Introduction to Enterobacteriaceae

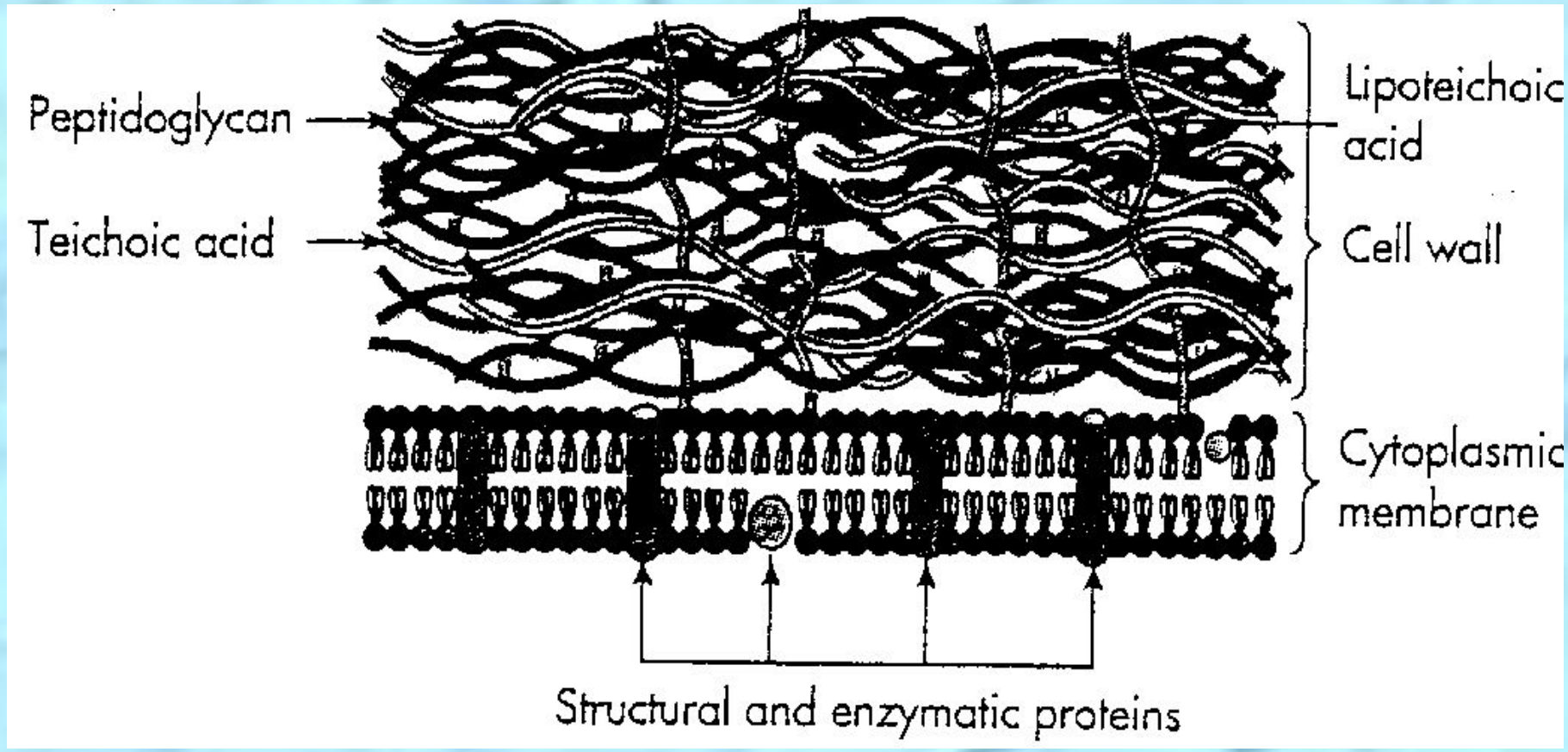
Enterobacteriaceae

- Small **gram-negative rods** (2-5 by 0.5 microns)
- Most motile with **peritrichous flagella**
  - *Shigella* and *Klebsiella* are nonmotile
- **Oxidase-negative facultative anaerobes**
- **Reduce nitrate**
- **Ferment glucose** and other carbohydrates
- Many genera
  - *Escherichia*, *Salmonella, Shigella, Klebsiella, Proteus, Enterobacter, Yersinia*, etc.
- Some strains **opportunistic** pathogens
- Some strains **true pathogens**
  - *Salmonella*, *Shigella*, *Yersinia*, some strains of *E. coli*

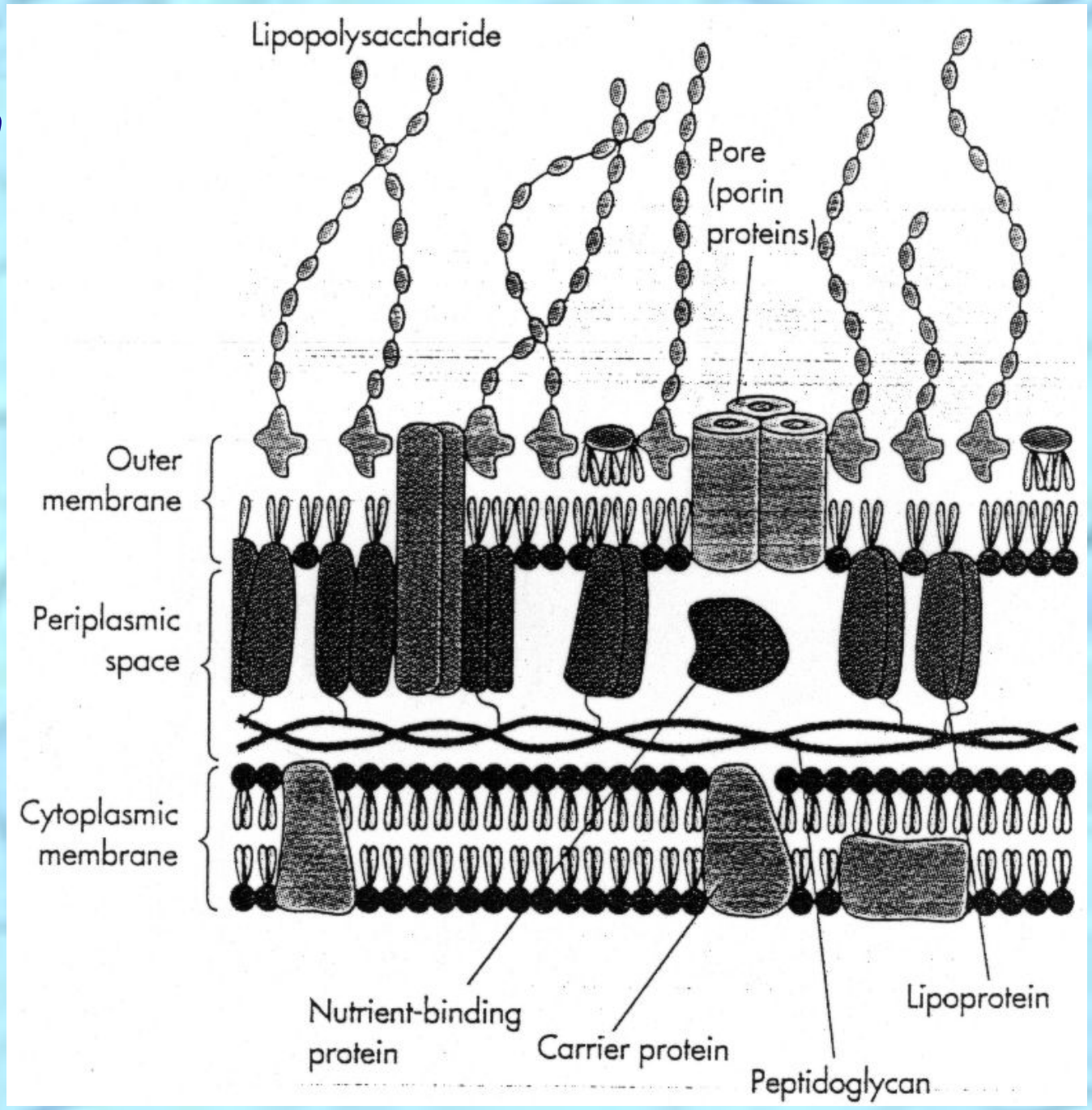
Distinguishing Properties Associated with All Enterobacteriaceae:

- **Ferment glucose**
- **Reduce nitrates**
  - NO_3 to NO_2 or all the way to N_2
- **Oxidase negative**

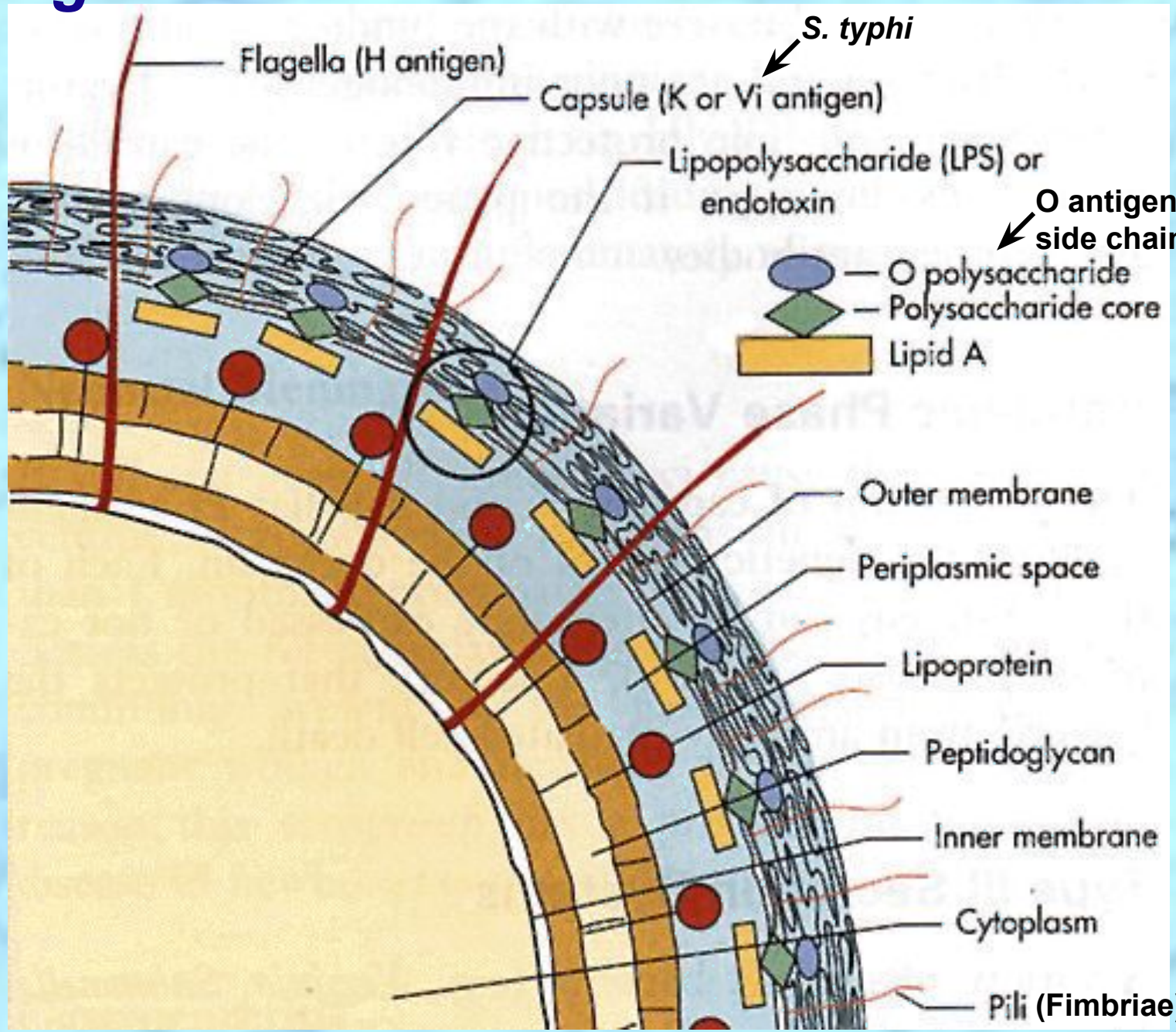
Gram-Positive Cell Wall

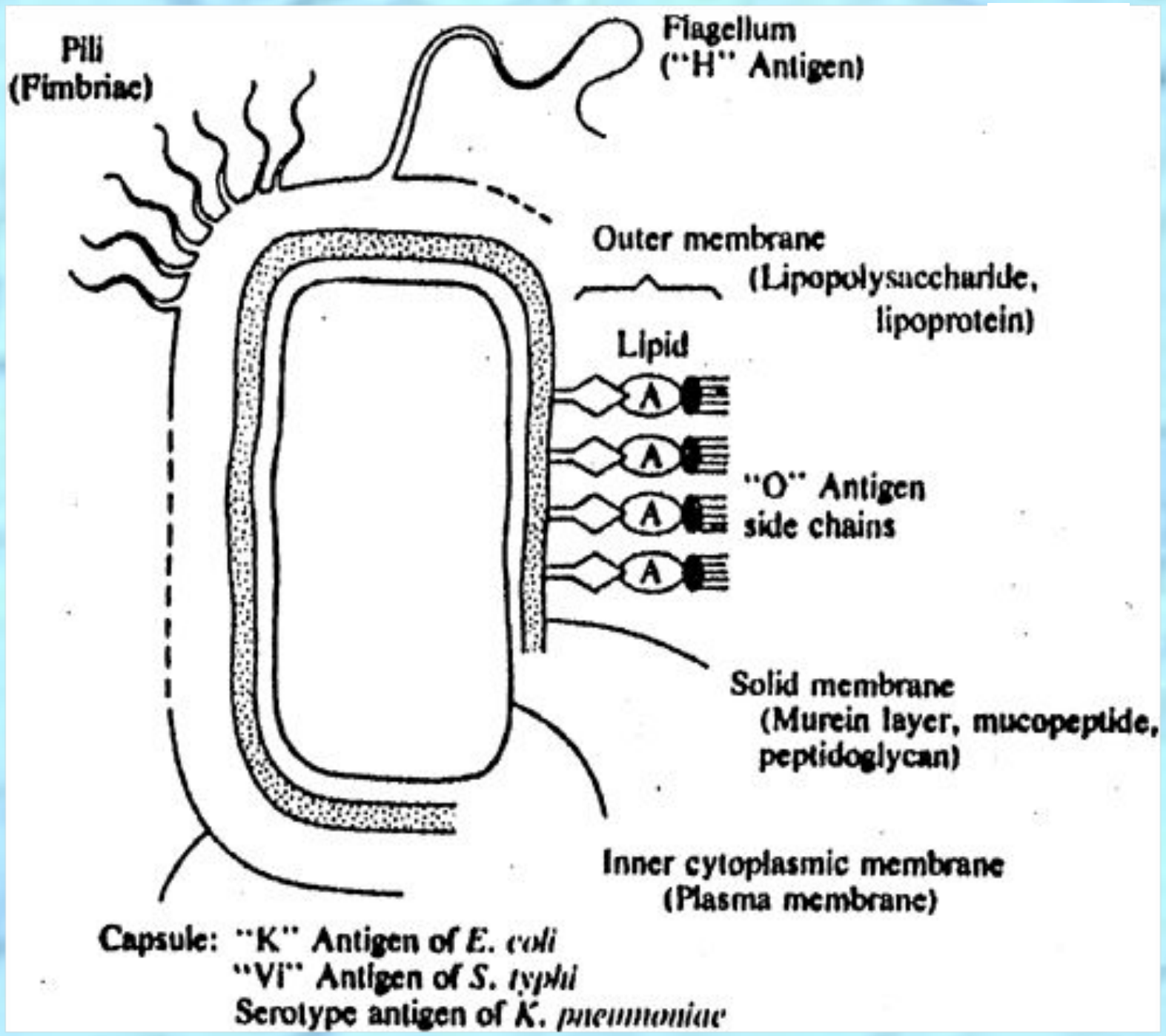


Gram-Negative Cell Wall

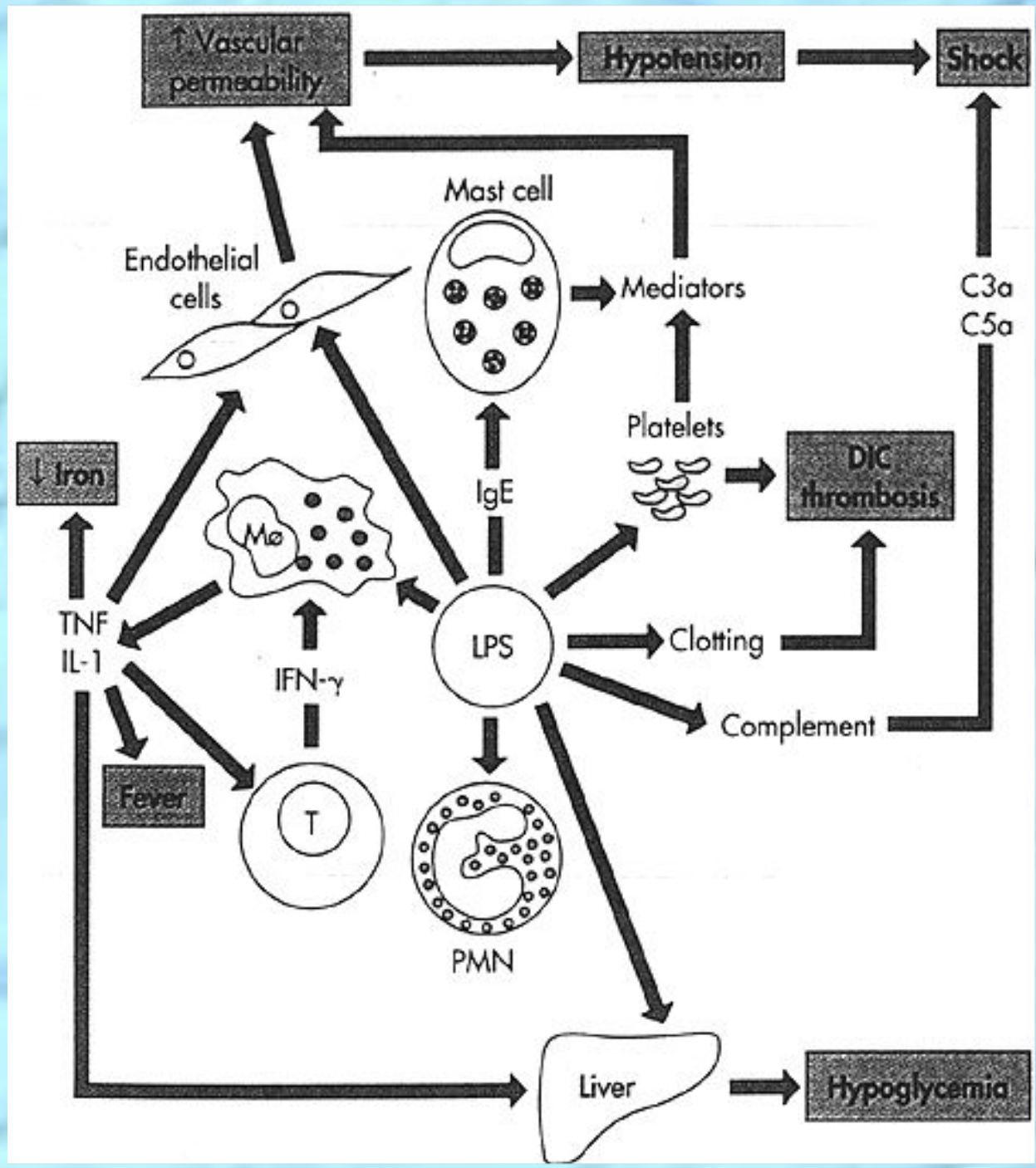


Antigenic Structure of Enterobacteriaceae



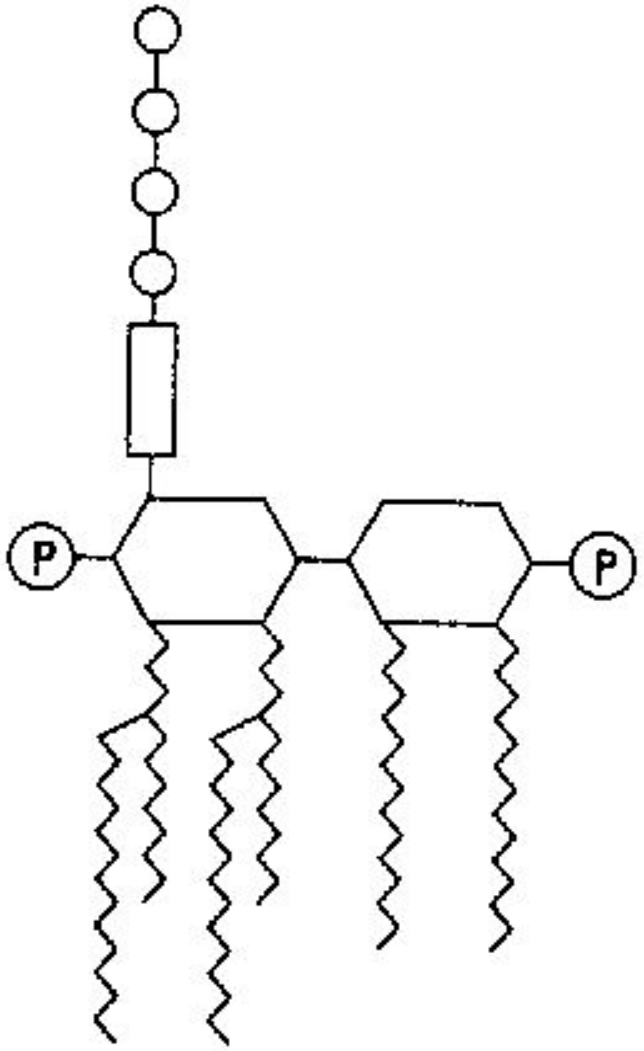

Pili
(Fimbriae)
Flagellum
("H" Antigen)
Outer membrane
(Lipopolysaccharide,
lipoprotein)
Lipid
"O" Antigen
side chains
Solid membrane
(Murein layer, mucopeptide,
peptidoglycan)
Inner cytoplasmic membrane
(Plasma membrane)
Capsule: "K" Antigen of E. coli
"Vi" Antigen of S. typhi
Serotype antigen of K. pneumoniae

Diversity of Activities Associated with LPS



EXOTOXIN	ENDOTOXIN
1. Released from the cell before or after lysis	1. Integral part of cell wall
2. Protein	2. Endotoxin is LPS; Lipid A is toxic component
3. Heat labile	3. Heat stable
4. Antigenic and immunogenic	4. Antigenic; ??immunogenicity
5. Toxoids can be produced	5. Toxoids cannot be produced
6. Specific in effect on host	6. Many effects on host
7. Produced by gram-positive and gram-negative organisms	7. Produced by gram-negative organisms only

Structure of Lipopolysaccharide



Repeat units (up to 40)

Core

Disaccharide-diphosphate

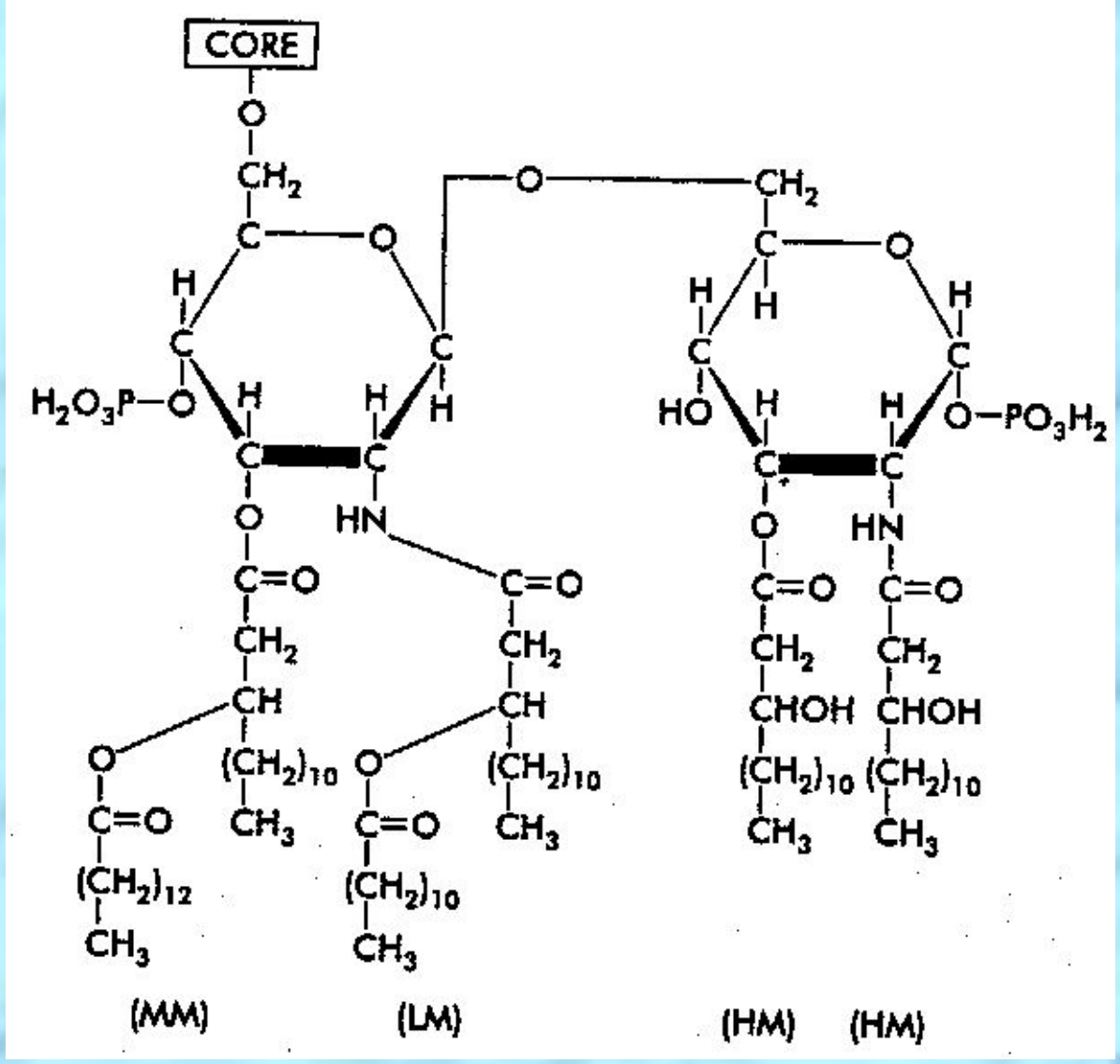
Fatty acids

O Antigen

Core polysaccharide

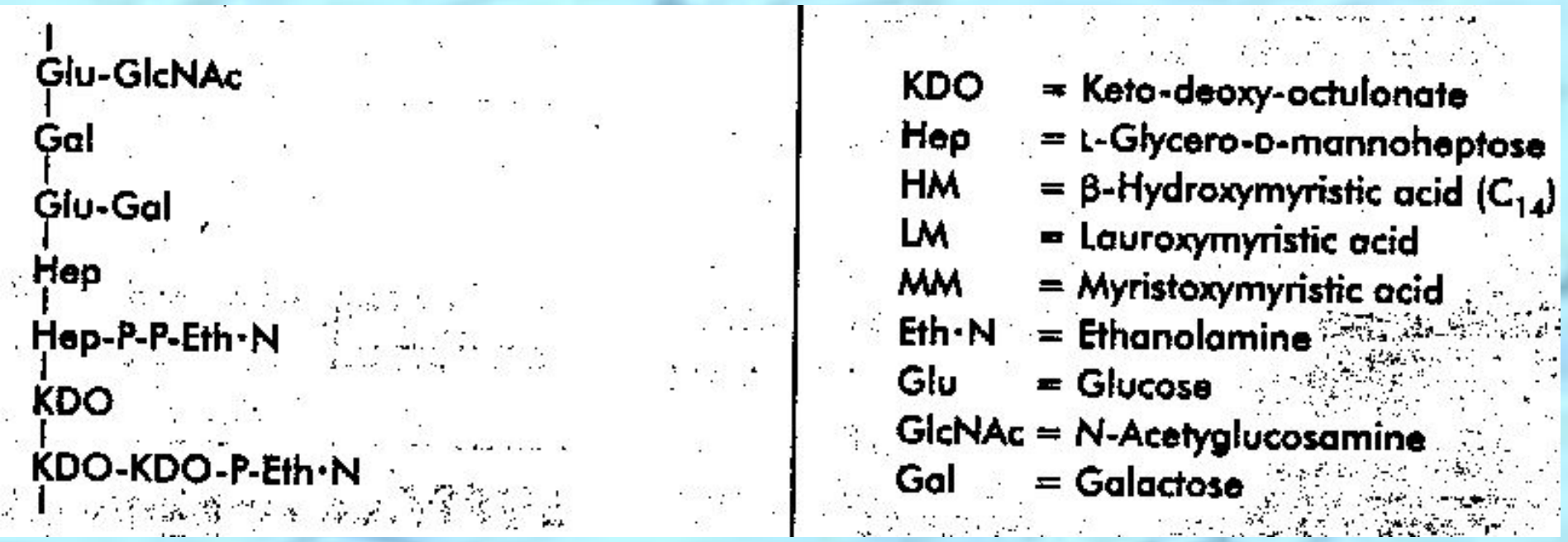
Lipid A

Structure of Lipid A



- **Hydrophobic** Lipid A is **endotoxic component**

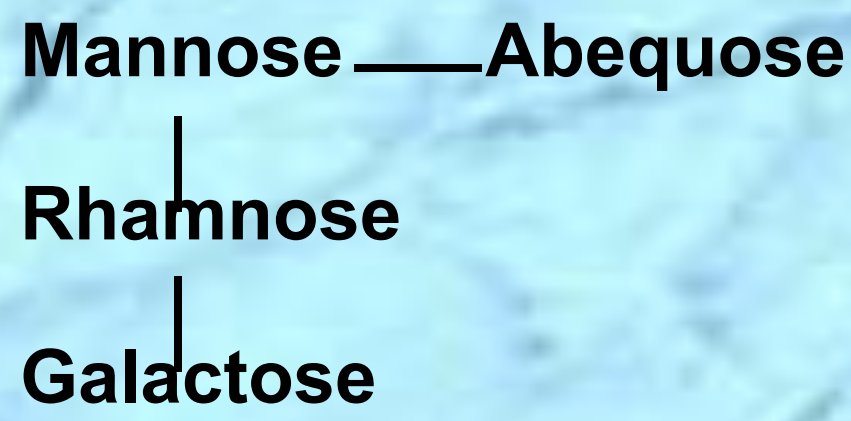
Structure of Core Polysaccharide



- **KDO** is **distinctive sugar** moiety in core polysaccharide

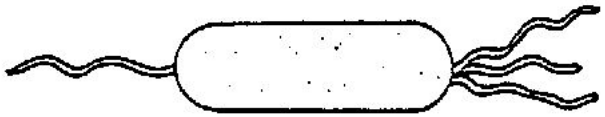
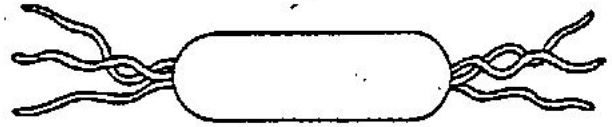
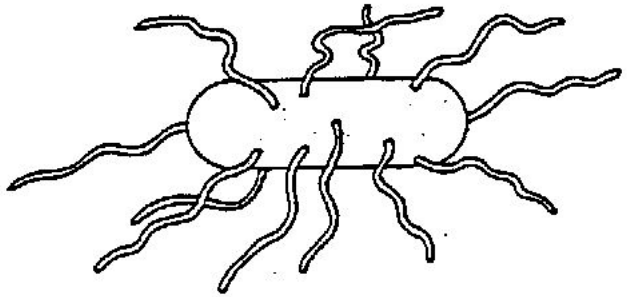
Repeat Units of O Antigen Side Chain

Example: (Repeated up to 40 times)



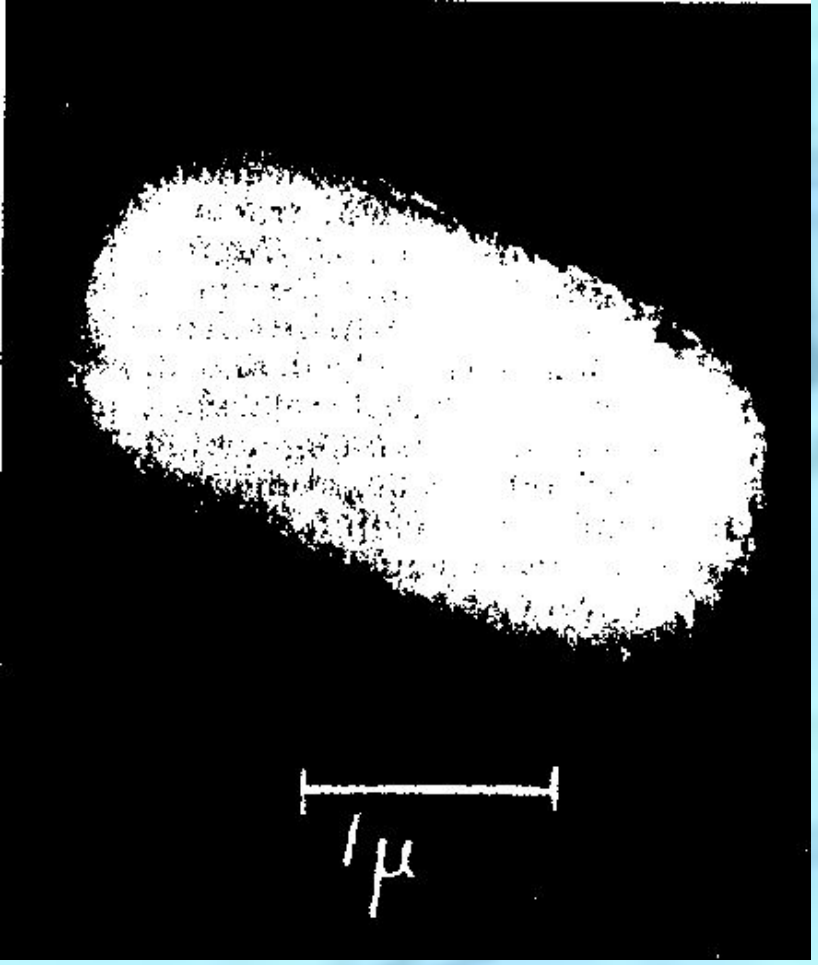
- **Heat stable** O antigen is often used to **serotype**

Taxonomic Descriptions of Prokaryotes Based on Numbers and Arrangements of Flagella

Terminology	Flagellum arrangement
Atrichous	No flagella
Monotrichous	One flagellum at one end
	
Amphitrichous	One or more flagella at each end
	
Lophotrichous	Tuft of Two or more flagella at one or both ends
	
Peritrichous	Flagella surrounding the cell
	

Taxonomic Descriptions of Prokaryotes Based on Numbers and Arrangements of Flagella (cont.)

Polar	**Monotrichous**, a single flagellum at one or both ends of the cell
	Multitrichous, two or several flagella at one or both ends of the cell
Lateral	Flagella arise predominantly from the **middle pole** of the cell
	Monotrichous, one flagellum
	Multitrichous, several flagella in the form of a tuft originating from the midportion of the cell
Peritrichous	**Random**, haphazard arrangement of flagella scattered around the bacterial cell
Mixed	Two or more flagella exhibiting distinctly different physical properties in different regions of the bacterial cell



Escherichia coli

Proteus vulgaris

- Hypermotile
- Swarming growth

Family Enterobacteriaceae

Genus	No. of species
Citrobacter	4
Edwardsiella	4
Enterobacter	13
Escherichia	5
Shigella (nonmotile)	4
Ewingella	1
Hafnia	2
Klebsiella (nonmotile)	7
Kluyvera	2
Morganella	2
Proteus	4
Providencia	5
Salmonella	7 subgroups
Serratia	10
Yersinia	11

Certain *E .coli* strains can be considered true pathogens →

True pathogen → *Shigella* (nonmotile)

True pathogen → *Salmonella* 7 subgroups

True pathogen → *Yersinia* 11

Medically Important Enterobacteriaceae

Citrobacter species

Enterobacter spp.

Escherichia spp.

Klebsiella spp.

Morganella spp.

Proteus spp.

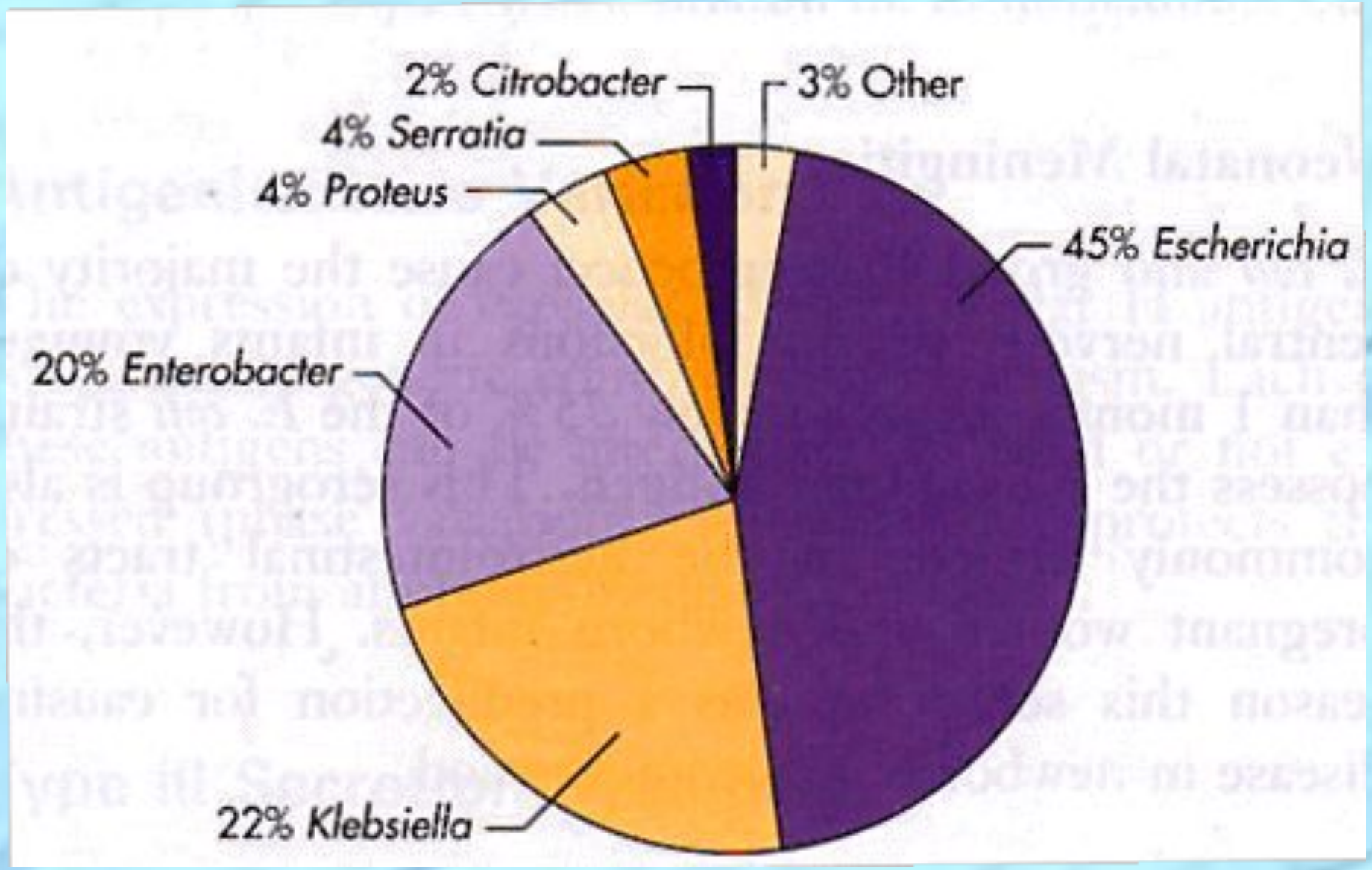
Salmonella spp.

Serratia spp.

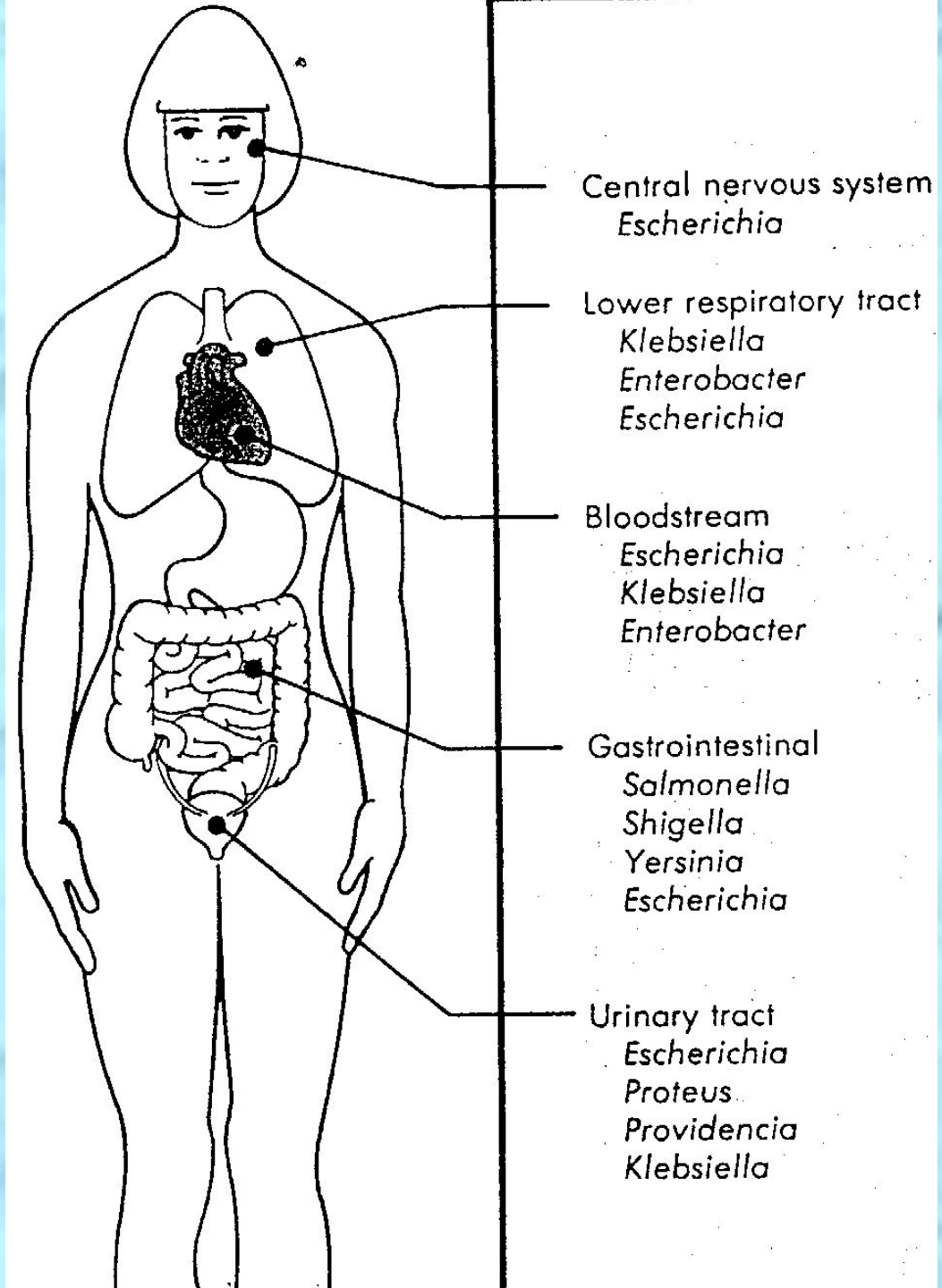
Shigella spp.

Yersinia spp.

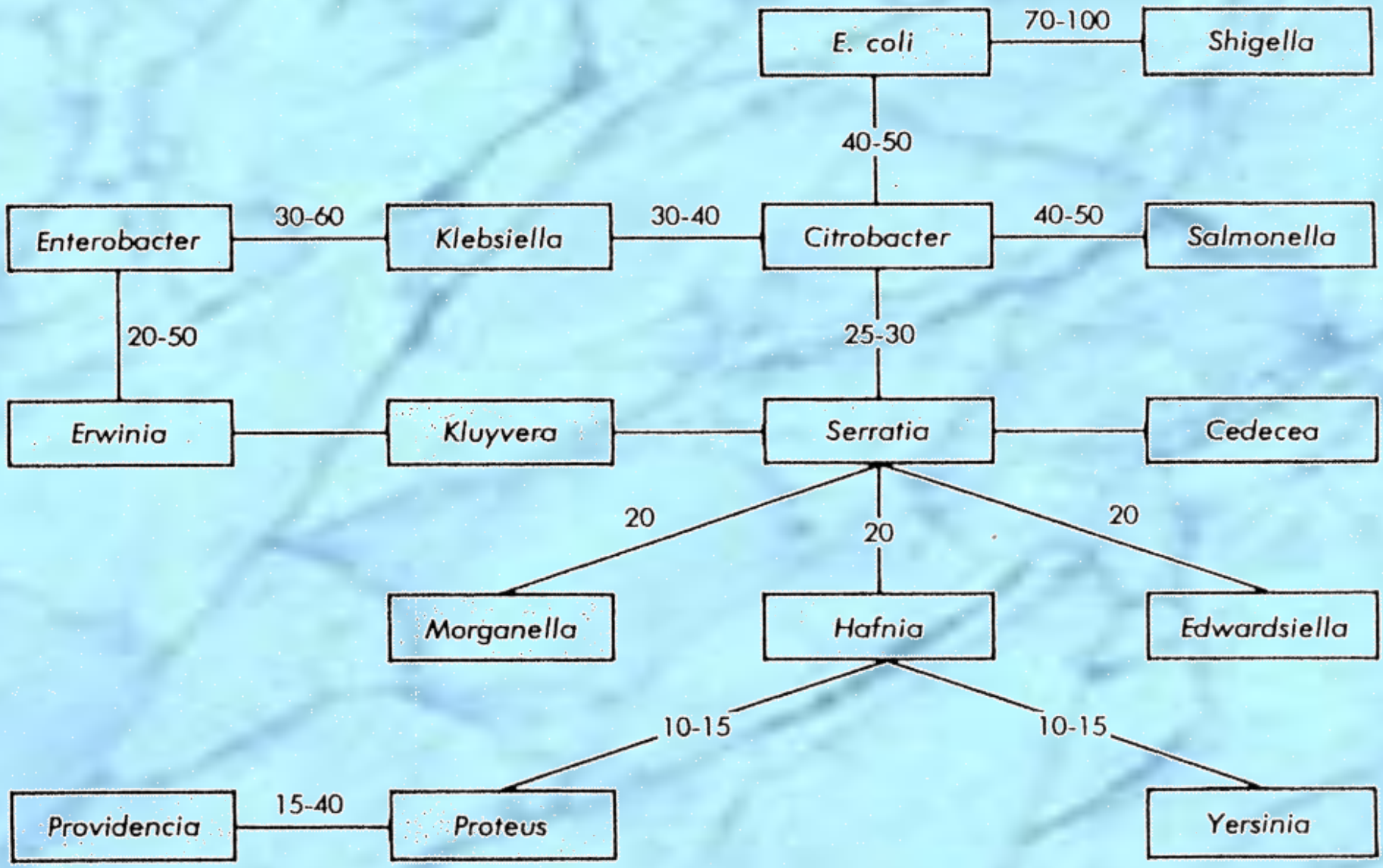
Incidence of Enterobacteriaceae *Associated with Bacteremia*



Sites of Infections with Members of the Enterobacteriaceae



DNA Relatedness Among Common Enterobacteriaceae



REVIEW

Distinguishing Properties Associated with All Enterobacteriaciae:

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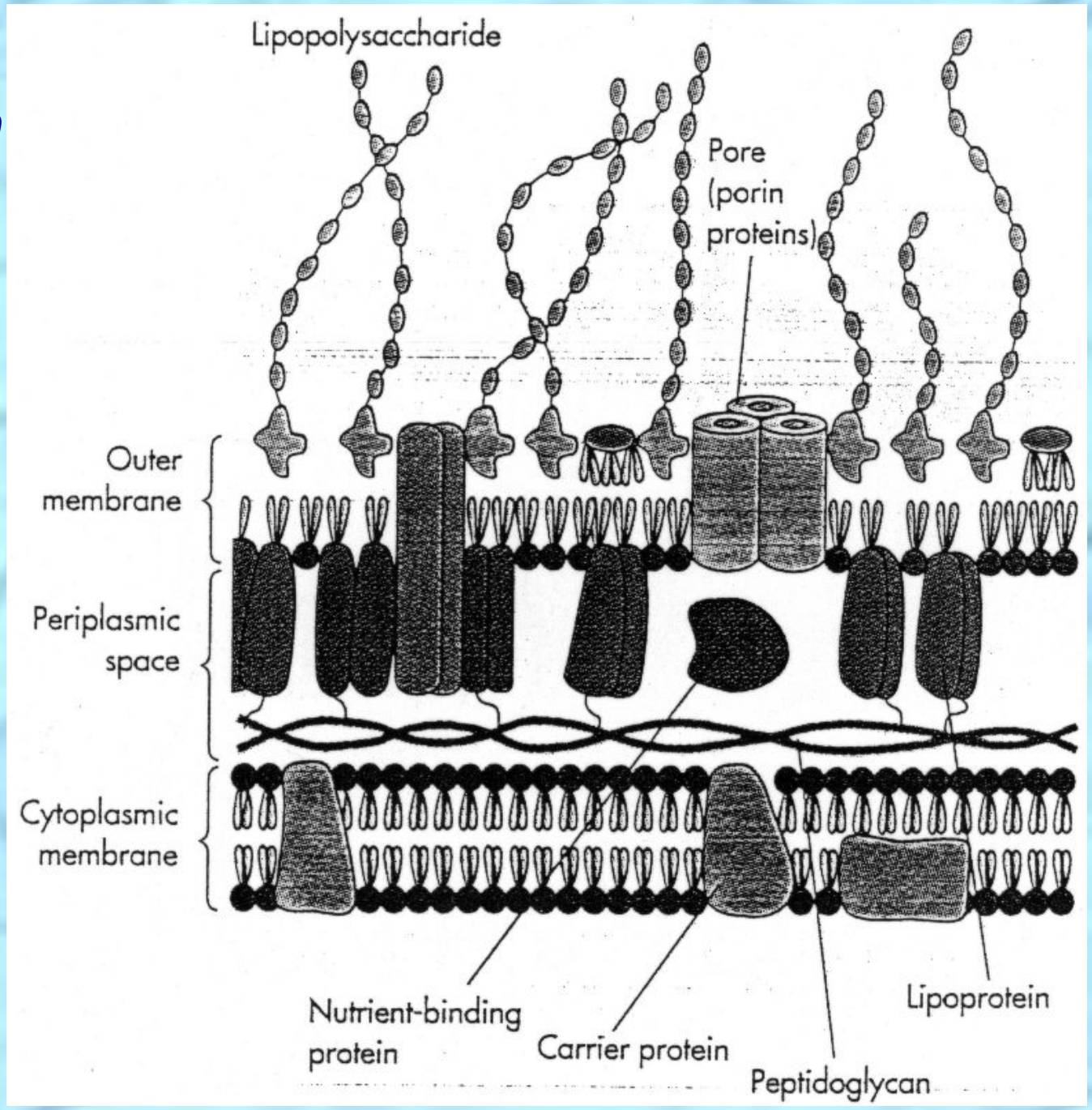
- **Reduce nitrates**
  - NO_3 to NO_2 or all the way to N_2
- **Oxidase negative**

Gram-Negative Cell Wall



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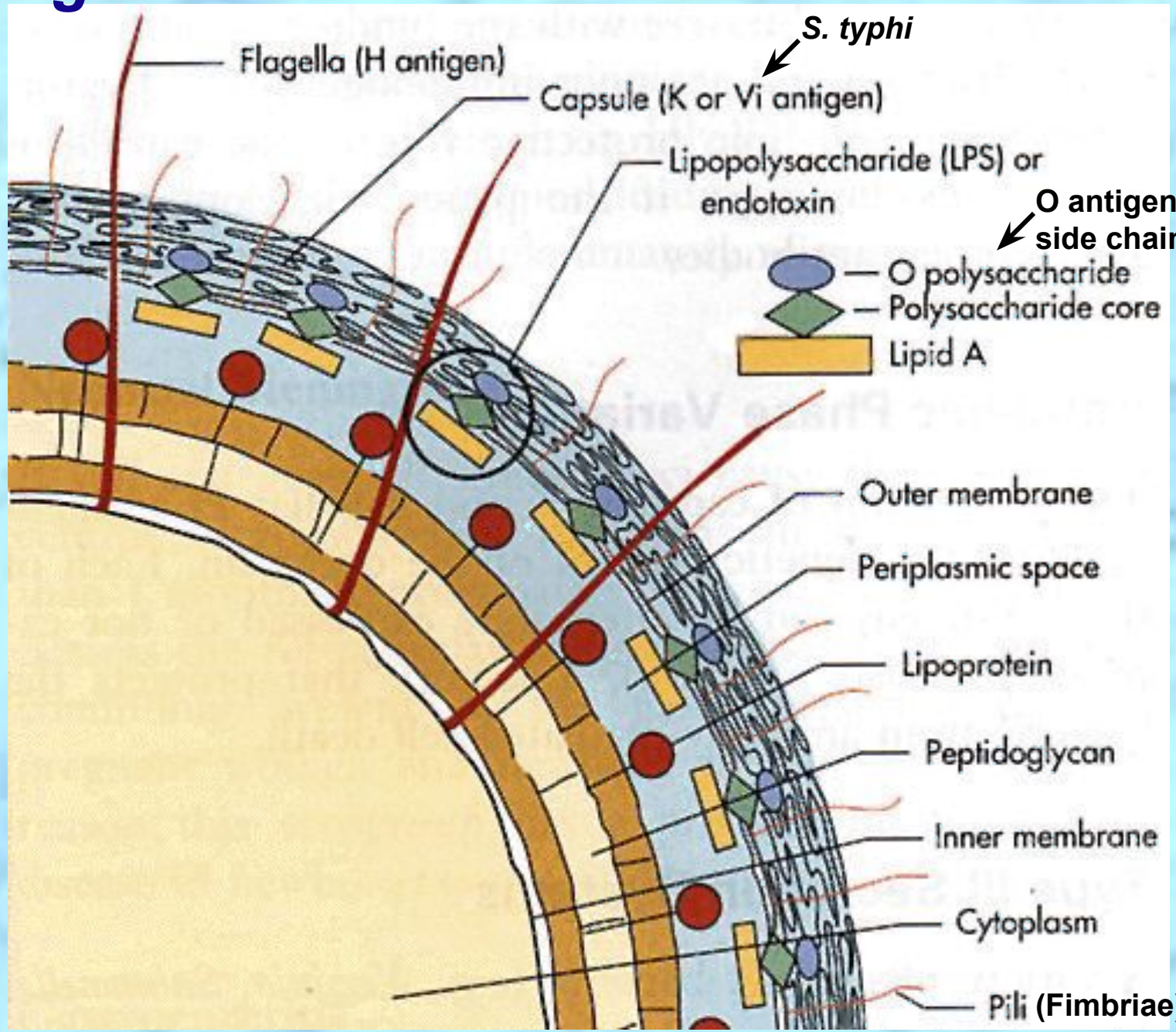

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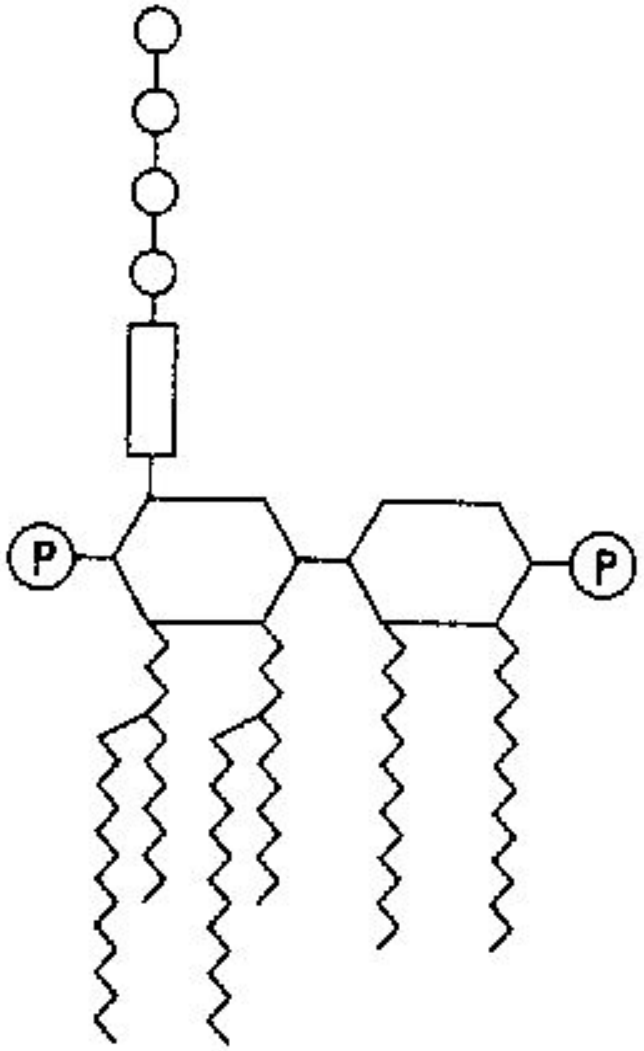

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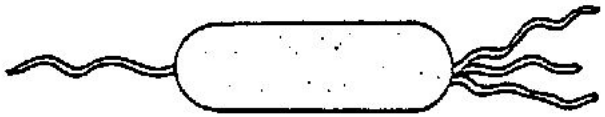

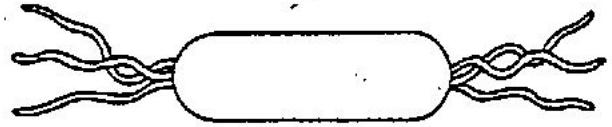

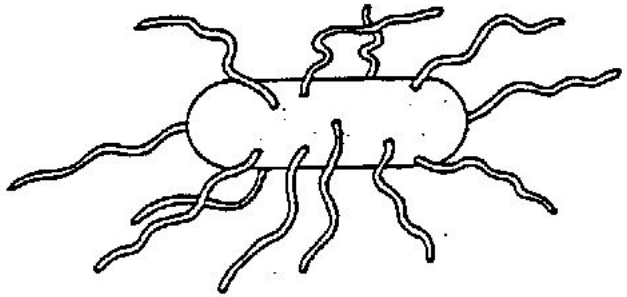

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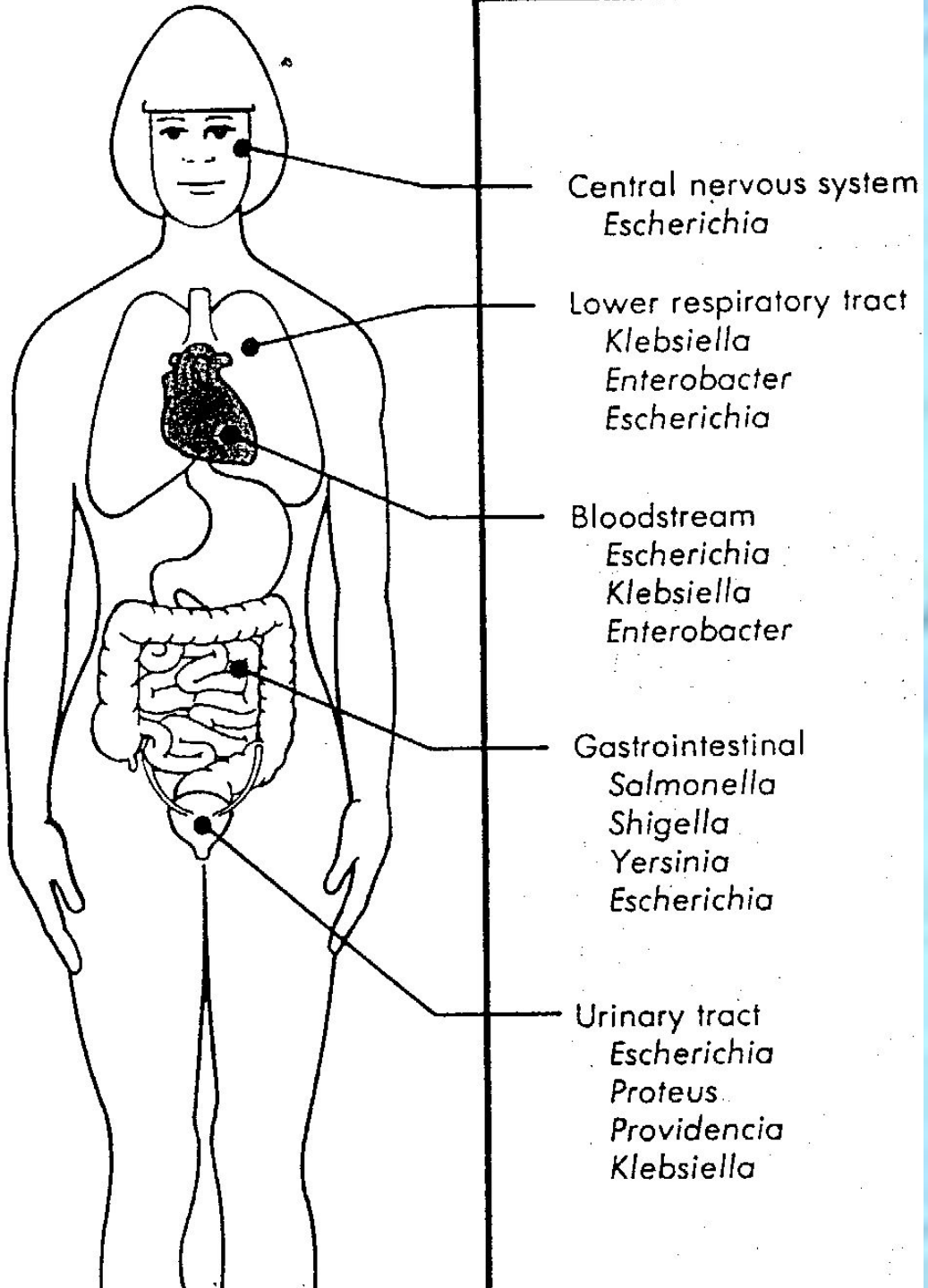

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