GLOSSARY OF TERMS ASSOCIATED WITH HUMAN GENETICS

ALLELE
Alternative forms of genes which can be found at a locus e.g. A, B or O blood groups are controlled by alternative alleles at the same gene locus on chromosome 9.

ANTICIPATION
A phenomenon in which a genetic disease appears earlier appearance and with increased severity with each succeeding generation. Anticipation has now been proven to occur in a large number of important genetic disorders, including Huntington disease and myotonic dystrophy. In molecular terms, anticipation is due to the expansion of a trinucleotide repeat sequence in the DNA. This phenomenon also occurs in the fragile X syndrome, the most common inherited form of mental retardation.

AUTOSOMAL
Associated with one of the 22 pairs of autosomes, chromosomes that are not sex chromosomes. Hence autosomal gene and autosomal inheritance.

CARRIER
An individual who has a disease-causing mutation but will not develop the disorder in question. Most commonly used with regard to autosomal and X-linked recessive disorders and refers to the situation in which the individual has one normal and one mutant gene at a particular locus (heterozygote).

cDNA
cDNA is a single stranded segment of DNA that is complimentary to the mRNA (messenger RNA) of a coding DNA segment; a whole exon or a whole gene or part of a gene.

CHIMERA
An organism that is made up of a mixture of cell lines from different conceptions. This may arise from the fusion of two conceptions, or the artificial mixture of cell lines in a conception as part of a gene transfer experiment.

CHROMOSOME
The thread-like structures found in the nucleus of cells and made up of coils of hereditary units, genes and other non-coding DNA. The nuclei of human cells normally contain 46 chromosomes, arranged in 23 pairs.

CODON
A unit of three nucleotides that code for a single amino acid of a protein is known as a codon.

DEGENERATE
Degeneracy in genetics refers to the fact that the genetic code contains more than one codon for most amino acids.

DNA
DeoxyriboNucleic Acid is a nucleic acid composed of long chains of molecules called nucleotides. Each nucleotide contains a nitrogenous base, a sugar molecule and a phosphate molecule. In DNA the sugar is deoxyribose. The nitrogenous bases are A adenine, G guanine, T thymine. and C cytosine**;** A is always paired, with T, and G with C. (In the other nucleic acid RNA, the sugar is ribose, and the bases are A, G, C and U uracil).

DOMINANT GENETIC DISORDER
Needs only one allele to be affected in someone heterozygous for a particular gene i.e. only one faulty gene needs to be inherited from father or mother (e.g. Huntington Disease, tuberous sclerosis, neurofibromatosis).

EXON
A portion of the DNA sequence of a gene that forms part of the final gene product

EXPRESSIVITY
Expressivity refers to the severity of the clinical symptoms (expression) as seen in the phenotype.

FRAMESHIFT MUTATION
This is a mutation (deletion/insertion) that results in a change in the reading frame of the gene with, usually, disastrous consequences for the gene.

GENE
The fundamental physical and functional unit of heredity material known as genomic DNA consisting of a sequence of DNA, occupying a specific position on a specific chromosome. Each gene encodes the information required to produce a protein or ribonucleic acid with a specific structure and function. Different sequences and numbers of the A=T and G≡C base pairs produce different genes.

GENE PRODUCT
The RNA or protein encoded by a specific gene.

GENETIC MOSAIC
An organism that is made up of multiple cell lines from one conception. This could arise as a result of a somatic mutation leading to the existence of two different, but related, cell lines in the organism

GENOME
The total genetic complement ie. complete DNA sequence. The term can be used with reference to a cell, an organism or a species.

GENOTYPE
This term may refer to (i) the particular DNA sequence of one of an individual's genes, or (ii) the sum total of such sequences for all the individual's genes.

GENOTYPING
This refers to the process of screening patients to identify the specific gene and mutation that cause a particular condition (phenotype).

HETEROZYGOTE
A person who has two different alleles at a locus on a pair of chromosomes (e.g. AB, AO, BO blood groups). Heterozygous refers to having two different alleles for a single trait.

HOMOZYGOTE
An individual who has two identical alleles (alternative genes) at a locus on a pair of chromosomes (e.g. AA, BB. OO blood groups). The term compound heterozygote is used when the two genes of a given pair both have mutations, but the mutations are different.

HOMOZYGOSITY
The state of possessing two identical forms of a particular gene, one inherited from each parent.

INTRON
A portion of the DNA sequence of a gene that is not present in the final gene product. Introns are removed from the gene sequence during the process of transcription when the DNA is copied into mRNA.

LOCUS
The position on a chromosome of a segment of DNA that has been identified as the location of a disease-causing gene. Often, when the exact gene has not yet been identified, loci are named after the disease. One also refers to marker loci which indicates the position on a chromosome of a genetic marker.

LYONISATION
Also known as X-inactivation. This is the process whereby, soon after fertilisation, all the X chromosomes in a cell, except one, are inactivated. This process ensures that females (and individuals with more than two X chromosomes), have only one active X chromosome.

MISSENSE MUTATION
This is a point mutation that changes a codon to represent a different amino acid. The protein that is then synthesised will have a completely different amino acid in its chain which could affect the function or even the secondary structure and thus the function of the protein. The effect on the protein function is thus dependent on the site of the mutation and the nature of the amino acid replacement.

mRNA
Messenger RNA is a form of RNA produced during the transcription of a gene in the nucleus. mRNA migrates from the nucleus into the cytoplasm where it is translated into the corresponding amino acid.

MUTATION
A change in the DNA normally expected in a single gene (like a point mutation). A mutation may result in a change in the characteristics of an organism. A mutation in the gametes (germ cells) can be inherited but a mutation in the somatic cells (body tissue cells) will not be inherited. Mutations can occur in cells through-out life. A mutation can also be described as a variation or change in the sequence of nucleotides in a gene's DNA that is permanent, may be transmissible to children, and which may cause, predispose to or modify a disease process. Ultimately, a disease –causing mutation disrupts the ability of a gene to correctly encode the specialised protein it produces.

NON-DYSJUNCTION
This is the failure of separation of a pair of homologous chromosomes in Meiosis I or sister chromatids at Meiosis II and Mitosis. This failure to dysjoin can lead to imbalances in the number of each chromosome in the daughter cells. Non-dysjunction is the primary cause of trisomy (three of a chromosome, rather than two).

NONSENSE MUTATION
This is a point mutation that results in one of the three stop codons which will then result in a premature termination in the translation process and therefor a truncated protein. (the word 'nonsence' is thus a misnomer since the stop codons do have a meaning, albeit a disastrous one which results in a smaller/shorter protein which will ultimately affect it's function).

NULL MUTATION
This is a mutation that destroys the normal code and results in the production of a non- or ill-functional protein.

PENETRANCE
The frequency with which individuals having a particular disease genotype develop the disorder is referred to as penetrance. Thus, the penetrance of mutations in the BRCA1 gene in women is 60-85 % ie. only 60–85 % of those with a mutation in this gene will develop breast cancer. Penetrance refers to the absence or presence of the phenotypic expression of a genotype whereas expressivity refers to the severity of the expression as seen in the phenotype. The same gene or combination of genes can produce different degrees of a phenotype in different individuals because of external influences like other genes, environmental influences like toxins, contagious diseases and nutrition. It is generally accepted that most disease-causing allele combinations are completely penetrant (ie : everyone who inherits the combination has some symptoms) but incomplete penetance can occur and is observed when some individuals who have the disease-causing genotype do not express the phenotype.

PHENOTYPE
The biochemical, physiological and physical characteristics of an individual that result from the interaction of his/her set of genes with the environment. Often used when referring to the particular features of a genetic disorder which can be observed in an affected individual.

RECESSIVE GENETIC DISORDER
Needs both alleles to be affected in someone homozygous for a particular gene, i.e. two faulty genes need to be paired, one inherited from the father and one from the mother, both of whom, in most cases, will be carriers.
A recessive gene can be an 'autosomal recessive' if the gene is located on one of the 'autosomes' (the chromosomes which are not sex chromosomes) or an 'X-linked, or sex-linked, recessive' if the gene is located on the X chromosome .

RNA (ribonucleic acid)
A linear sequence of ribonucleotides (nucleotides for short). One type of RNA is messenger RNA, or mRNA. In order to make a protein, the genetic information in DNA is copied (transcribed) into mRNA, which carries it from the nucleus to the protein producing part of the cell. There the information is translated using the mRNA as a template and is reflected in the amino acid sequence of the corresponding protein.

SILENT MUTATION
This is a point mutation that results in no change in the amino acid specified by the codon containing the mutation. This relies on the redundancy built into the genetic code, and is a way accumulating mutations that will have no effect on the gene product.

SOMATIC
Relating to the non-reproductive cells of the body.

TERATOGEN
An agent that causes mutations/abnormality in the developing foetus.

UNIPARENTAL DISOMY (UPD)
When an individual is carrying two homologous chromosomes with the same parental origin, ie two copies of chromosome 15 from the mother and none from the father.

VARIABLE EXPRESSION
Variable expression refers to a phenotype where the symptoms vary in intensity in different people.

X-LINKED GENETIC DISORDER
Is carried by females (XX) who carry one faulty gene on one X chromosome, but a normal allele on the other X chromosome. They are protected by the normal allele and not affected by the faulty gene. Males (XY) who have a faulty gene on their X chromosome are not protected as they have no normal copy of the gene (e.g. haemophilia, Duchenne muscular dystrophy).