# Summary of the [4] Main Genetic Types of Inheritance

# 1. Autosomal Dominant (AD)

## Definition

- Only **one mutant allele** is needed to express the disease.
- Affected individuals are usually **heterozygous (Aa)**.
- The mutant allele is **dominant**.

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## Main Features of Autosomal Dominant Inheritance

1. **Vertical transmission**
   - Disease appears in **every generation**
   - Passed from grandparent → parent → child
2. **Both sexes affected equally**
   - Male : female ratio ≈ **1:1**
3. **Both sexes can transmit the disease**
   - Father or mother can pass it to sons and daughters.
4. **Heterozygotes are more common**
   - Most affected people are heterozygous (Aa).
5. **Variable expressivity**
   - Disease severity differs between individuals.
6. **Variable age of onset**
   - Symptoms may appear at different ages.
7. **Homozygotes are usually more severely affected**
   - AA worse than Aa.
8. **May arise from new (de novo) mutations**
   - Example: Achondroplasia.
9. **Gene product usually structural (non-enzymatic) protein**

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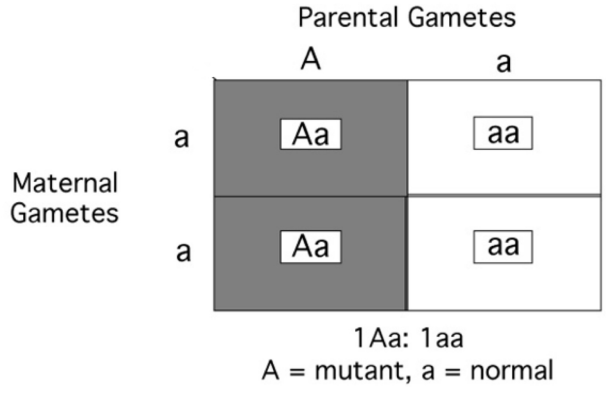
## Transmission Probabilities (AD)

**Aa × aa**

- 50% affected
- 50% unaffected



- **Aa × Aa**

- 75% affected
- 25% unaffected

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# Diseases with Autosomal Dominant Inheritance

## Familial Hypercholesterolemia

- Mutation in **LDL receptor gene**
- Causes elevated LDL cholesterol
- Leads to coronary heart disease
- Homozygotes are more severely affected.

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## Huntington Disease

- Neurodegenerative disorder
- Causes:
  - Dementia
  - Memory loss
  - Loss of motor control
- Late onset (usually 30s–40s).

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## Neurofibromatosis Type 1

- Peripheral nerve tumors
- Café-au-lait spots
- Lisch nodules
- Shows variable expressivity.

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## Myotonic Dystrophy

- Progressive muscle weakness
- Facial muscle weakness
- Cataracts

- Variable onset and expressivity.

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## Marfan Syndrome

- Connective tissue disorder
- Tall stature
- Long limbs
- Lens dislocation
- Aortic aneurysm/rupture risk
- Shows pleiotropy.

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## Achondroplasia

- Most common dwarfism
- Short limbs with normal trunk
- Megalocephaly
- Often due to new mutations.

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# 2. Autosomal Recessive (AR)

## Definition

- Disease expressed only when the individual is **homozygous recessive (aa)**.
- Two mutant alleles are required.

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## Main Features of Autosomal Recessive Inheritance

1. **Horizontal transmission**
    - Usually affects siblings in the same generation
    - May skip generations.
2. **Both sexes affected equally**
    - 1:1 ratio.
3. **Both sexes transmit equally**
4. **Consanguinity may be present**
    - Common in relatives' marriages.

5. **Gene product usually enzymatic protein**
6. **Carriers are heterozygous and usually normal**

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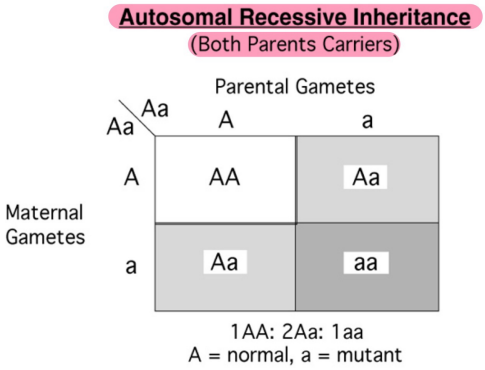
## Transmission Probabilities (AR)

**Aa × Aa**

- 25% affected (aa)
- 50% carriers (Aa)
- 25% normal (AA)
- If a child is unaffected, probability of being a carrier = **2/3**.

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# Diseases with Autosomal Recessive Inheritance

## Cystic Fibrosis

- Defective chloride channels
- Thick mucus accumulation
- Malabsorption
- Common lethal genetic disease in U.S. populations of European descent.

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## Sickle Cell Anemia

- Abnormal hemoglobin
- RBC sickling
- Poor oxygen transport
- Pain, weakness, organ damage
- Heterozygotes partially protected from malaria.

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## Tay-Sachs Disease

- Mentioned as AR example.

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## Phenylketonuria

- Inborn error of metabolism.

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## Albinism

- Lack of pigmentation in:
  - Hair
  - Skin
  - Eyes

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## Inborn Errors of Metabolism

- Most metabolic disorders are AR.

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# 3. X-Linked Recessive (XR)

## Definition

- Males are affected with only **one mutant allele** because they are **hemizygous**.
- Females usually need **two mutant alleles** to be affected.

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## Main Features of X-Linked Recessive Inheritance

1. **Diagonal inheritance**
   - Affected males connected through maternal females.
2. **No male-to-male transmission**
   - Fathers never pass disease to sons.
3. **More common in males**
4. **Full expression in hemizygous males**
5. **Carrier females may have mild symptoms**
   - Due to X-inactivation.

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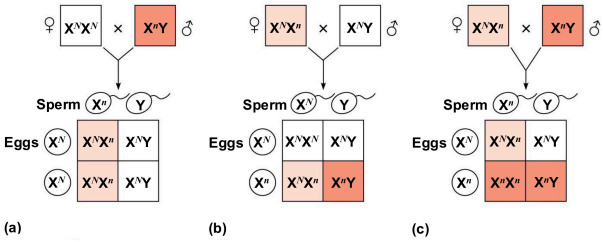
## Transmission Rules (XR)

1. Father never passes disease to son.
2. All daughters of affected males are obligate carriers.
3. Carrier mother:
    - 50% affected sons
    - 50% carrier daughters.

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## Diseases with X-Linked Recessive Inheritance

### Red-Green Color Blindness

- Much more common in males.

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### Duchenne Muscular Dystrophy

- Severe muscle degeneration
- Progressive weakness.

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### Becker Muscular Dystrophy

- Milder form than Duchenne
- Due to different mutation severity.

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### Hemophilia

- Bleeding disorder.

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# 4. X-Linked Dominant (XD)

## Definition

- One mutant allele on the X chromosome is enough to cause disease in both males and females.

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## Main Features of X-Linked Dominant Inheritance

1. **More females affected than males**
   - Approximately twice as many females.
2. **No male-to-male transmission**
3. **Affected father → all daughters affected**
   - No sons affected.
4. **Females usually milder**
   - Due to X-inactivation.
5. **Usually appears in every generation**
   - No skipping generations.

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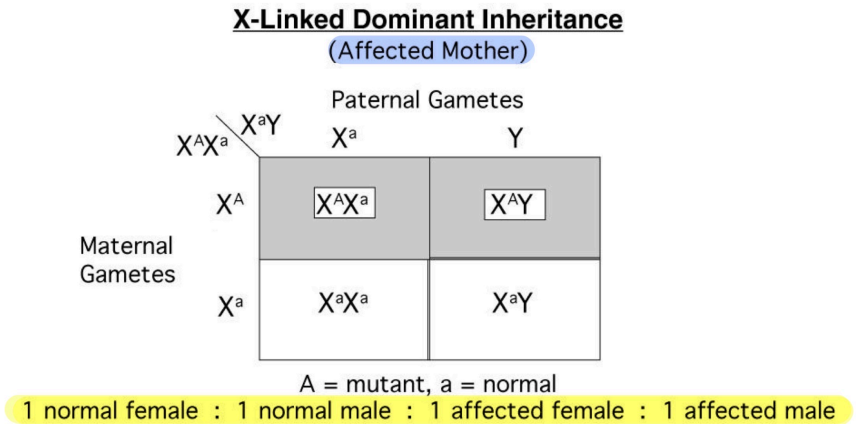
## Transmission Rules (XD)

### Affected father

- All daughters affected
- No sons affected.

### Affected heterozygous mother

- 50% affected sons
- 50% affected daughters.

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## Diseases with X-Linked Dominant Inheritance

### X-Linked Dominant Rickets

- Causes soft bones due to vitamin D metabolism problems.

# The End