, WC1H 9NE Tel: 0303 123 9999 www.rnib.org.uk

Wales Council for the Blind, Hallinans House, 22 Newport Rd, Cardiff CF24 0TB Tel: 029 2047 3954 Fax: 02920433920 E-mail: staff@ecb-ccd.org.uk
Exercise and case study reviews

Exercise 8 review

The following are general counselling points under each heading:

**The reason for using the product**
Use easily understood explanations, such as ‘the active ingredient in your eye drops is called timolol; it works by reducing the pressure in your eyes. Your doctor has prescribed them for you because he has done some tests that show that the pressure in your eyes is too high. High pressure in your eyes can damage the optic nerve and can result in deterioration in your vision and possible blindness.’

**Instructions on how to maintain the cleanliness of the drops during use**
Explain to patients that preparations for the eye are sterile when issued. To avoid contamination they should be told not to touch their eye or eyelid with the tip of the dropper or the end of the ointment tube. The container should be kept closed after use.

**The importance of following the dosage instructions**
Only one drop is required. If any more is used, it will either be drained down the nasolacrimal duct, increasing the likelihood of systemic absorption, or will run down the cheek, risking possible allergic reaction. If they miss a dose, it should be used as soon as possible. However, if it is almost time for the next dose, they should skip the missed dose and go back to the regular dosing schedule.

**The importance of using the product for as long as the prescriber has stated**
For antibiotic preparations it is important to avoid the emergence of resistant bacteria. For the treatment of asymptomatic conditions, the patient may be less inclined to continue treatment. They should be told to continue with the drops even if they have not noticed a difference in how they feel.

**Details, and preferably a demonstration, of the correct administration technique for the particular product dispensed**
Before and after using the eye drops the patient should wash their hands. The bottle should be shaken; although this may not be necessary for solutions, it is important for suspensions. Eye drops should be put into the pocket formed by gently pulling the lower eyelid, furthest from the drainage channel. The eye should be kept open to maximize the effect. Eye ointments are applied by squeezing a small amount in the lower fornix, with the eyelid pulled down gently. Blinking will help to spread the ointment.

**Advice on the order of use of products if more than one**
When two different preparations are required at the same time of day, for example pilocarpine and timolol in glaucoma, dilution and overflow may occur when one immediately follows the other. An interval of 5 minutes should occur between use, although this may not be practical. The order in which different preparations are used should follow the guidelines as overleaf:
• If any drops cause stinging, they should be used last because they will induce tear production, which will dilute any subsequent drops used
• Aqueous solutions should be used before suspensions or viscous preparations
• Drops should be used before ointments

The expiry date of the product
Once the product has been opened, the expiry date is immediately after use for single-use products and 28 days for multidose preserved eye drops. Newer devices have longer in-use shelf lives, e.g. Blink Intensive tears®, Oxyal®, Optive® and Systane®. Occasionally patients receive ‘specials’ as part of their treatment from hospital with the shelf life varying from one day (multidose preservative-free) to two weeks. Patients should be counselled appropriately and the expiry of the product dispensed emphasised to them.

Advice on reducing systemic absorption of eye drops
Traditional advice is that absorption may be reduced by compressing the lacrimal sac at the medial canthus for a minute during and following the instillation of the drops. The procedure, called punctal occlusion, blocks the passage of the drops via the nasolacrimal duct to the wide absorptive area of the nasal and pharyngeal mucosa. There is some debate as to how useful the technique is. It is possible that the pressure creates a suction effect, which increases drainage into the nasolacrimal duct.

Advice on storage
Storage in the fridge is recommended for drops, e.g. chloramphenicol, as their shelf life is based on storage at a temperature below 15°c. However, cold drops should not be put directly into the eye as this can be uncomfortable and can induce tear formation, which washes out the drops. Drops should therefore ideally be kept at room temperature for a few hours prior to use. Additionally, for a short course of chloramphenicol, it is better that the drops are held at room temperature rather than omitting dosage due to refrigeration being unavailable, e.g. when at work. Latanoprost drops do not require refrigerated storage whilst in use for up to 28 days. However, spare/extra bottles need to be stored in the fridge until opened for use. The Xalatan brand no longer requires refrigerated storage.

It is often assumed that patients who receive repeat prescriptions for ophthalmic products do not require any additional help or advice. However, this is frequently not the case and it has been shown that many patients, particularly the elderly, do experience difficulties with the administration of ophthalmic products and are frequently reluctant to reveal these. Many healthcare professionals seem to be unaware of the extent of difficulties faced by this group of patients and the community pharmacist is in an ideal position to provide support on a regular basis and deal with the problems as and when they arise. Additionally, by being able to obtain compliance devices for patients if required, you can play a major role in ensuring that ophthalmic treatment is optimized.

For customers with impaired vision all medicines should be labelled with larger print labels. The Royal National Institute of Blind People recommends a size of 14 point using lower case rather than capital letters, which can be more difficult to read. For example, the actual size would be:

‘One drop in the right eye once in the morning and once in the evening.’
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