

Battlefield Medicine:  
The American Response to Gas Gangrene on the Western Front



George Thompson  
The University of Kansas Medical Center

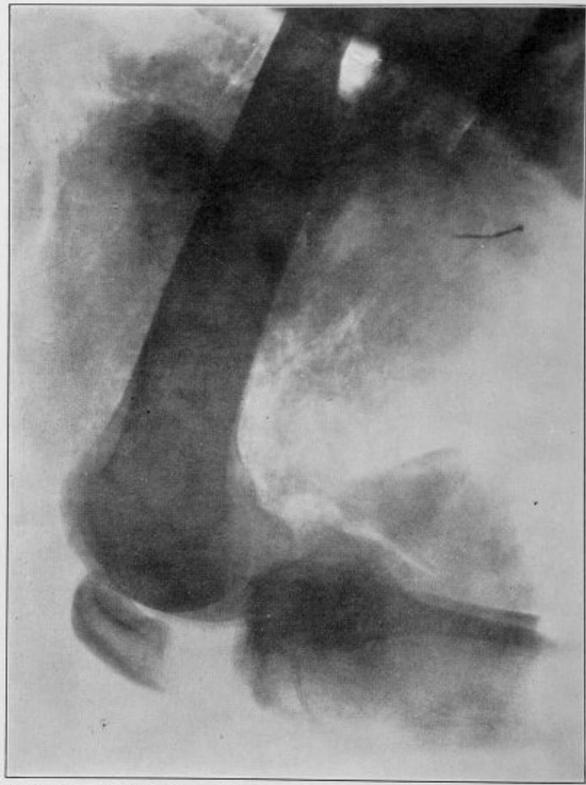
## Introduction

“No other disease that falls to the lot of the surgeon places so heavy a burden on his judgment nor is so dependent upon his management as this dread condition.”



It was found the infection complicated 1% of open wounds and 6% of open fractures

## Introduction



X-ray: Gas bubbles in the wound



## Introduction

This presentation examines six topics:

- Incidence
- Etiology
- Pathology
- Clinical Picture
- Prophylaxis
- Prognosis



Western Front battlefield in 1917

## Incidence

How many American soldiers had gas gangrene infections in World War I?



Evidence of why gas gangrene earned its lethal reputation

## Incidence

How many American soldiers had gas gangrene infections in World War I?



Operating room and surgical team of Evacuation Hospital No. 8, 1918

## Incidence

How many American soldiers had gas gangrene infections in World War I?

Part of body	Total number	For severity of injury		For simple infection		For gas gangrene	
		<i>Number</i>	<i>Per cent</i>	<i>Number</i>	<i>Per cent</i>	<i>Number</i>	<i>Per cent</i>
Arms.....	31	9	29.0	1	3.20	21	67.7
Forearms.....	16	11	68.7	1	6.25	4	25.0
Fingers.....	44	32	95.6	1	2.20	1	2.2
Thighs.....	60	5	8.33	10	16.60	45	75.0
Legs.....	38	12	31.5	4	10.6	22	57.8
Feet.....	6	4	66.6	0	0.0	2	33.3
Toes.....	11	10	90.9	0	0.0	1	9.1
Total.....	206	93	45.1	17	8.25	96	46.6

During this period the total number of deaths was 363. These deaths were due to the following causes:

Cause of death	Number	Per cent	Cause of death	Number	Per cent
Gas gangrene.....	01	17.0	Head injuries.....	50	14.0
Simple infection.....	7	2.0	Spinal injuries.....	12	3.3
Shock and hemorrhage.....	88	24.2	Multiple wounds.....	30	8.3
Chest wounds.....	53	15.0	Pneumonia.....	9	2.5
Abdominal wounds.....	47	10.2	Poison gas.....	6	2.0

Evauation Hospital No. 8: Study on Gas Gangrene, September 10-November 13, 1918

## Incidence

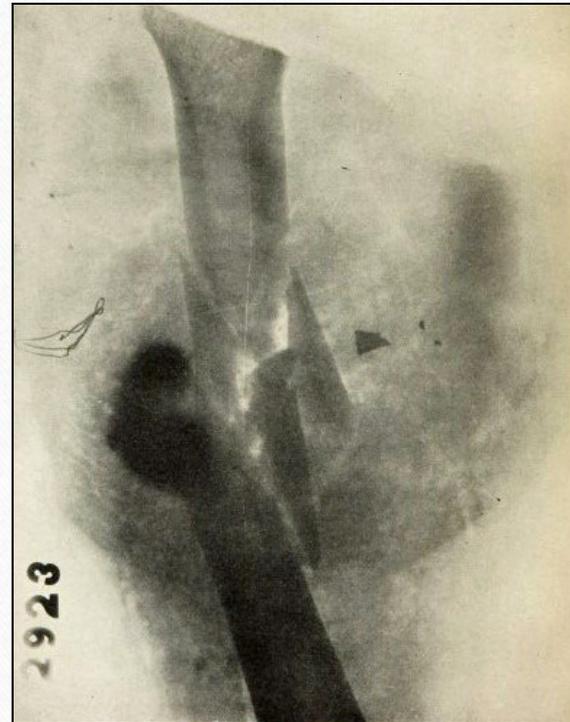
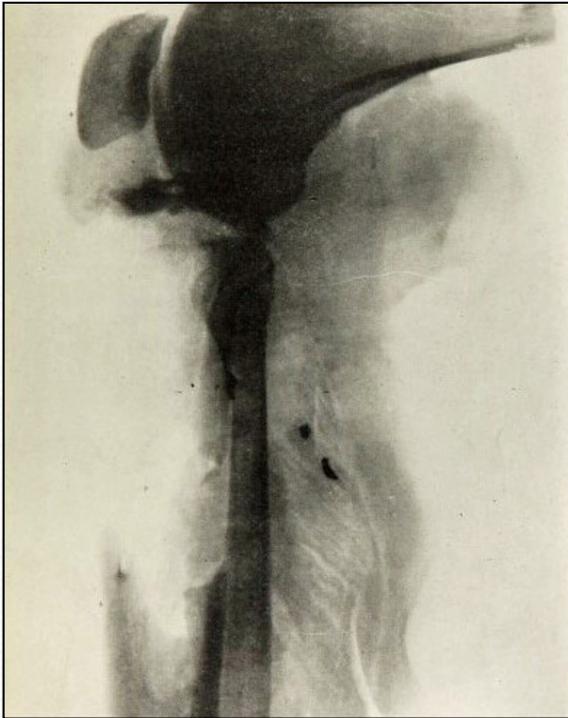
How many American soldiers had gas gangrene infections in World War I?

Time interval between injury and operation	With gan-grene	Without gan-grene	Total	Time interval between injury and operation	With gan-grene	Without gan-grene	Total
Received at hospital between—				Received at hospital between—			
0 to 6 hours.....	0	0	0	Continued.			
6 to 12 hours.....	12	80	92	60 to 72 hours.....	9	9	18
12 to 18 hours.....	15	90	105	72 to 96 hours.....	9	10	19
18 to 24 hours.....	27	55	82	96 to 120 hours.....	11	7	18
24 to 36 hours.....	30	56	86	120 plus.....	6	2	8
36 to 48 hours.....	20	17	37	<b>Total.....</b>	<b>162</b>	<b>349</b>	<b>511</b>
48 to 60 hours.....	23	23	46				

Evauation Hospital No. 8: Study on Gas Gangrene, September 10-November 13, 1918

## Etiology

What was the cause of gas gangrene in World War I?



X-Rays: Numerous foreign bodies, fractures and evidence of gas gangrene

## **Etiology**

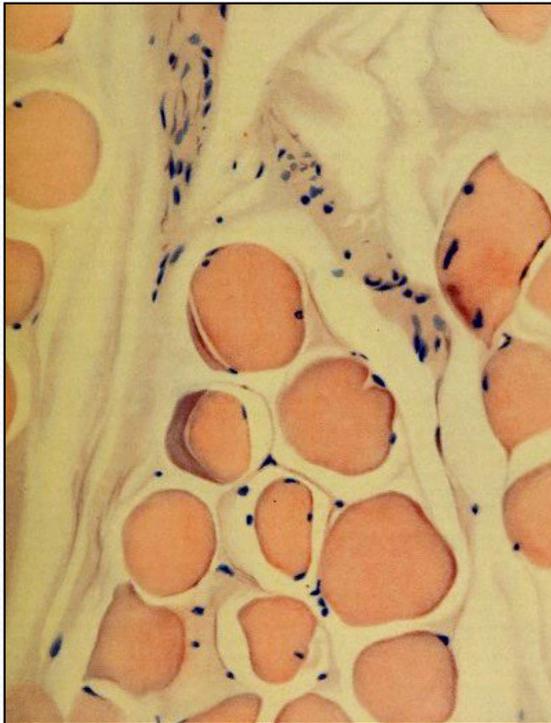
What was the cause of gas gangrene in World War I?



Muscle fibers showing Gram-positive and negative rods and Gram-positive cocci

## Etiology

What was the cause of gas gangrene in World War I?



Necrotic muscle fibers

Weinberg and Seguin:  
1917 study of 91 patients found:

- 11 different types of bacteria
- 10 had a single variety
- 14 had several varieties
- 67 had anaerobic and aerobic bacteria

The most frequent bacteria were:

- *B. welchii*-77%
- *B. oedematiens*-34%
- *B. sporogenes*-27%
- *Vibrion septique*-17%

## Etiology

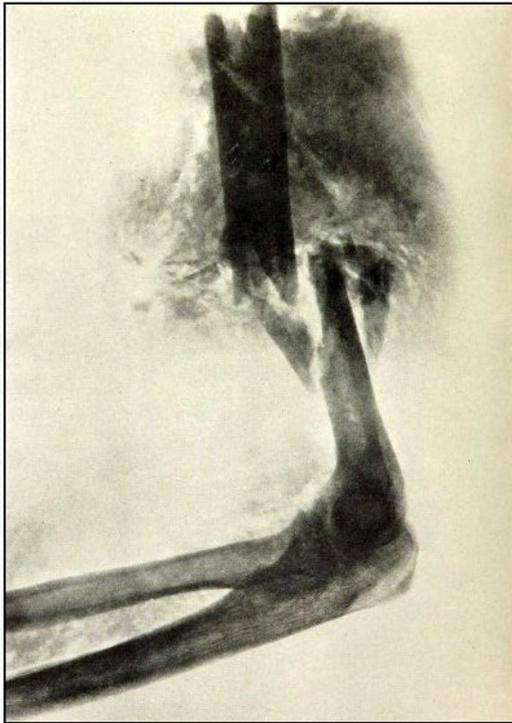
What was the cause of gas gangrene in World War I?



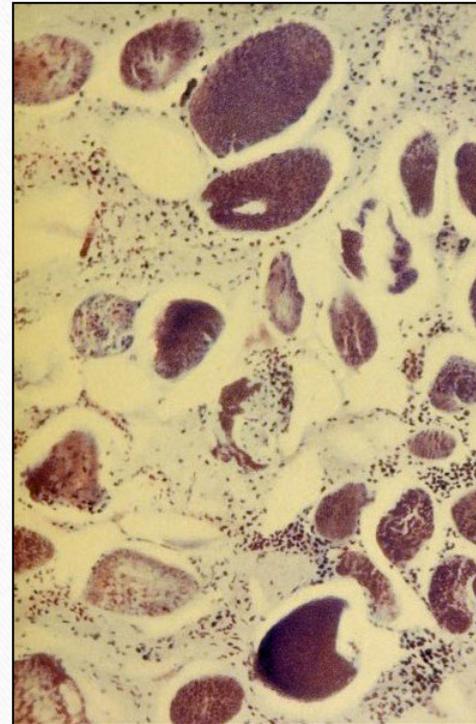
Treatment at an American Dressing Station, Lahayville France, 1918

## Pathology

What were the effects from a gas gangrene infection in World War I?



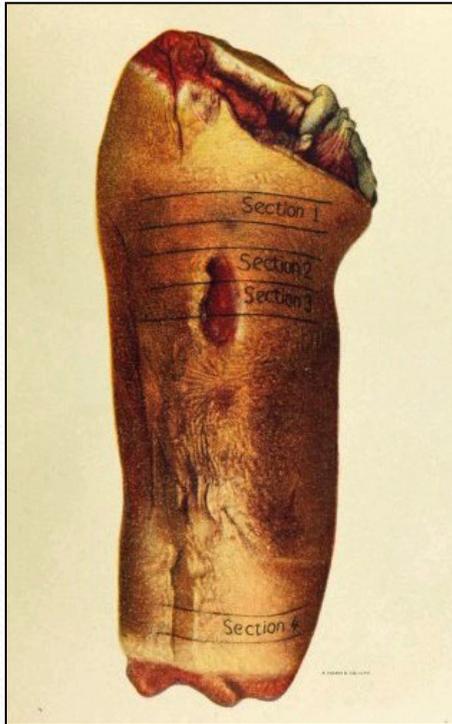
X-ray: Gas around point of fracture



Toxic edema at the wound track

## Pathology

What were the effects from a gas gangrene infection in World War I?



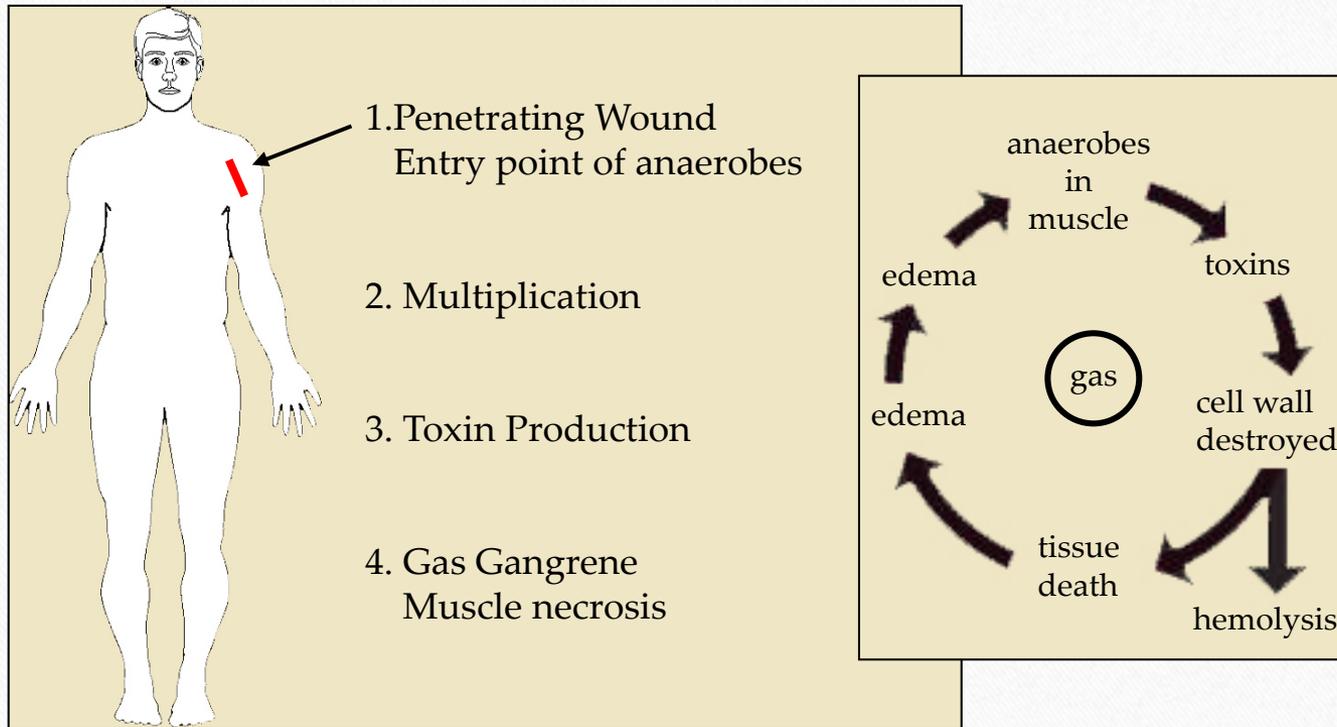
Bronzing of skin in avirulent Gas Gangrene



Contemporary image of coalescing vesicles

# Pathology

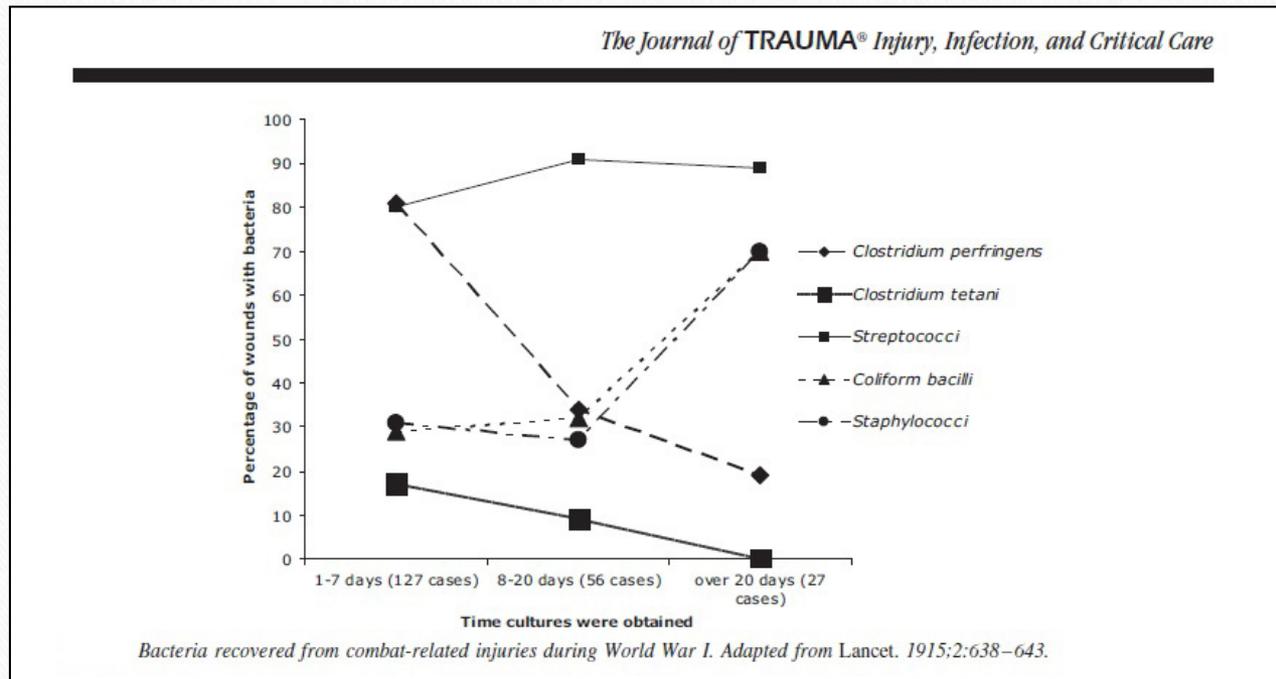
What were the effects from a gas gangrene infection in World War I?



Pathogenesis of Gas Gangrene

# Pathology

What were the effects from a gas gangrene infection in World War I?



Alexander Fleming's 1915 bacteriology of septic wounds for 137 patients

## Clinical Picture

What was the clinical picture for a gas gangrene infection in World War I?



Unloading wounded at Field Hospital No. 28, Varennes, October 2, 1918

## Clinical Picture

What was the clinical picture for a gas gangrene infection in World War I?



Deep portion of wound with bacteria



Contemporary image of gas gangrene

## Clinical Picture

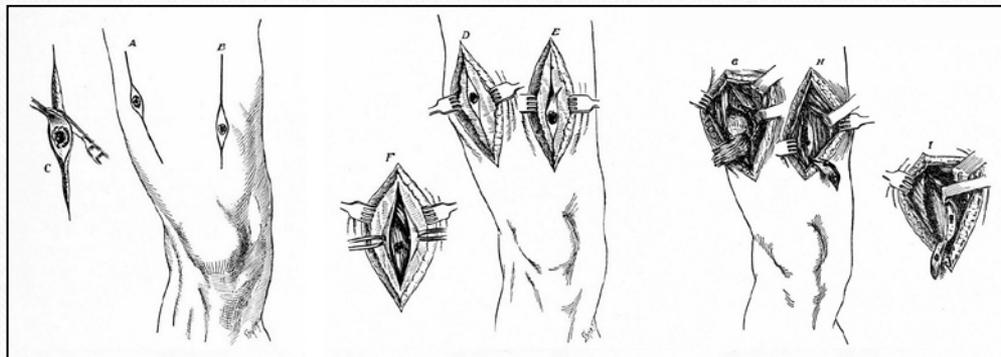
What was the clinical picture for a gas gangrene infection in World War I?



French Autochrome taken by Emile Chautemps

## Prophylaxis

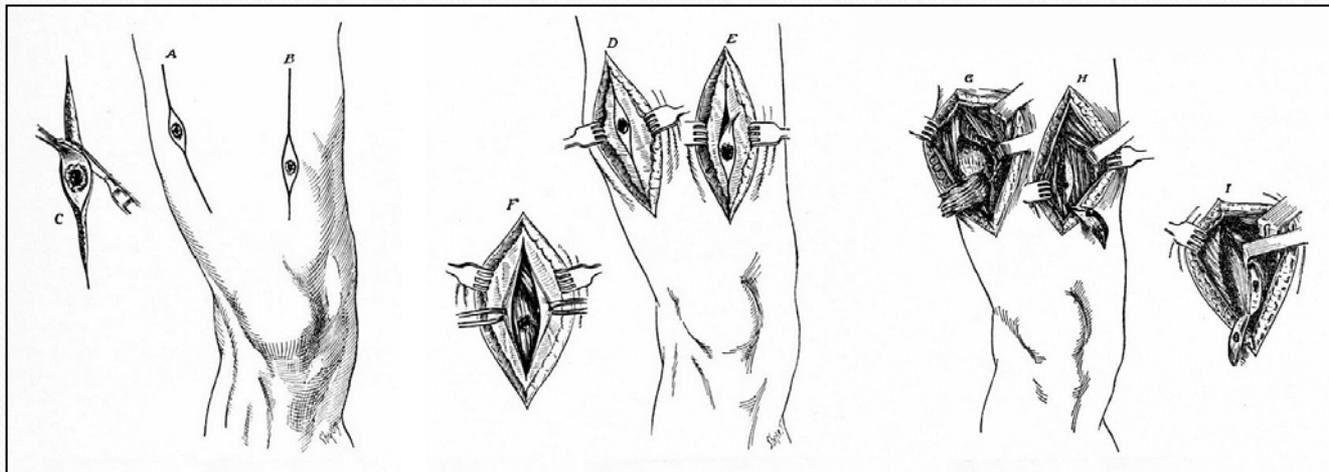
What were the measures taken to prevent gas gangrene infections in World War I?



Three techniques: Surgical Excision, Antibacterial Solution, Polyvalent Serum

## Prophylaxis

What were the measures taken to prevent gas gangrene infections in World War I?



Excision of the external wound, of the aponeurotic layer, of injured muscles

## Prophylaxis

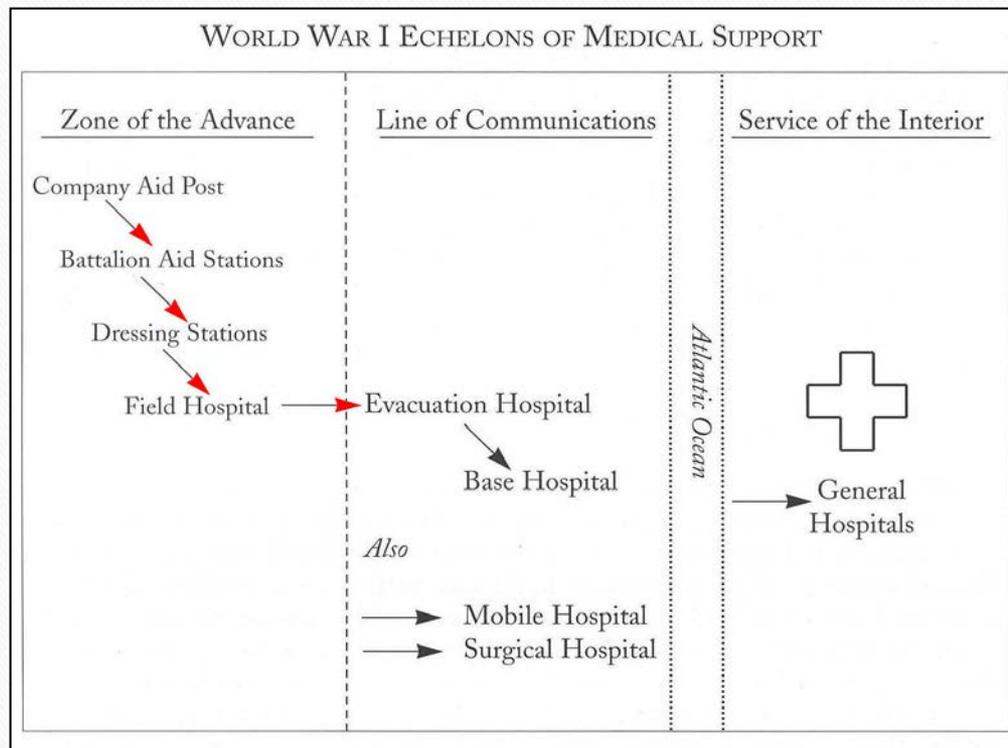
What were the measures taken to prevent gas gangrene infections in World War I?



Operating room and surgical team of Evauation Hospital No. 8, 1918

# Prophylaxis

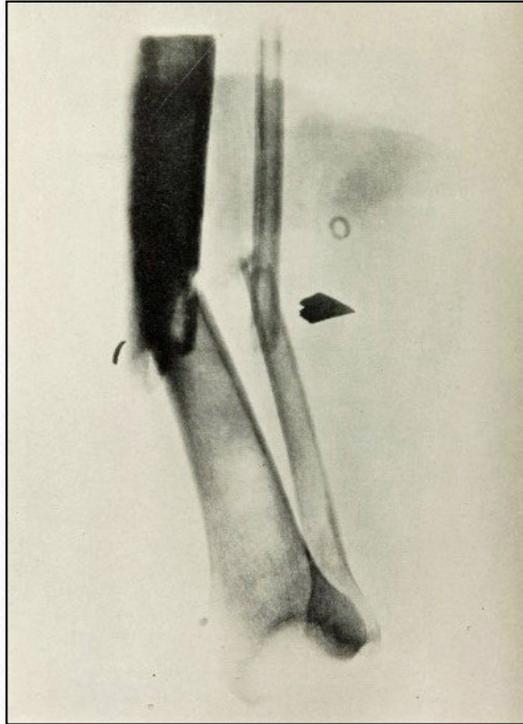
What were the measures taken to prevent gas gangrene infections in World War I?



Progressive stages of treatment and evacuation on the battlefield

## Prophylaxis

What were the measures taken to prevent gas gangrene infections in World War I?



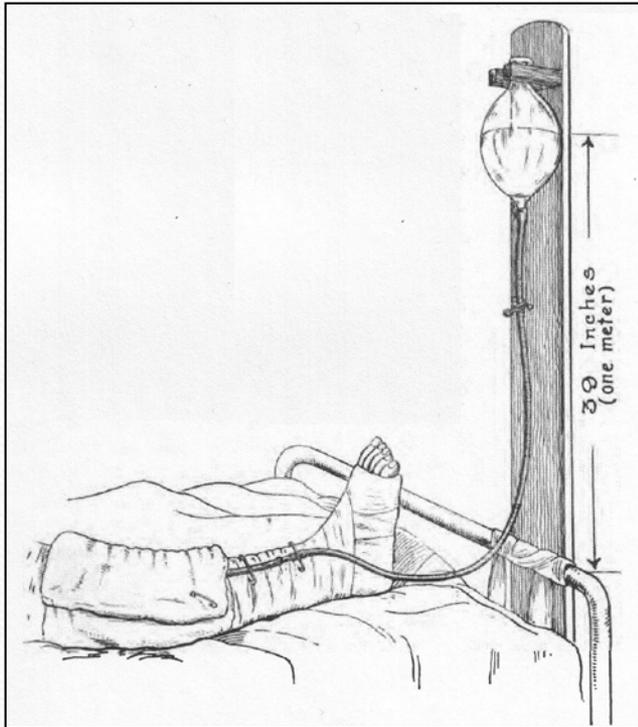
X-ray: bone fractures with foreign bodies

American response  
to prevent gas gangrene:

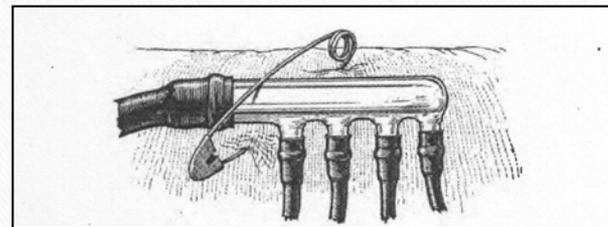
- Debridement
- Irrigation of the wound with a chemical antiseptic
- Bacteriological analysis

## Prophylaxis

What were the measures taken to prevent gas gangrene infections in World War I?



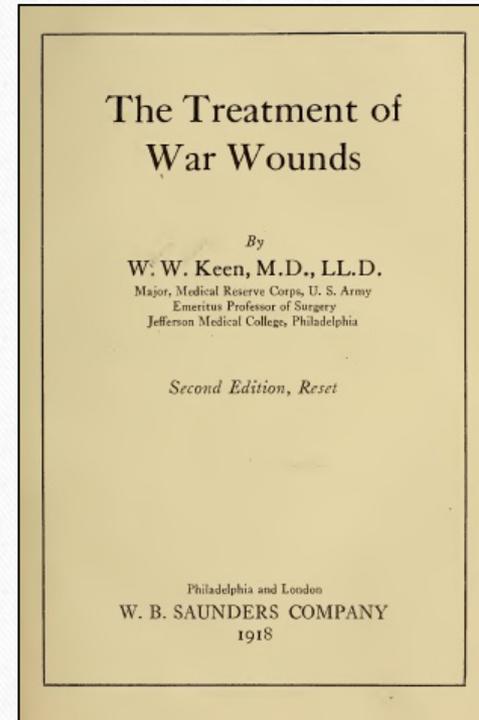
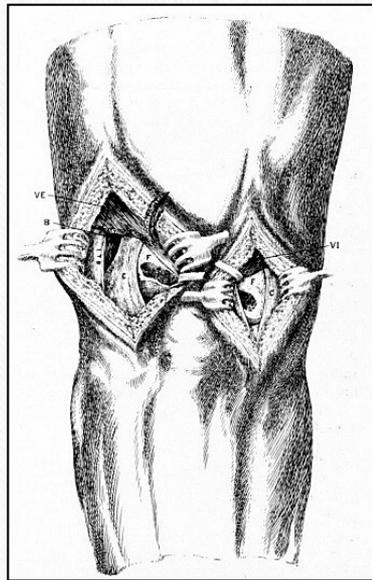
Dr. Alexis Carrel



Carrel's delivery system for Dakin's sodium hypochlorite solution

## Prophylaxis

What were the measures taken to prevent gas gangrene infections in World War I?



Major William Keen's The Treatment of War Wounds

## Prophylaxis

What were the measures taken to prevent gas gangrene infections in World War I?



Polyvalent Serum



Dr. Frances Ivens

## Prognosis

What was likelihood of an American soldier surviving a gas gangrene infection?



Adjusting splint on a litter patient, Brousey France, April 20, 1918