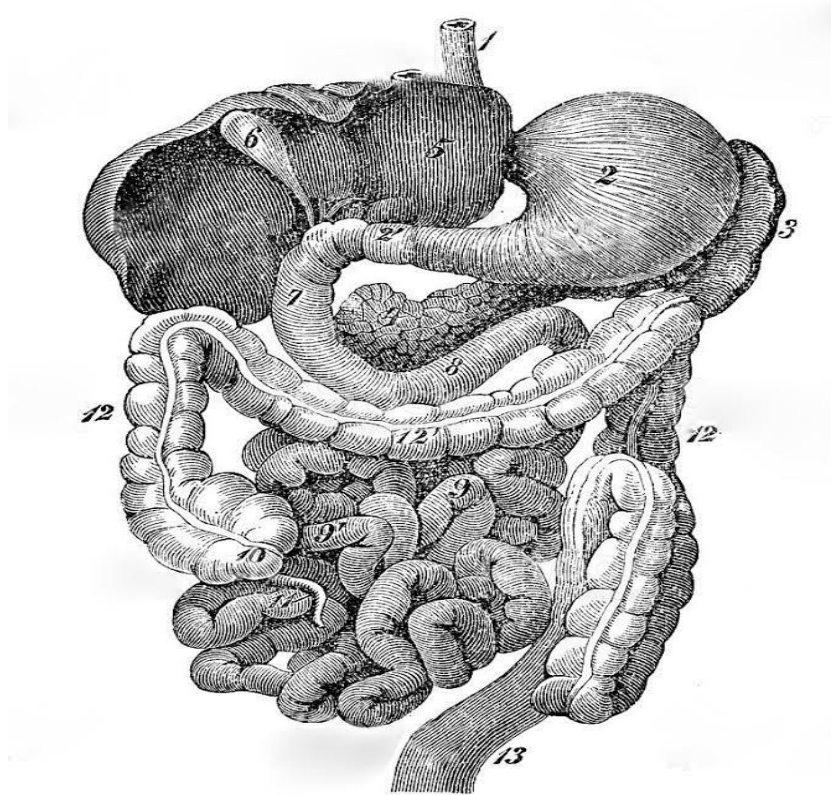


Microbiology

435's Teamwork
GastroIntestinal & Nutrition Block



- Please contact the team leaders for any suggestion, question or correction.
- Pay attention to the statements highlighted in **red**.
- Extra explanations are added for your understanding in **grey**.
- **Footnotes color code:** General | **Females** | **Male**

Revised by

خولة العماري & هشام الغفيلي



Shigella and salmonella

Resources: Sherris Medical Microbiology, LIR Microbiology,...

Learning Objectives: from us

By the end of this lecture, you should know the...

- classification & sources & complication & antibiotics **Of Shigella and salmonella**

SALMONELLA vedio (highly recommended)



INTRODUCTION:	<ul style="list-style-type: none"> ● Gram negative facultative anaerobic bacilli. It can grow aerobically and anaerobically ● Non lactose fermenting colonies. ● Motile 		
CLASSIFICATION	<ul style="list-style-type: none"> ● Has two species S.enterica (six subspecies I, II, III, IV, V, VI) & S.borgori انسوها (rare). We have to remember that salmonella has only two species and the rest are serotypes 		
VIRULENCE FACTORS	Antigenic structures:	S.Typhi	Salmonella non-typhi
		Vi (virulence) لأنها جدا خبيثة الكابوسل انتيجين مانسميه k	K.capsular antigen ¹
		H. Flagellar antigen	
		O. somatic antigen (Heat – stable) is lipopolysaccharide in the outer membrane.	
Source:	<ul style="list-style-type: none"> ● Salmonella Non-Typhi: Cold blooded animal, birds, rodents², turtles, snake and fish³. ● Salmonella typhi (most common in developing countries) and S. paratyphi : the source is human. Only ● Salmonella non typhi they go and infect the GI tract and stay in the mucosa , rarely they can go into the blood , in susceptible hosts and cause bacteremia while salmonella typhi is always invasive organism that can go to the blood and not only the blood , it can go the the tissues , lymphoid ,liver , spleen and to the brain and cause meningitis so we have to be careful when we see salmonella , we should do typing to differentiate between them . 		
Prevention	For S.typhi killed and live attenuated, 1 wk before travel to endemic area مالها تأثير قوي		

CLINICAL FEATURES:

Salmonella invade epithelial cells of the small intestine. Disease may remain localized or become systemic,

Salmonella infection can cause both intestinal and extraintestinal diseases:

- **Acute gastroenteritis** (localized)
- **Typhoid fever** (generalized) .it is one of the differential diagnosis of fever of non origin

¹ can be used for salmonella diagnosis and for epidemiological study

² القوارض

³ مصدر salmonella typhi موجود في أماكن محددة في العالم و لكن تنتقل للأماكن الثانيه عن طريق الناس اللي يسافرون، خصوصا visiting VFF = family and friends لأنهم يرحون مزارع فيها حيوانات و كذا .

- Non-typhoidal bacteremia

Someone who traveled to india and present with fever what is your diagnosis ? salmonella typhi

If a patient present in the ER with gram negative bacteremia what is the diagnosis ? salmonella typhi , if you did the typing and it was salmonella non typhi the pt might be immunocompromised (e.g. **In sickle cell**)


Non typhi is important in elderly people , children , immunocompromised pt . (gram - bacteria not common in non hospitalized pt)

	GASTROENTERITIS: video	ENTERIC(typhoid) FEVER:
Subspecies	<ul style="list-style-type: none"> • Caused by s.non typhi: S. enterica subsp. Enterica 	<ul style="list-style-type: none"> • Caused by Salmonella serotype typhi or S. paratyphi A, B and C (less severe).
Source	<ul style="list-style-type: none"> • Source poultry, milk, egg & egg products and handling pets • Food poisoning through contaminated food <p>بدون ماتحفظ من اسمها التهاب المعدة والامعاء يعني البلى من الاكل</p>	<ul style="list-style-type: none"> • Ingestion of contaminated food by infected or carrier individual
Signs & Symptoms	<ul style="list-style-type: none"> • fever, chills, watery diarrhea and abdominal pain, self limiting <p>نفس اعراض التسمم الغذائي</p>	<p>This is a severe, life-threatening systemic illness</p> <ul style="list-style-type: none"> • Nonspecific symptoms • Prolonged fever • Bacteremia • Involvement of the reticulo endothelial system (liver, spleen, intestines and mesentery) • Dissemination to multiple organs.
Infective dose	Infective dose 10^6 bacteria	--
Incubation period	8 – 36 hrs.	9 – 14 days.
Note	<ul style="list-style-type: none"> • In sickle cell, hemolytic disorder and ulcerative colitis, elderly or very young patient the infection may be very severe. • Treatment not indicated unless above • Carrier state following Salmonella infection <small>بمعنى آخر ان الشخص بعد فترة النقاهه ممكن يكون حامل لمدة شهر او اكثر لكنه نادرا ما يحصل والله الحمد</small> 	<ul style="list-style-type: none"> • Common in tropical ,subtropical countries, traveler due to inappropriate sewage disposal and poor sanitation • complications: <ul style="list-style-type: none"> • Necrotizing cholecystitis⁴ • (common)Bowel hemorrhage and perforation • (rare)Pneumonia and thrombophlebitis,Meningitis, osteomyelitis, endocarditis and abscesses • A small percentage of patients become chronic carriers. [Note: Infected gallbladders are the main source of chronic carriage.]
treatment	Antibiotics are not normally used except in immunocompromised individuals uncomplicated cases require fluid and electrolyte replacement only	<ul style="list-style-type: none"> • Ciprofloxacin first line(Azithromycin or Ceftriaxone from patients from India and SE Asia due to resistance of strains.) • Ceftriaxone first line(from patients from other areas.) • Trimethoprim – Sulfamethoxazole • Ampicillin <p>ابغاكم تعرفو ان السلمونيلا والشيفيلا كوفرد باي oral Ampicillin , TMP-SMX or Ciprofloxacin</p>

⁴ necrosis of the gallbladder wall التهاب المرارة

Typhoid fever الحمى المعوية

What You should know : it has two stages : stage one constipation , after it spreads the pt will have bacterimia and it will spread again to gallbladder , intestine and the the pt will present with diarrhea

	<u>First week</u>	<u>2nd and 3rd week</u>
Pathogenesis	Engulfment of Salmonella by mononuclear phagocytes (multiply intracellularly) ⁵ able to stay inside the phagocyte >it can go by macrophages into Mesenteric lymph node > blood stream liver, spleen and bone marrow >Released into the bloodstream again that can lead to high fever (blood culture positive)	organisms From blood>Invade gallbladder>Biliary tract > payer's patches > GIT> Diarrhea
Clinical Features	<ul style="list-style-type: none"> ● fever, malaise, anorexia, myalgia and a continuous dull frontal headache → Patient develops constipation ● -faint salmon-colored maculopapular skin lesions⁶ 	<ul style="list-style-type: none"> ❖ Sustained fever, prolonged bacteremia ❖ Rose spots 2nd week of fever ❖ Organism isolated from stool in largenumber 

Extra pics

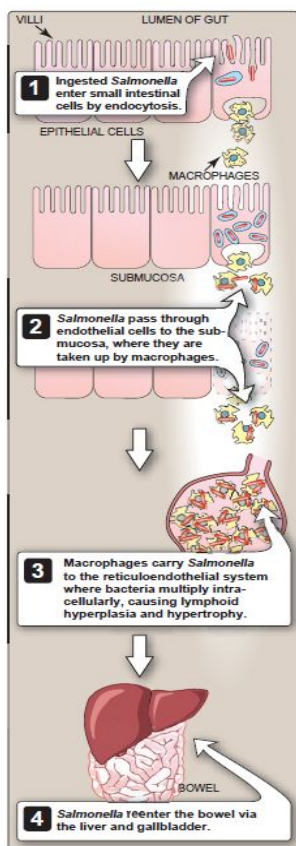
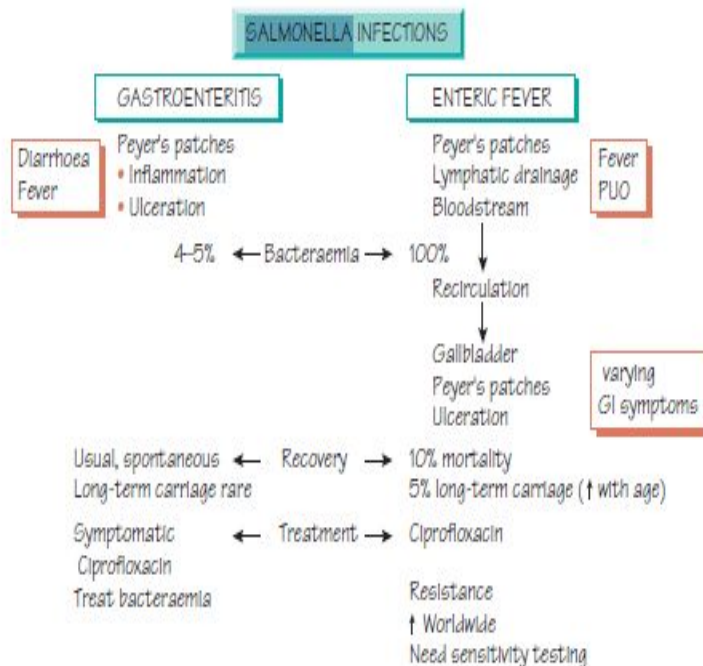



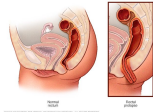
Figure 12.6
Mechanism of *Salmonella* infection causing enteric fever.



⁵ V capsulae make the *S. typhi* able to stay inside the phagocyte (resist the phagocytosis)

⁶ يصير بجلده بقع زهرية (نفس لون سمك السلمون) بسبب bacteremia

SHIGELLA video

Introduction	<ul style="list-style-type: none"> • Non lactose fermenter. • Cause bacillary dysentery (الاسهال الدموي) (blood, mucus and pus in the stool). 	
CLINICAL INFECTION	<ol style="list-style-type: none"> 1) S.sonnei most predominant in USA (produce fever & watery diarrhea). 2) S.flexneri 2nd most common in developing countries. 3) Young adult & man who have sex with man. 4) S. dysenteriae and S. boydii are most common isolates in developing countries. 5) S. dysenteriae type 1 associated with morbidity and mortality.⁷ Most dangerous ,common in saudi 6) Human is the only reservoir. 	
ANTIGENIC STRUCTURE	<ul style="list-style-type: none"> • Has 4 species and 4 major O antigen groups. عندها تقريبا نفس انتيجينات السلمونيلا الا الانتيجين الي يسمحتها بالحركة. • All have O antigens some serotype has K antigen. • Shigella are non motile, lack H antigen. 	
TRANSMISSION	<ul style="list-style-type: none"> • Person to person through fecal –oral route. • Flies, fingers (have role in spread) • Food and water. • Young children in daycare, people in crowded area and anal oral sex in developed countries. • Low infective dose⁸ < 200 bacilli. • Penetrate epithelial cells leads to local inflammation, shedding of intestinal lining and ulcer formation⁹. shigella is more virulent than salmonella but it very rarely cause bacterimia 	
SYMPTOMS	<ol style="list-style-type: none"> 1) High fever, chill, abdominal cramp and pain accompanied by tenesmus , bloody stool with mucus & WBC 2) IP : 24 - 48 hrs 	
COMPLICATION N	<ul style="list-style-type: none"> • Can lead to rectal prolapsed¹⁰ in children • Complication ileus, obstruction dilatation and toxic mega colon • Bacteremia in 4 % of severely ill patient • Seizures, HUS Hemolytic uremic syndrome 	
TREATMENT of Shigella Dysentery	<p>-Antibiotic indicated if symptoms were severe and to reduce duration of illness. Ampicillin , oral TMP-SMX or Ciprofloxacin ابغاكم تعرفو ان السلمونيلا والشيقبلا كوفرد باي</p> <p>-Antimicrobial agents depending on susceptibility testing including :</p> <ul style="list-style-type: none"> • Ciprofloxacin first line • Azithromycin first line • Ampicillin /Ceftriaxone /TMP-SMX 	
prevention	<p>Improve food process and water treatment and sanitation</p>	

⁷ exotoxin (Shiga toxin) with enterotoxic and cytotoxic properties has been isolated from S. dysenteriae type 1, and its toxicity results in the development of hemorrhagic colitis and HUS.

⁸ عشان تتذكرون شقبيلا (شقردى) كمية قليلة من الشقرديين كافيه لاحداث مشاكل و (invasive):

⁹ Shigellae invade and destroy the mucosa of the large intestine. Infection rarely penetrates to deeper layers of the intestine and does not lead to bacteremia

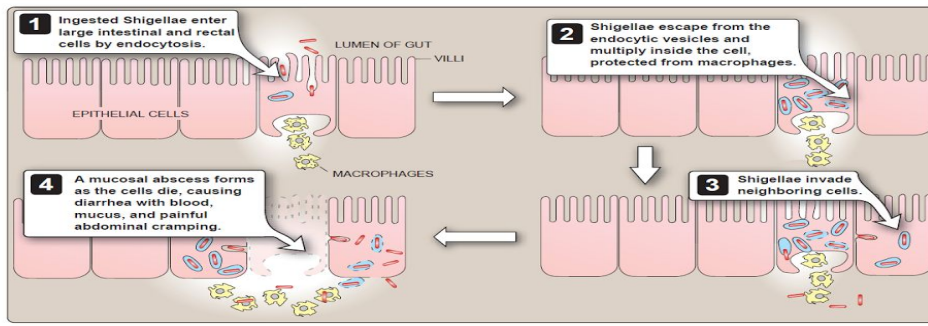


Figure 12.11
Mechanism of *Shigella* infection causing diarrhea.

Differences between salmonella and shigella are:

Salmonella : motile (has flagella) + causes bacteremia+human & animals both are reservoirs

Shigella : non motile (does not have flagella) + does not cause bacteremia+human only reservoir

Lab diagnosis of *Salmonella* & *Shigella* in stool

- Culture in selective media
- Biochemical tests
- Serology for serotypes.
- Motility test
- **BLOOD CULTURE** : لما يجيك بالاختبار سالومونيلا تايفي وحرارة وسفر دائما فكر بال

Both are Gram negative bacilli

SIM medium: Motility test

POSITIVE:
Organism moves
away from stab



NEGATIVE:
Organism does **NOT**
move away from
stab

Summary

	SALMONELLA	SHIGELLA
ORGANISM	Non lactose fermenter gram negative bacilli	
MOTILITY OF ORGANISM	Motile	Non-Motile
INCUBATION PERIOD	Gastroenteritis > 8-36 hrs Typhoid fever > 1-2 weeks	24 - 48 hrs (1-2 days)
INFECTION DOSE	10 ⁶ bacteria (Highly Infectious)	Low infective dose < 200 bacilli (Low infectious)
SOURCE	<ul style="list-style-type: none"> Salmonella non typhi > Water, food and milk contaminated with human or animal excreta Salmonella typhi and S. paratyphi > the source is human 	Person to person through fecal – oral route
ANTIGENIC STRUCTURE	O. Somatic Antigen (Heat Stable) H. Flagellar Antigen (Heat Labile) VI. Capsular Antigen (s.typhi)-K. capsular (non typhi)	O. Somatic Antigen K. Capsular Antigen NO H Flagellar antigen (non-motile)
SYMPTOMS	1st week: fever, malaise, anorexia, myalgia and a continuous dull frontal headache 2nd week: Sustained fever, prolonged bacteremia	High fever, chill, abdominal cramp and pain accompanied by tenesmous, bloody stool with mucus & WBC
TREATMENT	<p style="text-align: center;">Ampicillin, oral TMP-SMX or Ciprofloxacin</p> <ul style="list-style-type: none"> Salmonella gastroenteritis uncomplicated cases require fluid and electrolyte replacement only. 	

EXTRA: summary taken from lippincott

Gram (-) rods

Salmonella species

Salmonella enterica serovar

Typhi

Salmonella enterica serovar

Typhimurium

Common characteristics

- Gram-negative rods
- Facultative anaerobes
- Ferment glucose and a wide range of carbohydrates, but most species of *Salmonella* do not ferment lactose
- Catalase positive, oxidase negative
- Culture on MacConkey agar

Salmonella enterica serovar Typhi

Pathogenesis/Clinical Significance

S. enterica serovar Typhi is transmitted between humans, without animal or fowl reservoirs. Infection is via the oral-fecal route, generally through food or water contaminated by human feces. Young children and older adults are particularly susceptible to *Salmonella* infections, as are individuals in crowded institutions or living conditions.

S. enterica serovar Typhi causes disease by attaching to and invading macrophages of the intestinal lymphoid tissue (Peyer's patches). The bacteria replicate rapidly within these cells, and eventually spread to the reticuloendothelial system (including both liver and spleen, which become enlarged) and potentially to the gallbladder.

● Enteric (typhoid) fever

This is a severe, life-threatening systemic illness, characterized by fever and, frequently, by abdominal symptoms. About 30 percent of patients have a faint, maculopapular rash on the trunk (termed "rose spots"). After 1 to 3 weeks of incubation, *S. serovar* Typhi can enter the blood, with the resulting bacteremia causing fever, headache, malaise, and bloody diarrhea. Bacterial endotoxin can cause encephalopathy, myocarditis, and intravascular coagulation. Perforations of the intestine can lead to hemorrhage. Some infected individuals may become chronic carriers for periods as long as years due to persistent residual infection of the gallbladder. Public food handlers and health care deliverers who are carriers can present a serious public health problem (remember "Typhoid Mary!").

Treatment and Prevention

- **Treatment:** Ceftriaxone and fluoroquinolones such as ciprofloxacin are the first-line drugs of choice.
- **Prevention:** Two vaccines are available. One consists of a live attenuated strain of *S. enterica* serovar Typhi and is administered orally. The other vaccine contains capsular material and is delivered parenterally. Prevention requires maintaining proper hygiene and cooking food thoroughly.

Laboratory Identification

- Serovar Typhi can be isolated from blood, feces, bone marrow, urine, or tissue from rose spots.
- Serovar Typhi can be cultured on MacConkey agar, where it produces colorless, non-lactose-fermenting colonies.
- Serologic tests for antibodies against O antigen in patient's serum also aid in the diagnosis.

Salmonella enterica serovar Typhimurium

Pathogenesis/Clinical Significance

S. enterica serovar Typhimurium (and other *Salmonella* species that cause enterocolitis) reside in the gastrointestinal tracts of humans, other animals, and fowl. They are transmitted through contaminated food products, or via the oral/fecal route.

● Enterocolitis (gastroenteritis, foodborne infection)

Contaminated poultry products including eggs are the primary vehicles for infection of humans by serovar Typhimurium, although raw milk and pets such as turtles also transmit the disease. *Salmonella* adhere to and invade enterocytes of both the small and large intestine, causing a profound inflammatory response. Within 10 to 48 hours after ingestion, nausea, vomiting, abdominal cramps, and diarrhea ensue. Diarrhea usually ends spontaneously within a week.

Treatment and Prevention

- **Treatment:** Fluid and electrolyte replacement are important if diarrhea is severe. Antibiotics are not normally used except in immunocompromised individuals to prevent systemic spread of the infection.
- **Prevention:** No vaccine or preventive drug is available. Prevention is accomplished by proper sewage disposal, correct handling of food, and good personal hygiene.

Laboratory Identification

- Organisms isolated from stool samples produce colorless colonies on MacConkey agar.

Gram (-) rods

Shigella species

Shigella sonnei
Shigella dysenteriae
Shigella flexneri
Shigella boydii

Common characteristics

- Gram-negative rods
- Facultative anaerobes
- Most *Shigella* species are unable to ferment lactose, except *S. sonnei* does so weakly.
- Catalase-positive, oxidase negative
- Culture on Hektoen agar

Pathogenesis/Clinical Significance

Shigella species are spread from person to person, with contaminated stools serving as a major source of organisms. Flies and contaminated food and water can also transmit the disease. The organism has a low infectious dose (less than 200 viable organisms are sufficient to cause disease). Therefore, secondary cases within a household are common, particularly under conditions of crowding and/or poor sanitation.

S. sonnei, which is a common cause of shigellosis in the United States, invades and destroys the mucosa of the large intestine but rarely penetrates to the deeper intestinal layers. *S. dysenteriae* also invades the colonic mucosa but, in addition, produces an exotoxin (Shiga toxin) with enterotoxic and cytotoxic properties.

● Bacillary dysentery (shigellosis)

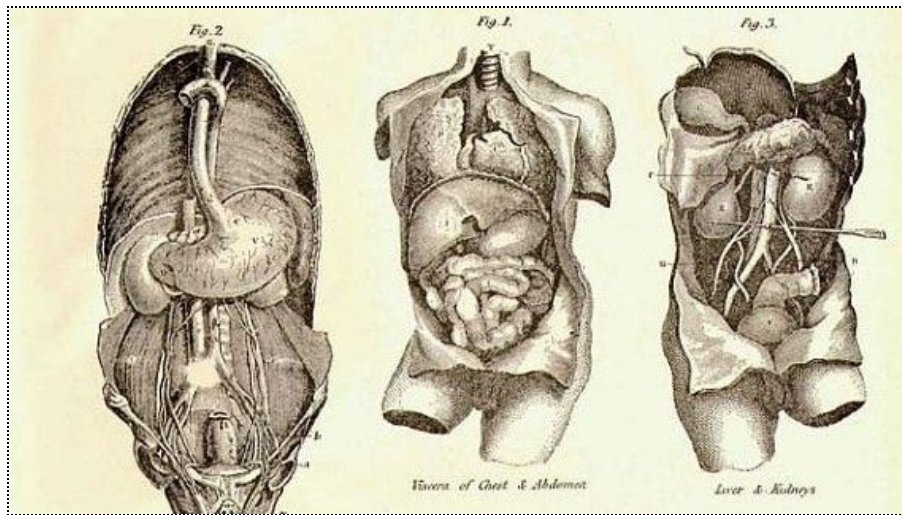
This disease is characterized by diarrhea with blood, mucus, and painful abdominal cramping. The disease is generally most severe in the young and in older adults, and among malnourished individuals, in whom shigellosis may lead to severe dehydration and even death.

Treatment and Prevention

- **Treatment:** Antibiotics such as ciprofloxacin or azithromycin can reduce the duration of illness and the period of shedding organisms, but usage should be guided by susceptibility tests.
- **Prevention:** Protection of the water and food supplies and personal hygiene are crucial for preventing *Shigella* infections. Vaccine development is currently experimental.

Laboratory Identification

- During acute illness, organisms can be cultured from stools using Hektoen agar or other media specific for intestinal pathogens.



إِنَّا كُلُّ شَيْءٍ خَلَقْتَهُ بِقَدْرِ ٤٩

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Heartful thanks to our phenomenal team members

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