# Optometry (2. LF UK)

## Introduction

Optometry is the science of examining the eye, its visual acuity - like the ability to focus objects on the retina, the clarity of vision, ability to recognize small details with precision, its refractive properties (lens and cornea) and its defects. As a complex sensory organ, the eye contains an optical imaging and light sensory equipment. Modern optometry uses suitable instruments, like **optotypes** (Snellen eye-charts) and refractometers (used in manual and automatic modes), that help detect eye abnormalities to set a medical diagnosis. Through visual training or prescription of correctional lenses, the **Optometrist** can get the visual system to work effectively. The most common disorders of the eye are vision defects, such as hyperopia (long-sightedness) and myopia (near-sighted). Optometry is part of the medical specialty of **Ophthalmology**.

## Importance in clinical medicine

An optometrist makes a diagnosis of a patient with vision complications based on the help of optometry. When a diagnosis is made the optometrists can write prescriptions for corrective lenses such as glasses or contact lenses.

**Hyperopia aka hypermetropia (far-sightedness)** - which is when the eyeball is too short where the patient sees nearby as well as distant objects poorly and is corrected by convex lenses.

**Myopia (short-sightedness)** - when the eyeball is too long where patients can see nearby objects but sees distant objects badly and is corrected by concave lenses.

**Astigmatism** - a refractive error in which the eye doesn't focus light evenly on the retina which causes blurred vision at all distances (corneal curvature) and is corrected by toric lenses.

**Presbyopia** - the gradual loss of your eyesight, which is a natural part of aging process.

Optometry can also benefit patients regarding detection of serious health conditions such as high cholesterol, autoimmune disorders, diabetes and even cancer.

## Literature review

### Advantages and disadvantages

The biggest advantage is that a good examination can improve the patient's eyesight.

A Refractometer measures the **focusing power** of the eye in **Dioptries**. In an adult emmetropic eye (no corrective lenses needed) the approximate power is +60 Dioptres, divided approximately +40D to the Cornea and +20D to the eye-lens. This will vary slightly between individuals as the length of the eye can differ. Manual and automatic **refractometry** have different pros and cons. The automatic refractometer is simple to handle, the procedure is fast, so it's not as tiring as with the manual refractometer. However there's the possibility of calibration errors and it might not be as accurate. To recognize other diseases an ocular examination by an ophthalmologist should be made.[1]

The Snellen chart has more disadvantages. The patient may try to memorize the symbols on the card and fake their result or may have problems to answer the test. It's crucial that the patient cooperates. The chart isn't standardized, there can be different results depending on which chart is used.

### How it works

An optometric examination can be made through various ways.

First, one is tested through the usage of **eye-charts (optotype charts)**. It's a subjective method, the patient tells the examiner what he sees. The correction is made through trial and error by trying out lenses with different optical powers.

To further determine eye disorders one is likely to use a refractometer. It's an objective way of determining the visual acuity. The apparatus emits an infrared light beam and it's reflected from the retina. Depending on the refraction the refractometer calculates an exact value for the optical power of the eye.

### Risks (for patient and clinical staff)

"In optometric practice, infection may be transmitted from patient to staff, staff to patients, patient to patient and staff to staff by direct contact, aerosol formation or contamination of equipment or instruments in the practice." [2]

The highest aim is decreasing the risk of transmission of infection. It's compulsory to reprocess devices by disinfection or sterilisation, to reach a hygienic state and to act in accordance with the infection control guidelines.[2]A distinction is made between "standard precautions" and "additional precautions". Additional precautions are taken, when handling with body fluids, for example blood, tears or mucous membranes of possibly infected patients and when there's a risk of droplet transmission.[2]

### Ethical issues

The four basic principles of medical ethics will help the optometrist in their decisions - these are beneficence, non-maleficence, justice and autonomy but also confidentiality and protection of the vulnerable have been included.

It's unavoidable to get into situations where those principles conflict with each other. Choosing one will require disrespecting another, causing an ethical dilemma. Then the optometrist has to weigh the different perspectives against each other. [3]

Examples:

1) The optometrist is bound to maintain confidentiality but in case of a patient having a heritable or infectious disease, he has also the obligation towards the patient's family and society.

2) Autonomy of a patient is indispensable until he risks his or other people’s health by behaving unreasonably. It's not justifiable to let a person with poor vision drive a car.

## Equipment

### Refractometer (Fig 1)

The refractometer is composed of four photoelements and infrared light. The instrument detects and focuses on the eye before radiating a light ray, that is reflected off the retina and captured by a CCD camera. The index of refraction is measured by calibrating the character and direction of reflection of light as it passes through the eye. The size and shape of a ring in the retina can then be determined by the refractometer. The abnormality of the eye is calculated in Dioptries by a computer, after the CCD camera captures the image. The rays can be divergent (hypermetropia), convergent (myopia) or parallel (physiological state), depending on the refraction. [4]

Fig 1 Refractometer

### Eye chart/ Snellen chart (Fig 2)

The use if eye-charts is a subjective method that requires the patient’s cooperation, and is used for measuring general visual acuity. The charts are composed from sets of images of different sizes called optotypes. Usually the largest optotypes are at the top, while they become smaller the further one goes down the chart. The acuity 6/6 vision, (or 20/20 in some countries that do not use the metric system) is used as a **reference** when comparing results from different patients. The fraction “6/X” describes the length in meters between the chart and the examined person (6m), while “X” is the number of the last row that the person could read on the chart. The expression describes the visual acuity for each eye. For example: 6/10 vision means that at a 6 meters distance the examined person was able to read a row of optotypes that an individual with 6/6 vision would be able to read at a 10 meters distance from the chart. There are different types of eye charts such as the Landolt ring/Landolt broken ring and Pflüger E-symbol. However, the most common chart used is the Snellen chart which consists of numbers and letters. The most commonly used letters are C, D, E, F, L, N, O, P, T, Z. This are arranged in random order in eight lines of different sizes. The chart is designed so that the letters are placed in a square. The squares are seen at a visual angle of 5 angular minutes (5´) when standing 5 to 6 meters away from the chart. The lines that make up the letters are ⅕ in width to the side of the square, meaning they are 1 angular minute (1´) (see figure. 3). If a patient has 6/12 vision it means that they have half of the visual acuity that a person with 6/6 vision has, to separate two object at a certain distance apart. The most common vision, considering varaiables such as age, genetics, stress etc., is 6/4.[5]

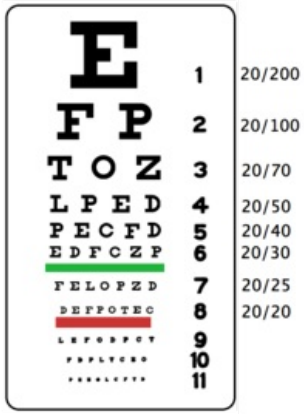


Figure 2: Snellen Chart

## Methodology

- For the methodology of optometry it’s most important that the examiner explains the procedure to the patient in a proper and comprehensible way. The patient on the other hand has to be attentive and willing to cooperate. Optometry is an advanced science, but no device can replace the communication between patient and examiner in this subject.
- For instance the examination by a Snellen chart can get easily impaired by the missing attendance of the patient.
- The examiner makes sure, that the devices he/she uses are secure and safe.

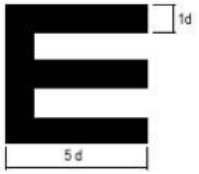


Figure 3: Snellen Haken

- Equally important as in other medical fields are disinfection and right adjustment of the device (e.g. proper measurement, as comfortable as possible for the patient etc.)
- The examiner explains the procedure of the applied examination.
- If the patient has questions all misunderstandings should be eliminated before testing.
- Motivating the patient while testing (depends on the difficulty and length of the examination) is the purpose of the examiner to reach best results.
- If the attention of the patient gets worse the examiner should make a pause.

### Procedure of examining by a Refractometer:

1. The Refractometer is a fully automatic device which can be operated via its task bar (If required there is the possibility to use the manual mode as well.)
2. Turn the device on.
3. For the automatic mode set the following parameters: VD 12, CYL +/-, COUNTON ON, AUTO MEASURE 3, R-L MEASURE ON, AUTO PRINT OFF
4. To finish the selection offer: Press the SET switch.
5. Positioning of the patient accurately has high priority: the eyes of the patient have to be straight on the level of the mark. With the CHIN REST it’s possible to help the patient getting a suitable position.
6. While pressing START the device will measure both eyes.
7. If the examiner needs the manual mode: MANU switch has to get actuated.
8. Manual measurement is possible by moving the TRACKBALL: make sure that the ring on the display encircles the middle of the eye’s pupil.
9. The line of the three white points should be upright.
10. Pushing START button sets in the examination.
11. Three measurements have to be done in the manual mode.
12. Same procedure with the other eye is obligatory.

### Procedure of examining by a Snellen chart:

1. The Examiner has to make sure, that the chart will be enough illuminated by natural or artificial light.
2. The patient get’s informed about the method.
3. First positioning of the patient is at a distance of six meters from the chart.
4. If known, the “bad” eye should get measured first.
5. To make a proper examination possible, the patient should use an occlude or pinhole (clean hands to cover one eye are sufficient as well).
6. Measurement rules:
    1. The smallest lines the patient can read are called “fraction”. For instance: 6/18 or 6/24 (written on the chart)
    2. The upper number refers to the distance the chart is from the patient (6 meters).
    3. The lower number is the distance in meters at which a person with no impairment should be able to see WHAT YOU HAVE SEEN.
7. Make sure that you put down in writing the results for each eye. Note if the eye is with or without correction (spectacles). → If the patient is not able to identify the top letter at six metres, move him/her closer. One meter at a time until the top letter gets identified.In this case the result will be recorded as 5/60 or 4/60, etc.
    1. Worse case: The patient can’t read the top letter at one meter (1/60). → Hold up your fingers at varying distances of less than one meter and check whether the patient can count them.
    2. Worst case: The patient can’t count fingers, wave your hand and check if he/she can see this.
8. Same procedure with the other eye is obligatory.

## Conclusion

The eye is maybe the most important sensory organ used in everyday life. Therefore, it's very important to have it examined regularly from a young age in order to detect errors before they can become more serious with age. During the last century there has been a huge development in the detection of eye disorders and their correction. Having problems with one's eye is becoming lesser of an obstacle each day. The future of optometry is bright. With new technologies being produced constantly, the patient will be provided with more possibilities to choose from. The use of lasers for correcting vision can even make contact lenses and glasses unnecessary.

## Resources


1. Sahasranamam, V., Dr. (n.d.). Autorefractometers. Retrieved December 17, 2016, from http://ksos.in/ksosjournal/journalsub/Journal_Article_10_121.pdf
2. http://onlinelibrary.wiley.com/doi/10.1111/j.1444-0938.2007.00192.x/pdf Journal compilation © 2007 Optometrists Association Australia Infection control guidelines for optometrists 2007 Lakkis, Lian, Napper and KielyClinical and Experimental Optometry 90.6 November 2007 1) page 435 Risk factors in optometric practice 2) page 435 Disinfection, sterilisation and reprocessing3) page 434 continously
3. http://www.journalofoptometry.org/en/ethics-in-optometric-practice-/articulo/S1888429608700554/ Copyright © 2008. Spanish Council of Optometry Ethical Principles original source: B.K. Pierscionek Law & Ethics for the Eye Care Professional Butterworth Heinemann Elsevier, (2008)
4. Center of Disease Control and Prevention (2005) National Health and Nutrition Examination Survey- Vision Procedures Manual. (page 2-2 to 3-23) Availiable at https://www.cdc.gov/nchs/data/nhanes/nhanes_05_06/VI.pdf (Accessed 2016-12-15)

5. Precision Vision (2016) Snellen Eye Test Charts Interpretation. Available at http://precision-vision.com/snellen-eye-test-charts-interpretation/. (Accessed 2016-12-15)