

MICROBIOLOGY

- An Overview



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Introduction

- Major Achievements of Medical Sciences in the 20th Century
 - Microbiology
 - DNA Sequencing
 - Surgical Techniques
 - Pharmaceuticals
- Lower Mortality Rates (Especially Maternal and Neonatal)
- Improved Quality of Life
- Higher Human Life Expectancy



Human Life Expectancy

- UNITED STATES:
 - In 1900... < 50 YEARS
 - In 2000... ~ 77 YEARS
- GLOBALLY:
 - In 1955.... ~ 48 YEARS
 - In 1997... ~ 66 YEARS
 - an increase of ~ 38% in 40 years!

Global Mortality from Selected Infectious and Parasitic Diseases and Syndromes

<u>Disease</u>	<u># of Deaths</u>	<u>% of all Deaths</u>
Acute lower respiratory infection	3,745,000	7.2
Tuberculosis	2,910,000	5.6
Diarrheal disease	2,455,000	4.7
HIV/AIDS	2,300,000	4.4
Malaria	1,500,000	2.9
Measles	960,000	1.8
Hep B	605,000	1.2
Pertussis	410,000	0.8
Neonatal tetanus	275,000	0.5
Dengue fever	140,000	0.3

Based on 52.2 million estimated deaths, 1997 estimate

From World Health Organization, World Health Report, 1998. Geneva.



Infectious Diseases

- Understanding and Treating ID a Major Contribution
 - Improved Sanitation
 - Hygienic Practice
 - Food & Water Safety
 - Development & Administration of Vaccines
 - Discovery, Development & Production of Safe and Effective Antimicrobials

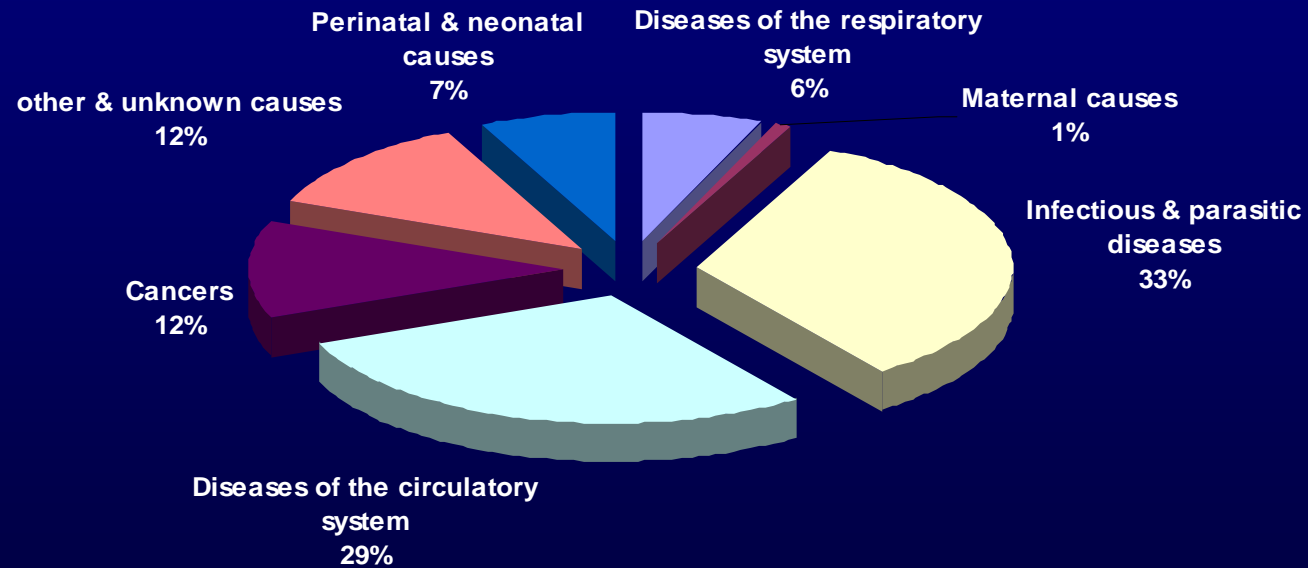


Infectious Diseases

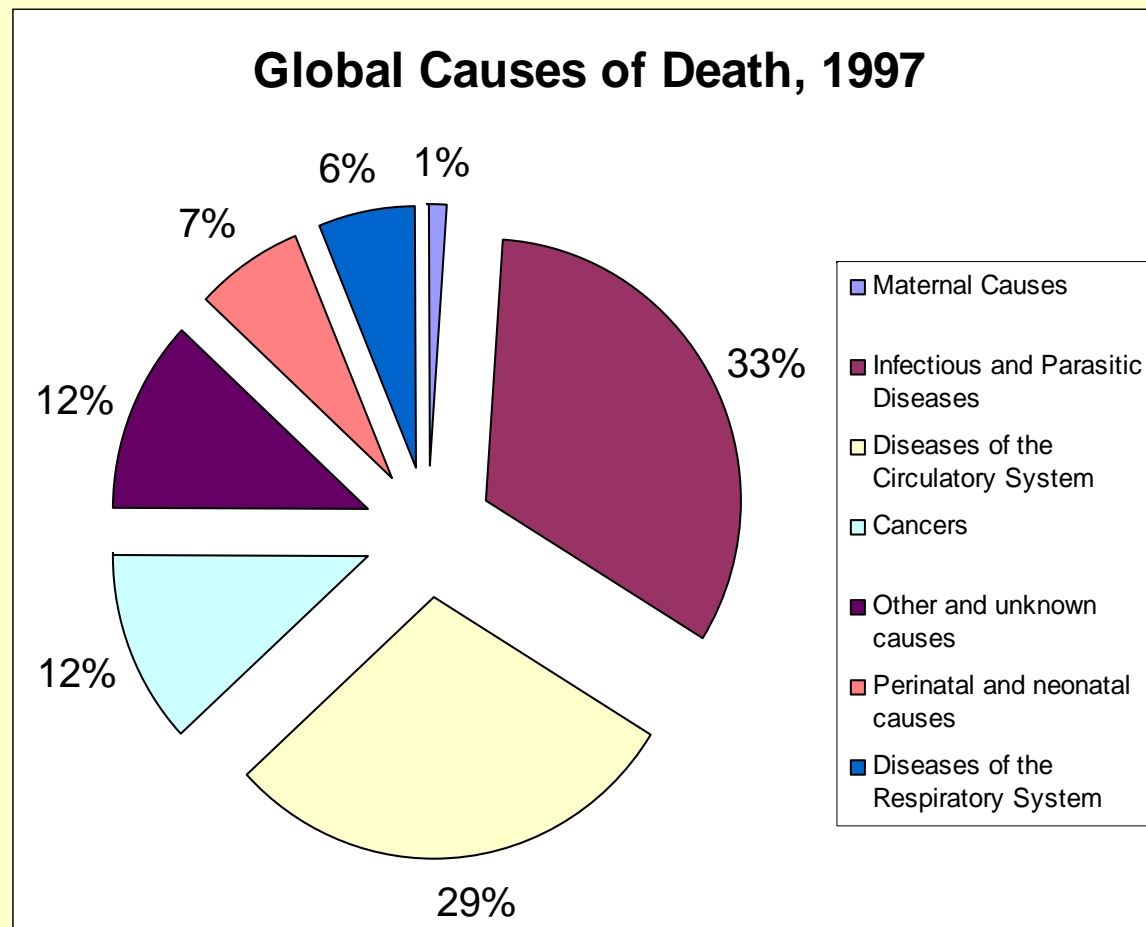
...still a global threat

- In Light of Major Advances, ID Remain the Leading Cause of Morbidity and Mortality.
- According to the World Health Organization (WHO), 1 in 3 Deaths Is Due to an Infection.

Global causes of death, 1997



Global Mortality from Infectious Diseases





INFECTIOUS DISEASES

- Condition Of The Human Body When Exposed To A Microbial Agent Causing Deviation From Normal State, Therefore Disease
- When A Person Presents With Signs And Symptoms Of Altered Physiology Or Damage, When Exposed To A Microbial Agent



Factors Influencing Infection

- *PATHOGEN*
- *VIRULENCE or INFECTIVITY*
- *HOST DEFENSES*
- *ROUTES OF TRANSMISSION*



PATHOGEN

- Usually a microscopic organism with the capacity to cause a disease
- Generally, a pathogen is one or more of:
 - Bacteria
 - Viruses
 - Parasites (worms or protozoa)
 - Fungus
- Severity of disease depends on the load (or number of) of pathogen
- And rate of multiplication (or replication) of the pathogen



VIRULENCE or INFECTIVITY

- Strength of the Infection
- Type or Strain of Pathogen
- Weakness of the Host Being Infected
- Favorable Environment
- Special Characteristics



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HOST DEFENSES

- Natural ways for the human body to fight off diseases
- Passive immunity by vaccinations to protect the body against infections
- When impaired, the host defenses are weakened to fight infections



HOST DEFENSES

- Natural Barriers of the Body
- Antibodies or Immunoglobulins Production
- Cellular Immunity by Phagocytosis
- Soluble Factors



Natural Barriers of the Body

- Skin/mucous Membrane
- Respiratory Tract.
- Intestinal
- Genitourinary
- Eye



Immunoglobulin Production

- Mediated by B-lymphocytes, a Subset of the White Blood Cells
- *Antibodies Are Very Specific in Binding to Certain Target Antigen on the Pathogen, Prior to Destroying the Pathogen*
- 5 Known Subclasses of Immunoglobulins, Classified by Their Structural Morphologies



Immunoglobulin Subclasses

■ *IgM*

- First to Form in Newborns/Infants
- First to Respond to a New Pathogen
- ~ 10% of All Immunoglobulins



Immunoglobulin Subclasses (cont.)

■ IgG

- Most abundant, ~ 75% of all Ig's
- Transplacental; provides primary immunity in first six months of life
- found in lower respiratory tract
- 4 known subclasses



Immunoglobulin Subclasses (cont.)

■ IgA

- Small Amount in Serum
- Found in Many Other Body Fluids (Breast Milk, Saliva, Stomach Lining)



Immunoglobulin Subclasses (cont.)

- *IgD*

- Less Than 2% in Serum
- Function Not Clear

- *IgE*

- Most Understood in Role of Hypersensitivity (Ex. Asthma)
- Role in Host Defense Not Well Understood



OTHER HOST IMMUNITY

- *Cellular Immunity* - Phagocytosis of Pathogen or Modified Pathogen by Natural Killer Cells or Macrophages
- *Soluble Factors* - to Trigger and Maintain an Inflammatory Reaction



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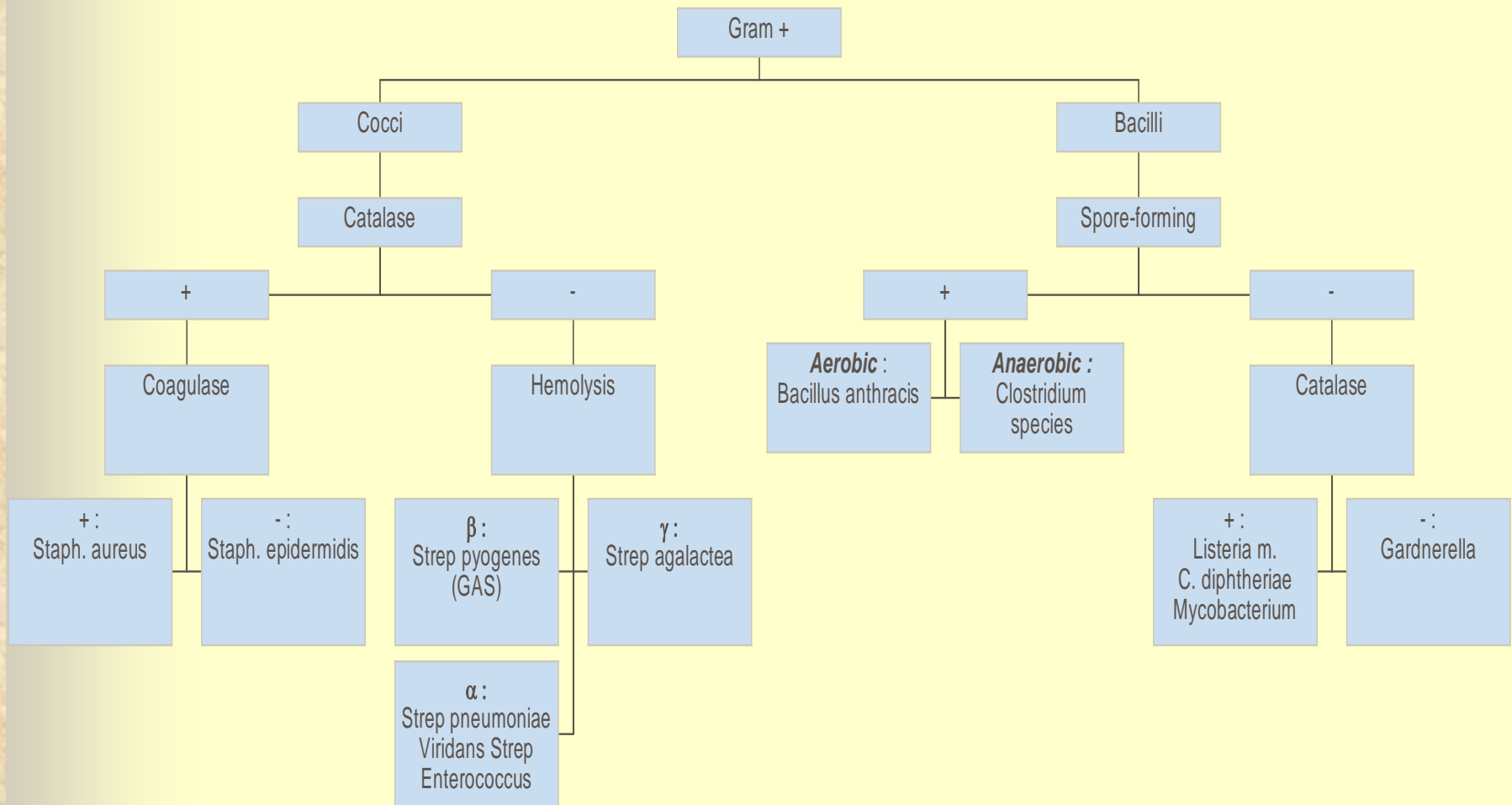
ROUTES OF TRANSMISSION

- From Person to Person
 - Direct Contact
 - Respiratory Droplets in Coughing

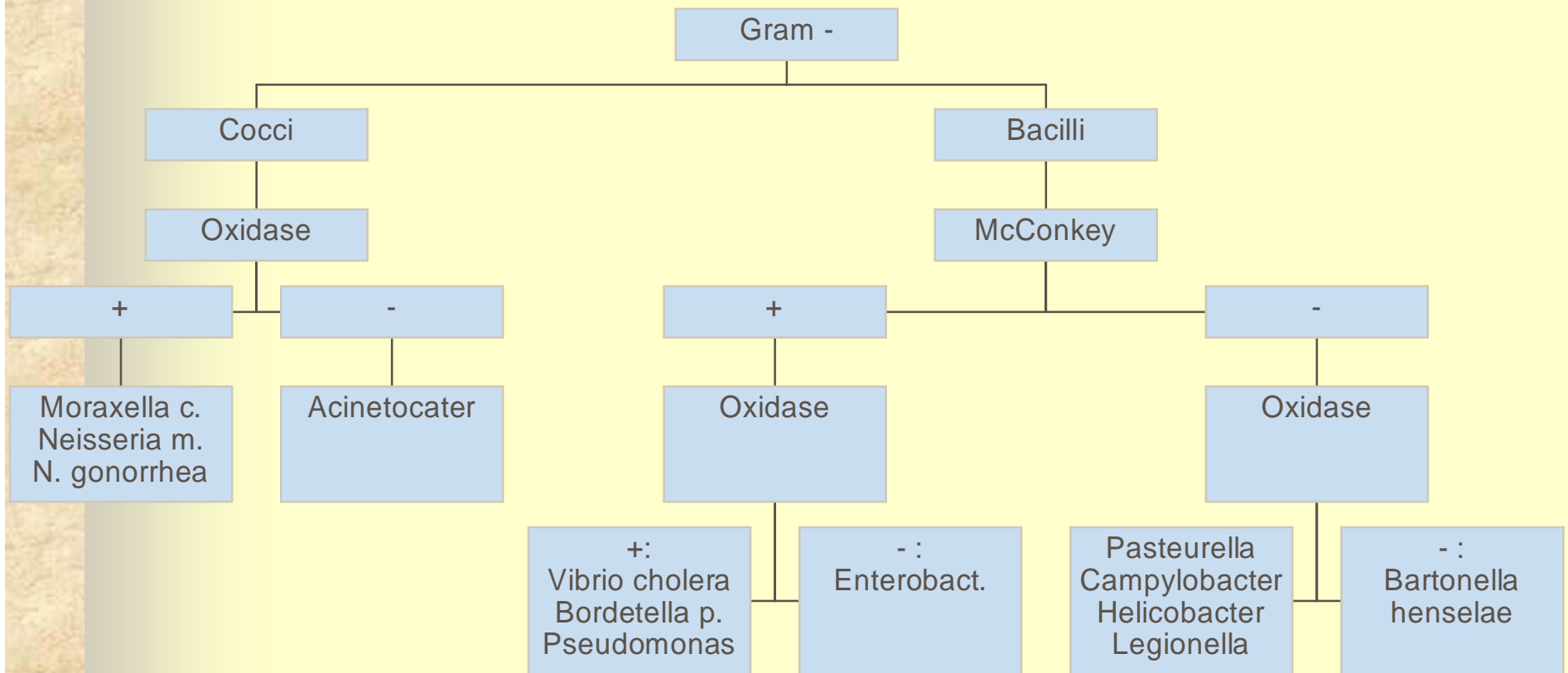
- In Food or Soil (Vehicle-borne)

- Vector-borne

Classification of Bacteria



Classification of Bacteria





Anti-Microbials- Historical

- **China** >2500 years ago: moldy soybean skins for boils
- **Greeks:** wine & inorganic salts for wound
- **1900's** : Heavy metals (Bismuth & Arsenic), used for syphilis
- **1928:** Dr. Fleming discovered penicillin
- **1936:** Discovery of sulfamides
- **1941:** first successful production of penicillin
- **Post World War II:** increase in knowledge of anti-bacterials/anti-virals/anti-fungals



Choosing Anti-Microbials

- Identity of pathogen strongly suspected, based on clinical information
 - lab-based evidence
 - biostatistics
- Susceptibility (or potential) is supported



Choosing Anti-Microbials

- Understanding the Particular Characteristics of the Drug Agent
 - Pharmacokinetics
 - Pharmacodynamics



Choosing Anti-Microbials (cont.)

- Host factors
 - Site of infection
 - Age
 - Co-Morbidity
 - Allergy History
 - Pregnancy - teratogenic effects



Choosing Anti-Microbials (cont.)

- Synergy
 - Trimethoprim/Sulfonamide
 - Penicillin/Aminoglycosides
- Cost
- Adverse Effects/Safety
- Route of Administration (oral, intravenous)



Table Antimicrobial of Choice



Table Antimicrobial of Choice (cont.)



Disease Prevention & Control

■ Goals:

- Prevent Transmission of Pathogen
- Early Diagnosis & Treatment of Suspected Infection
- Reduce Morbidity & Mortality
- Reduce Costs of Health Care



Disease Prevention & Control

- Individual
- Institution
- Community
 - Chlorination of Water
 - Food Irradiation
 - Condom Distribution
- Global



Disease Prevention & Control

- *Communicability More Alarming in Recent Time:*
 - Increased Foreign Travel
 - High Rate of Migration
- *Disease Control in Any One Region Depends Heavily on Global Interaction and Cooperation*



Future Challenges

- Development of Vaccines for Known Diseases
- Antimicrobial Resistance
- Unexpected Epidemics
- Biological Warfare/terrorism
- Chronic Diseases Linked to Infectious Causes