

## New and emerging technologies for inherited retinal diseases

Inherited retinal diseases are now the most common cause of blindness in working age adults in England and Wales, and the second commonest in childhood. Currently, there is no cure or specific treatment. Management of these conditions consists of early diagnosis, specialised genetic counselling, treatment of any associated genetic conditions, as well as visual rehabilitation, support and training (e.g. to use visual aids).



We looked for new and emerging technologies that aim to slow or stop disease progression and/or reverse sight loss by consulting clinical experts and developers, and by searching specialised databases and other online sources. Clinical experts and two patient focus groups (facilitated by the charity [Fight for Sight](#)) reviewed the technologies we identified and commented on innovation, potential for future impact (on patients, NHS systems and resources), and any potential barriers to adoption. The patient focus groups provided valuable insights into the technologies from a potential user's perspective.

We found forty new and emerging technologies. These included nine gene therapies, ten medical devices, five pharmacological (drug) technologies, and five regenerative and cell therapies. The other eleven technologies identified were at a very early stage of development. The majority are in or anticipated to be in clinical trials; very few treatments are already available to a small number of patients. Several technology areas were of particular interest to clinical experts and potential users and these are discussed below. The [full report](#) that provides details of the specific technologies we identified can be found on the HSC website.

### Gene therapy

Gene therapy has the potential to slow and reverse retinal degeneration. It appears to be most effective in treating conditions before the degenerative process has resulted in the loss of large numbers of retinal cells. It promises both a reduced risk of side effects and the potential for long term effectiveness following a single administration of a vector (a carrier that delivers a new gene) that could be more cost effective than repeated drug administrations. Most inherited retinal degenerations result from mutations in photoreceptor-specific genes and further genetic research could expand the range of retinal disorders potentially treatable using this approach. Current trials are at early stages and longer term follow up will be needed to understand the effectiveness and safety of these technologies.

### Medical devices

A number of innovative retinal implants were identified with potential to restore vision. Early

trials have shown patients with these devices can have some restoration of vision, although currently the best visual acuity is in the range of about 20/600 to 20/1200, and these devices only provide a small field of vision. This level of vision can aid navigation, as well as recognition of large objects. Clinical experts commented that most of the devices we identified are for patients with advanced and end-stage disease; patients with retinal dystrophies who have lost the majority of their photoreceptors and have minimal vision. These devices are not suitable for patients with infantile onset retinal dystrophies who have never had sight.

### Regenerative and cell therapies

Stem cells may have the capacity to regenerate lost photoreceptors and retinal neurons and improve vision. According to clinical experts, stem cell therapies are generally considered safe. However, a person's immune system may recognise the transplanted cells as foreign and this can trigger an immune reaction that results in rejection of the new cells.

A NT-501 ciliary neurotrophic factor implant (encapsulated cell technology), was of interest to the patient focus groups and growth factors in general were highlighted by the clinical experts as an area of innovation. Growth factors are substances that are made by the body to enable it to sustain and repair itself, and have important roles in cell survival.

### Very early developments

We identified a number of very early (pre-clinical) developments. For example, studies have suggested that 'clumping' (deposits) of vitamin A (known as vitamin A dimers) in the retina may be associated with this condition. Researchers have created an altered form of vitamin A that appears to slow the formation of vitamin A dimers in the eye when given to mice with the same genetic defect as humans with Stargardt disease. An expert also indicated that ALK-00 (an oral compound) designed to prevent the formation of toxic vitamin A dimers in the eye, also has therapeutic potential in patients with Stargardt disease. Clinical experts commented that both of these technologies have a good scientific basis and need to be assessed in clinical trials.

### Conclusions

Clinical expert and patient opinion indicates that the technologies likely to have the most impact in the future are gene therapies, and regenerative and cell therapies. Some technologies are more applicable to earlier stages of disease such as gene therapy, while others are more applicable to advanced stages, such as artificial vision and stem cell therapy. According to clinical experts, these treatments are not mutually exclusive and may be complementary, potentially used either together or one after the other.

Clinical experts commented that although this is time of great innovation for developing potential treatments for inherited retinal diseases, most of the health technologies identified in this review are still at an early stage of development. Further well designed trials and data on effectiveness, safety and usability, and costs of the technologies, as well as the long term impacts for patients are required, before these can be considered for adoption into clinical practice.

**For further details of the technologies we identified and references, please read the full [NIHR Horizon Scanning report](#) which is free to download.**