**Stem cells**

- **Stem cells** are undifferentiated cells that can renew themselves and differentiate into any cell type of the body.
- They are the source of all other types of cells and tissues.

**Cell-based therapies**

Treatment in which stem cells are induced to differentiate into the specific cell type required to repair damaged or depleted adult cell populations or tissues.

**Cellular therapy**

A new way to treat disease and injury. It aims to repair damaged and diseased body-parts with healthy new cells provided by stem cell transplants.

**Cones**

A type of specialised light-sensitive cells (photoreceptors) in the retina that provide sharp central vision and colour vision. See also Rods.

**Differentiation**

The process whereby an unspecialised early embryonic cell acquires the features of a specialised cell, such as a heart, liver, or muscle cell.

**Embryonic stem cells**

Primitive (undifferentiated) cells from the embryo that have the potential to become all cell types found in the body (totipotent). Embryonic stem cells (ESCs) are derived from four to five day-old embryos.

**Gene therapy**

Therapy aimed at counteracting the gene defect by substituting normal gene material at the site of the problem.

**Mesenchymal stem cells**

Stem cells found primarily in the bone marrow that can transform into bone, cartilage, fat, and connective tissue. These cells are also referred to as bone marrow stromal cells.

**Multipotent stem cells**

Stem cells that can give rise to several other cell types, but those types are limited in number. An example of multipotent cells is haematopoietic cells – blood stem cells that can develop into several types of blood cells.

**Photoreceptors**

Cells that are sensitive to light.

**Plasticity**

The ability of stem cells from one adult tissue to generate the differentiated cell type of another.

**Progenitor cells**

Cells that can produce only one cell. They can differentiate into a limited number of cell types, but cannot make more stem cells (or renew themselves).

**Proliferation**

Expansion of a population of cells by the continuous division of single cells.

**Regenerative medicine**

A treatment in which stem cells are induced to differentiate into the specific cell type required to repair damaged or depleted adult cell populations or tissues.

**Retina**

The light-sensitive layer of tissue that lines the back of the eyeball; sends visual messages through the optic nerve to the brain.

**Retinal pigment epithelium**

The pigment cell layer that nourishes the retinal cells; located just outside the retina and attached to the choroid.

**Rods**

A type of specialised light-sensitive cells (photoreceptors) in the retina that provide side vision and the ability to see objects in dim light (night vision). Also see Cones.

**Stem cells**

Unspecialised cells that serve as the source, or ‘stem’, for specialised cells like heart, brain, or blood cells. They have two important characteristics that distinguish them from other cells in the body. Firstly, they can replenish their numbers for long periods through cell division. Secondly, after receiving certain chemical signals, they can differentiate, or transform into specialised cells with specific functions, such as a heart cell or nerve cell. Found in days-old embryos and a few adult organs.

**Subfoveal**

Beneath the fovea, the central pit in the macula that produces the sharpest vision.

**Undifferentiated cells**

Cells that have not changed to become a specialised type of cell.
What will be new at the back of the eye in the year 2020?

**Retinoblastoma**

Dr Carol Shields, Professor of Ophthalmology and Co-Director of the Oncology Service at the Wills Eye Hospital, Philadelphia, foresees earlier detection of cases through increased awareness (e.g. routine screening of the red reflex) which will potentially identify the sporadic cases. A change in chemotheraphy treatment from systemic to local delivery will reduce overall side-effects. New developments in slow-release mechanisms (e.g. a reservoir system inserted into the sub-Tenon space which can then be regularly filled with chemotherapeutic agent) and increased use of adjunctive treatments (e.g. locally placed anti-proliferative agents like combretastatin), will further improve treatment success.

Dr Alejandra A. Valenzuela of the Royal Children’s Hospital, University of Queensland, Australia, considers that by 2020, better education and increased surveillance by the health community will be fundamental to earlier diagnosis and successful outcomes. Multimodal therapeutic advances will save not only the life of the patient, but also preserve the eye and, in some cases, preserve the vision. The addition of gene therapy to the particular Rb1 mutation affecting some children may provide a further avenue in management.

**Retinal detachments**

Dr Yasuo Tano, Professor of Ophthalmology, University of Osaka, President of Asia-Pacific Academy of Ophthalmology, envisages that pars plana vitrectomy (PPV) will take over as the primary choice for detachment repair. Improved imaging with 3-dimensional OCT high resolution imaging will improve visualisation of the posterior segment. Non-vitreomising macular surgery may offer the hope of non-accelerated progression of nuclear cataract that currently occurs following PPV. Binocular techniques for surgery are also likely to be more widespread.

Dr G W Aylward, Medical Director at Moorfields Eye Hospital, London, foresees no significant change in the diagnostic and management techniques for routine retinal detachments, as reattachment rates currently reach 90 per cent. He suggests that the main thrust by the year 2020 will be focused at the public health level, such as alerting the public to early symptoms and signs in order to ‘catch’ detachments before the macula is affected.

Dr Borja Corcostegui, President of Española de Retina y Vitreo (SERV), Barcelona, added that, as the posterior segment diseases are better understood, and animal models in place, Gene therapies will predominantly be available for large families or populations, however there will be some scope for developing customised treatments. In general, the strategy will be:

- Autosomal recessive – replace the defunct gene
- Autosomal dominant – insert a separate gene.

**Retinal dystrophies, e.g. retinitis pigmentosa**

Dr Ian Constable, Professor of Ophthalmology, University of Western Australia and Director of Lions Eye Institute, Perth, believes that by the year 2020, the range of specific gene defects will have been documented for the various clinical phenotypes. Gene function (e.g. enzymatic, cell signalling) for most dystrophies will also be understood, and animal models in place. Gene therapies will predominantly be available for large families or populations, however there will be some scope for developing customised treatments. In general, the strategy will be:

- Autosomal recessive – replace the defunct gene
- Autosomal dominant – insert a separate gene.

**Age-related macular degeneration (AMD)**

Dr. Rosario Brancato, Professor of Ophthalmology, University San Raffaele, Milan, Italy and Editor of the European Journal of Ophthalmology, predicts that diagnosis for AMD will be directed at three levels:

- Understanding pathological angiogenic mechanisms
- Understanding these effects in the local tissue
- Epidemiological and genetic research regarding predispositions to AMD.

FA, indocyanine Green (ICG) angiography and OCT will continue to prove useful for diagnosis and monitoring evolution of the disease.

Treatments will be directed by the diagnosis and will specifically target the pathogenic mechanisms. In this regard, finding an effective drug for the prevention and the regression of pathological neovascularisation will be important. Research and development into regenerative therapies will also increase in importance. An important challenge will also be to identify the best delivery systems for these medications (e.g. oral, subconjunctival, even topical).