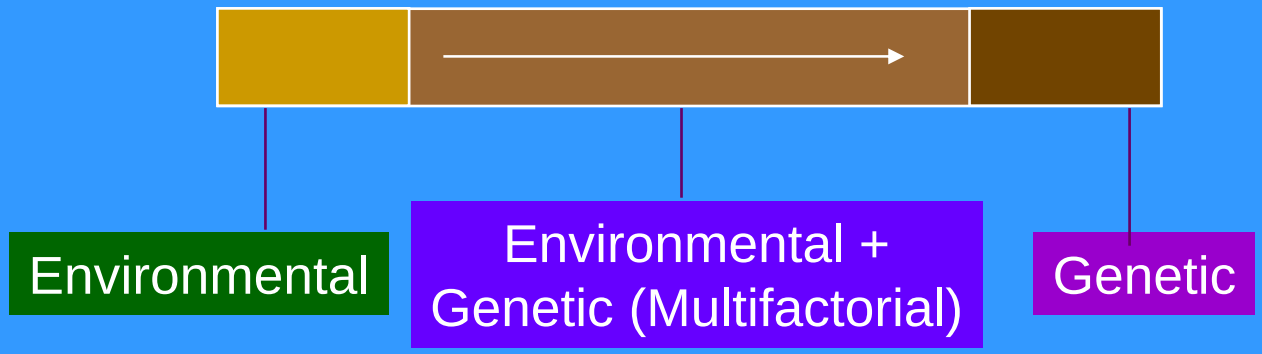
Control and Prevention of Genetic Disorders

- Carrier Detection
- Genetic and Health Counselling

Disease Spectra in Human Population



Over the last 1-2 decades, a significant transition has taken place in the aetiology of diseases affecting mankind where,

Environmentally related disorders have decreased and genetic disorders and non-communicable disorders have become a major cause of morbidity and mortality.

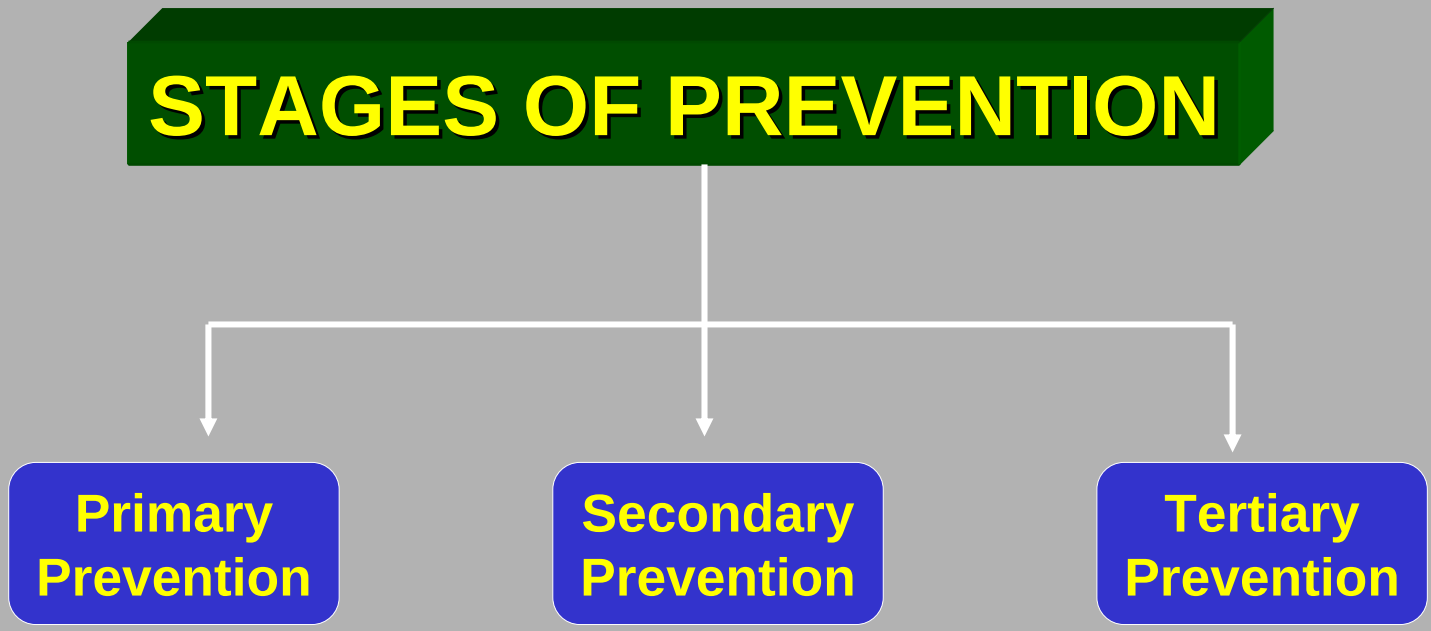
Several single gene, multifactorial and chromosomal disorders occur at a high frequency in several populations

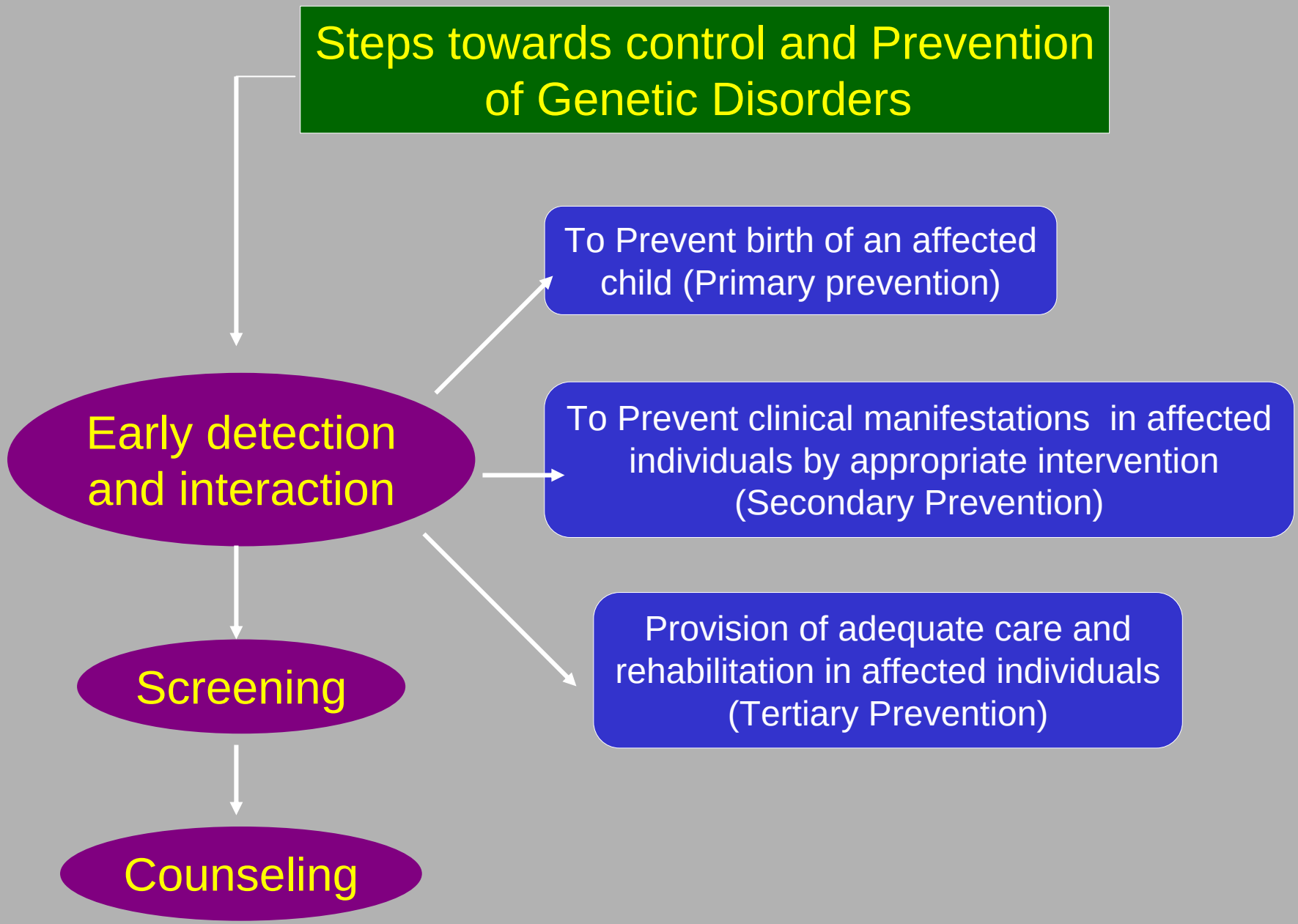
Implementation of control and prevention programs

Can achieve ‘primary prevention’ i.e. prevent the birth of an affected child

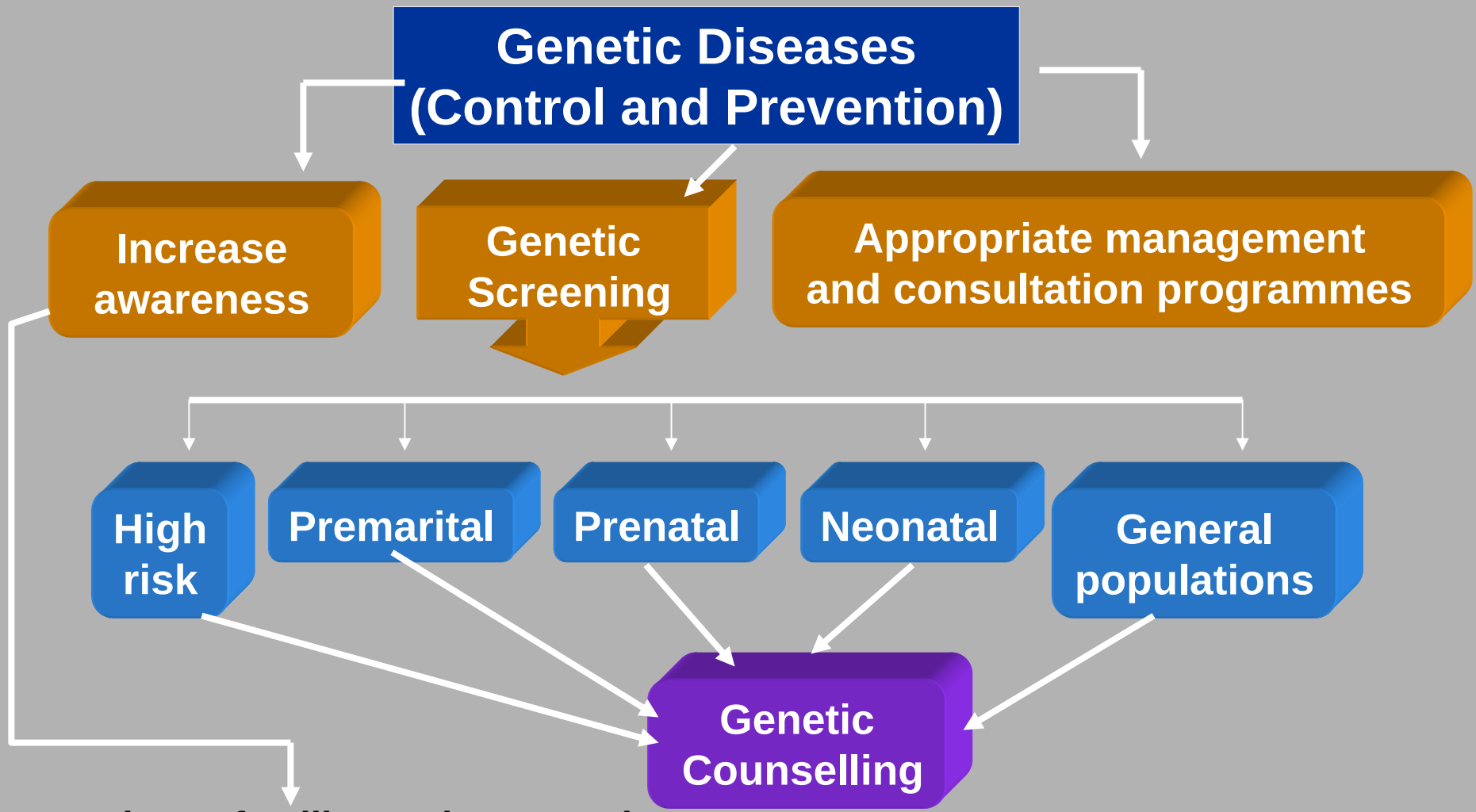
Control and prevention of the Genetic Diseases

- Control and prevention programmes if effectively implemented can reduce the:
  - frequency of homozygous and double heterozygous states
  - morbidity
  - psychosocial trauma
- Successful implementation of control and prevention programmes require awareness amongst:
  - professionals
  - community


STAGES OF PREVENTION
Primary Prevention
Secondary Prevention
Tertiary Prevention

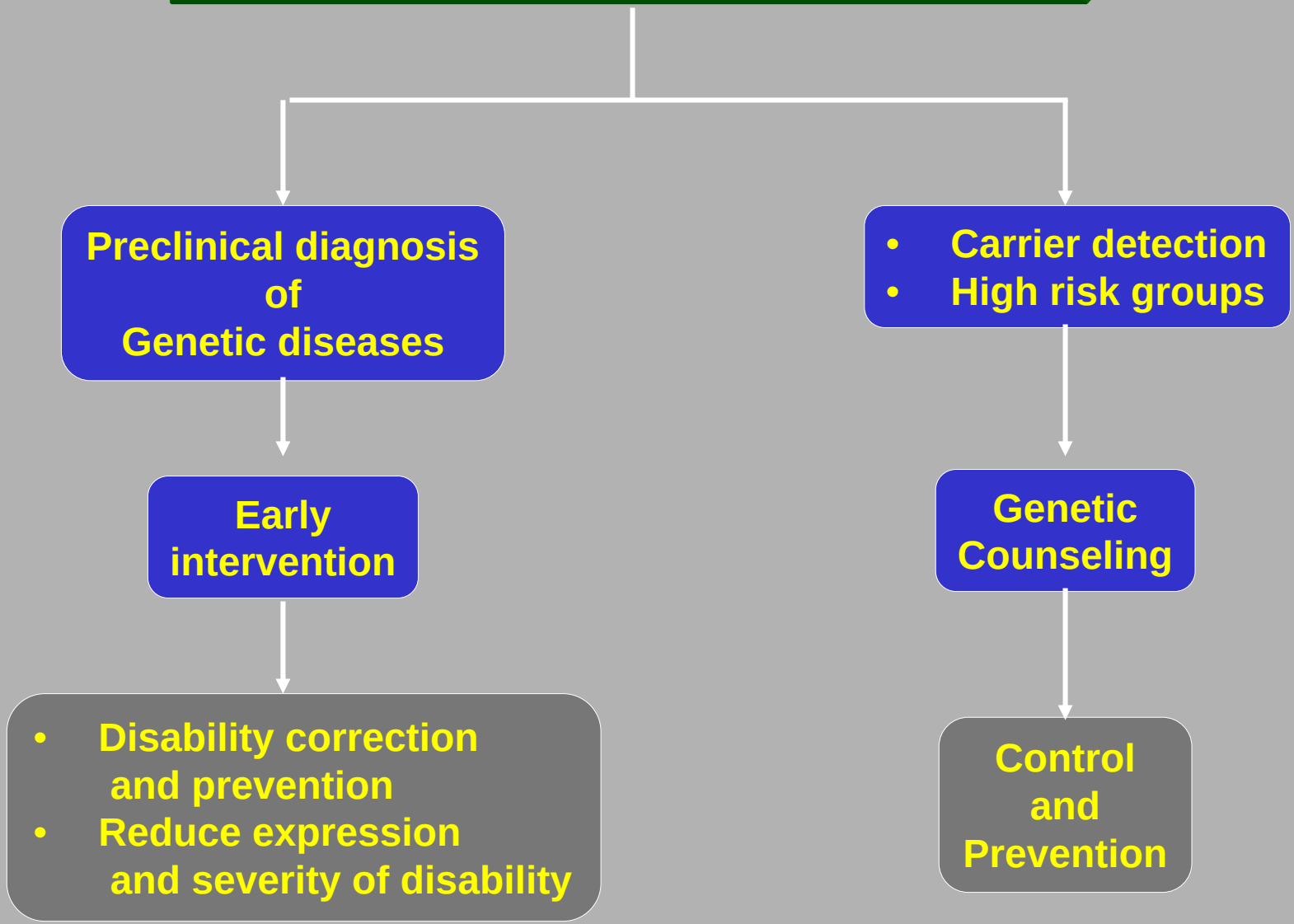

Steps towards control and Prevention of Genetic Disorders
Early detection and interaction
Screening
Counseling
To Prevent birth of an affected child (Primary prevention)
To Prevent clinical manifestations in affected individuals by appropriate intervention (Secondary Prevention)
Provision of adequate care and rehabilitation in affected individuals (Tertiary Prevention)

Control and Prevention Programmes For Genetic Diseases



- Patients, families and community
- Clinical staff and premedical personnels
- Health policy makers and administration

PREVENTIVE SCREENING



Examples of primary prevention of genetic diseases

- Carrier detection
- Premarital
- Preconception
- Preimplantation

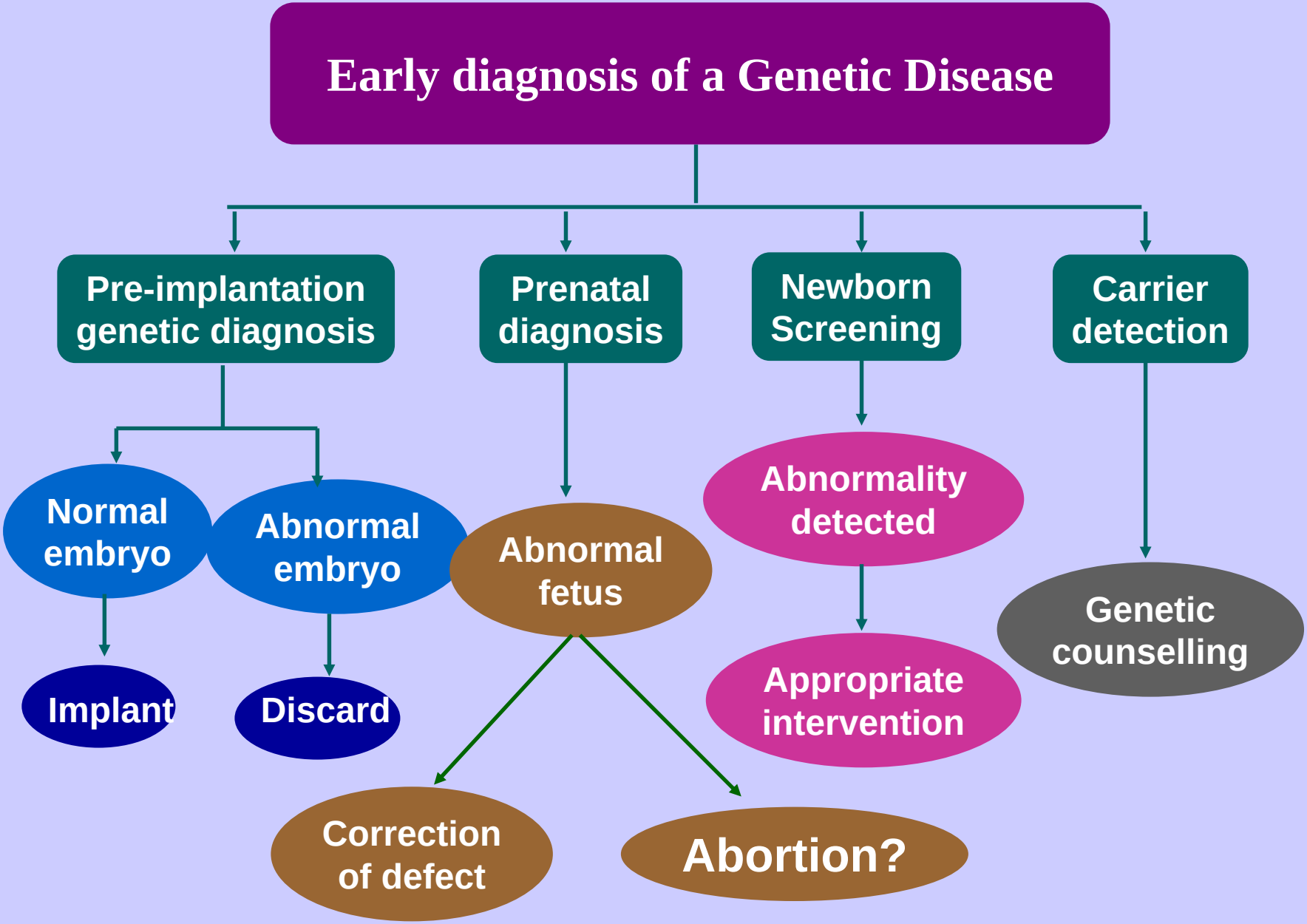
→ Genetic Counselling → To prevent the birth of an affected child

Vaccinating the females against Rubella → Prevention of genetic defects in the fetus

Folic acid supplementation prior to and during pregnancy → Prevention of neural tube defect in newborn

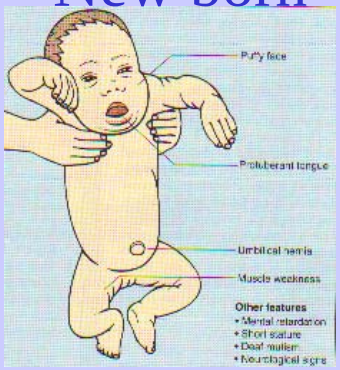
Early Detection and Intervention

- Early detection is possible for several diseases using genetic engineering techniques.
- Early and appropriate intervention plays a key role in either preventing the genetic disease or reducing the severity of its clinical manifestations.


Early diagnosis of a Genetic Disease
Pre-implantation genetic diagnosis
Prenatal diagnosis
Newborn Screening
Carrier detection
Normal embryo
Abnormal embryo
Abnormal fetus
Abnormality detected
Genetic counselling
Implant
Discard
Appropriate intervention
Correction of defect
Abortion?

Prevention of Congenital Hypothyroidism

New born

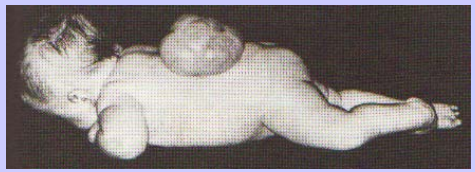


Neonatal Screening

Hormone Replacement Therapy

Prevention of congenital hypothyroidism

Prevention Of Neural Tube Defect



NTD

Normal baby

Folic Acid supplementation prior to & during Pregnancy

Detection and Intervention of Carrier`

Carrier detection

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Genetic Counselling

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Primary Prevention

(Prevention of birth of a child with homozygous or double heterozygous state)

Population, Premarital and preconception Screening

Objectives

To identify carriers for a particular gene defect

To identify individual with a genetic predisposition to a disease

Genetic counseling for prevention of birth of affected child

Genetic counseling to prevent or delay disease development

Autosomal Recessive Disorders Suitable for Population Screening

- α-thal.
- β-thal.
- Hb S.
- G-6-PD deficiency.
- Cystic fibrosis.
- Tay-Sachs disease.
- Multifactorial disorders are included in several population screening programs

Screening for carriers of recessive genetic diseases

The following criteria must be met

(I) Disease presentation is severe.
(ii) Screening is directed towards high risk population
(iii) Availability of an inexpensive sensitive and specific test.
(iv) Reproduction options are available to couples found to be at risk.
(v) Genetic counselling is available.

Examples of screening to identify individuals at increased risk of having children with genetic diseases

Screening for Hb S or β-thalassaemia

Both partners carriers

Genetic counseling

Prevent the birth of an affected child

Screening programs for β-thal. in Greece and Italy have resulted in a drop in the incidence of affected homozygotes by almost 95%.

Premarital Screening for β-thalassaemia in Cyprus

The success of a genetic screening program can be judged on the basis of a reduction in the births of affected babies.

In 1974:	Birth incidence of β-thal. major = 1 in 250.
	Introduction of a comprehensive screening program to determine carrier status of young adults and premarital couple.
1984:	Incidence of affected babies declined by over 95%.
1990's:	No new birth of a β-thal. major baby.

Screening for presymptomatic individuals at risk for adult-onset genetic disease

e.g.:

- Diabetes mellitus?
- Coronary heart disease?
- Breast cancer.
- Colon cancer.
- Ovarian cancer.

Examples of screening to identify individuals with a genetic predisposition to a disease

Screening for familial hypercholesterolemia (FH)

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Identification of heterozygous carriers of FH
(at increased risk of premature coronary artery disease)

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Control of environmental factors
e.g. cigarette smoking, diet and exercise

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Prevention or delayed development of CAD

Prenatal Screening

Prenatal Screening in High Risk Group

To identify affected fetus

Termination of pregnancy

Before 120th day

Acceptability of termination?

- Genetic counselling to prepare the couple psychologically.
- Preparation for adequate management and care of affected child.

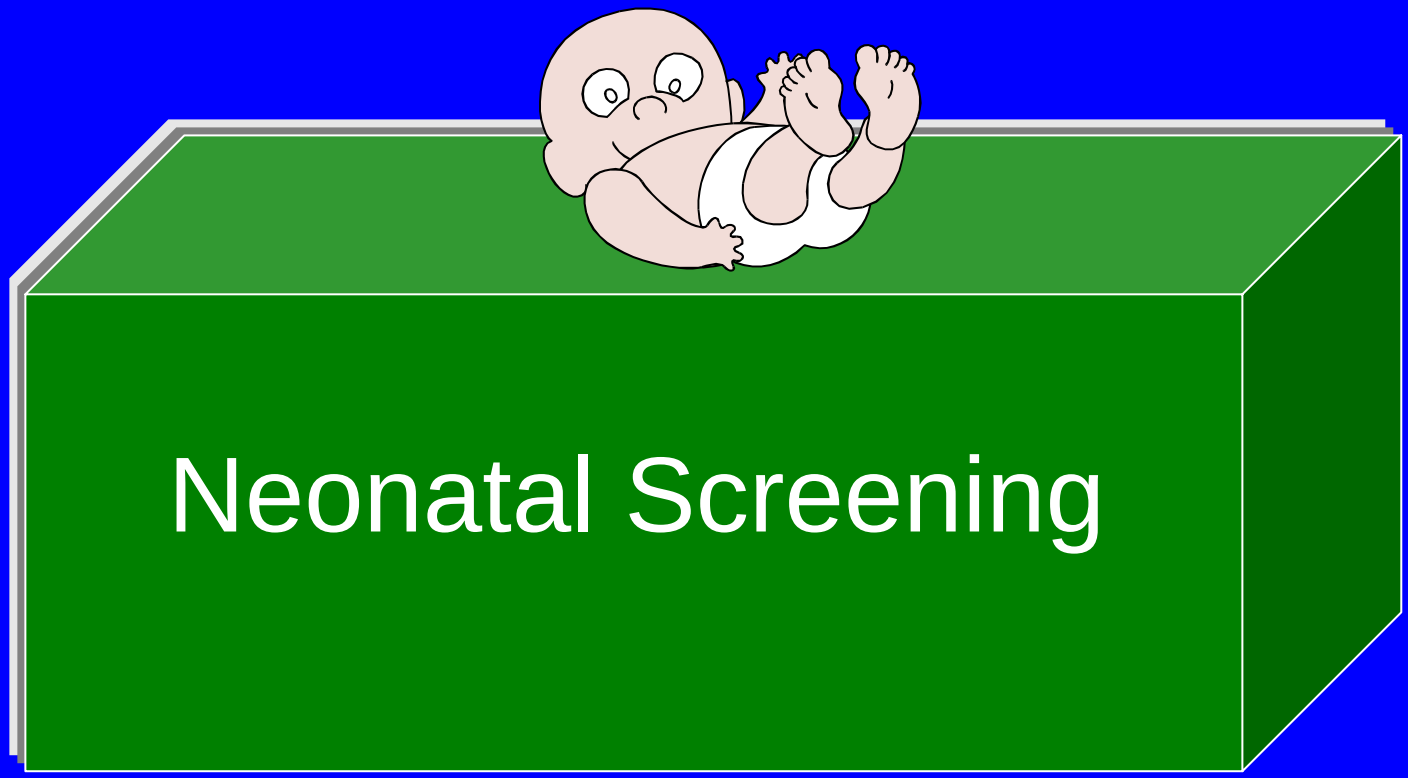
“Multiple Markers Screening”

Screening for a genetic disease using two or more markers

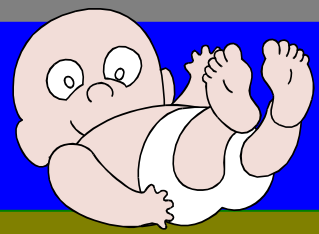
e.g. Triple test*
for Down Syndrome in pregnant females

- αFP
- βHCG
- UE3

*The American College of Medical Genetics recommend that the riple test should be offered to all pregnant woem”


Neonatal Screening

Neonatal screening for identification of neonates with a genetic disease



Screening in new borns

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Recognition of affected newborn

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Dietary restriction or appropriate management

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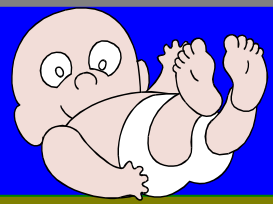
Prevention of severe clinical presentation

Examples of screening for identification of neonates with a genetic disease



Phenylketonuria screening in newborns

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Recognition of PKU in new born

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Dietary restriction of Phenylalanine

⇣

Prevention of severe mental retardation and other clinical manifestations.

Newborn screening for treatable and/or preventable diseases

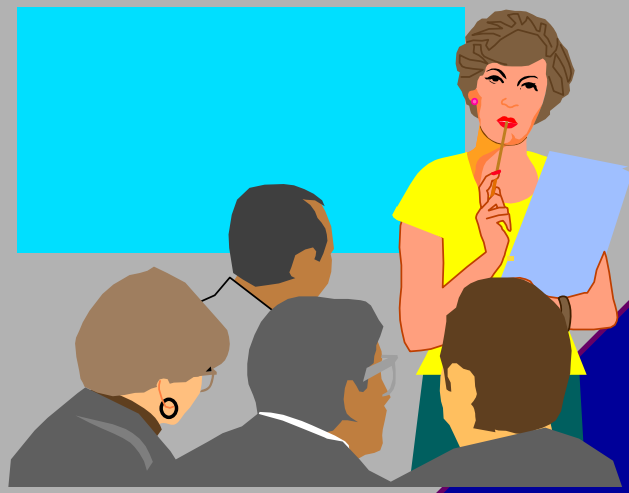
In several countries newborn screening is carried out for:

- Phenylketonuria.
- Congenital hypothyroidism.
- Sickle cell disease.
- Congenital adrenal hyperplasia.
- Galactosemia.
- Biotinidase deficiency.
- Maple syrup urine disease.

Genetic Counseling

Genetic Counselling

A educational process by which patients or/& at risk individuals are given information to understand the nature of the genetic disease, its transmission and the options open to them in management and family planning.



Genetic counselling -
an integral part
of the management of
patients and families
with
genetic disorders

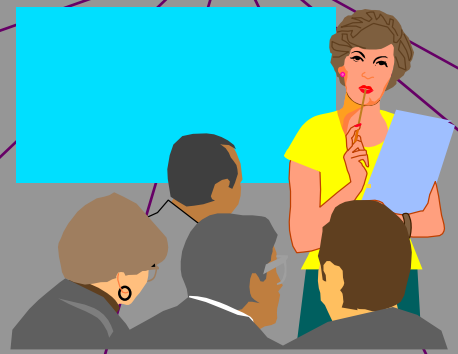
Genetic Counselling

An essential component of health counselling

For control of diseases with partial or complete genetic aetiology

- Single gene disorders
- Chromosomal anomalies
- Multifactorial disorders
- Mitochondrial disorders

Essential Components of Genetic Counselling



History and pedigree construction

Clinical Examination

Confirmatory diagnosis

- History findings
- Clinical examination findings
- Radiology findings
- Laboratory parameter results
- DNA studies results
- Others

Calculation of recurrence risk

Counseling

Available options

Follow-up

COMPONENTS OF GENETIC COUNSELLING TEAM FOR CONGENITAL MALFORMATION

- Clinical Geneticist
- Obstetric.Gynaecologist
- Neonatologist
- Pediatrician
- Internist
- Cytogeneticist
- Molecular biologist
- Laboratory technologist
- Radiologist
- Data Analyst

One or more of these specialists

Comprehensive Genetic Counselling

The Genetic Counselling Process

Beneficiaries → **Individual or couple seeking counselling**

Why?
- Have affected child
- Are carriers
- Have genetic disease in family
- Have recurrent abortions
- High maternal/paternal age
- Exposed to a mutagen/teratoge
- Are consanguineous

Counselling elements

Reaching accurate diagnosis

- Family history
- Physical/clinical examination
- Cytogenetic studies/radiology
- Laboratory/DNA analysis

Estimation of recurrence risk

- Family pedigree
- Applying various risk calculation methods:
  - Bayesian
  - Mendels

Genetic counselling

- Available options
- Risk calculations
- New developments, etc.
- Disease course
- Treatment availability

Decision making

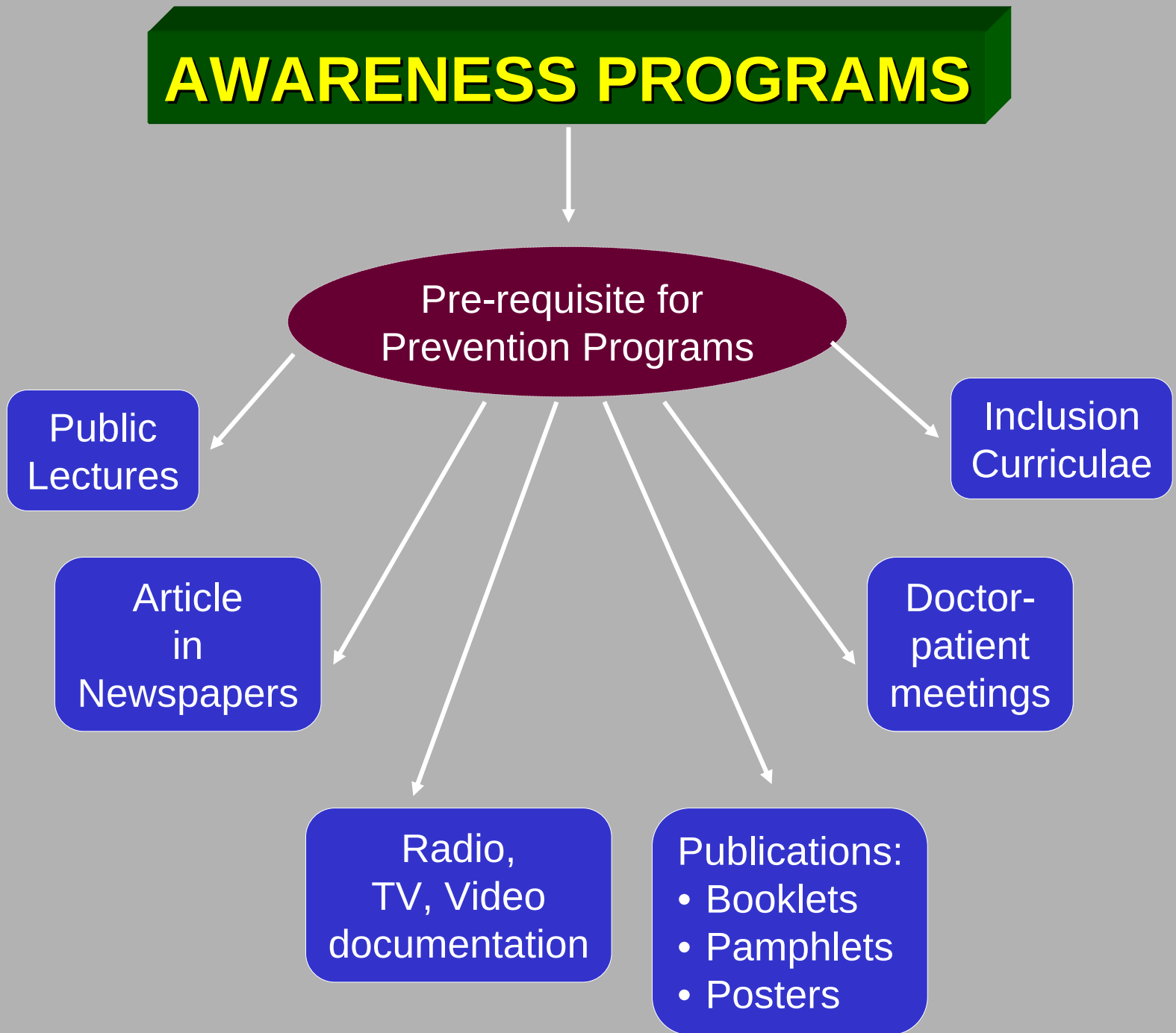
Knowledge of disease recurrence
- Non-directive
- Available options
- Family pressure
- Religious beliefs
- Social status
- Economic status
- Community influence

FUTURE STRATEGIES FOR CONTROL OF GENETIC DISORDERS

- Determine the frequency and distribution of genetic disorders in the population.
- Construct data bases of genetic disorders.
- Establish care and counselling facilities.
- Establish programs for carrier detection.
- Provision of appropriate counselling.
- Increase awareness of the genetic defects.
- Better understanding of molecular pathology of genetic defects.
- Update information.

AN ESSENTIAL ELEMENT OF ALL CONTROL AND PREVENTION PROGRAMS IS:

AWARENESS


AWARENESS PROGRAMS
Pre-requisite for Prevention Programs
Public Lectures
Article in Newspapers
Radio, TV, Video documentation
Publications:
• Booklets
• Pamphlets
• Posters
Doctor-patient meetings
Inclusion Curriculae