

# Gastrointestinal infections: The British and U.S. Army experiences in World War I

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- Nothing to disclose

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# Objectives

- Describe how previous wars determined prevention efforts
- Understand the differences in the British and American Army medical experiences
- Describe lessons learned from the Gastrointestinal infections of World War I

# Pre-WWI medical experiences

- In both the British and U.S. Army, much of the medical risk assessment was shaped by the most recent conflicts
- However, there were significant differences in the British and American pre-WWI medical experiences

# British Army

- The British Army serving during the South African War 1899-1902 experienced few enteric infections in Great Britain but significant outbreaks in South Africa
- Typhoid Fever: 57,684 admissions 8,022 deaths and 19,454 disabled
- Dysentery: 38,108 admissions, 1,343 deaths and 5,776 disabled

Mitchell TJ, History of the Great War based on Official Documents, Medical Service, Casualties and Medical Statistics of the Great War. Imperial War Museum, London, 1931, pp 268-273

# British Army

- Enteric diseases were associated with deployment to endemic areas and ineffective preventive sanitation efforts
- During the South African War, Typhoid vaccination was voluntarily instituted to British troops deploying outside of Europe

Hardy A, Bull Hist Med 2000;74:265-290

# Union Troops: Civil War

	<u>Patient reports</u>	<u>Deaths</u>
• Diarrheal disease	1,739,135	44,558
• Typhoid fever	79,462	29,336

Barnes JK, The Medical and Surgical history of the War of Rebellion, Government Printing Office, Washington, 1879, Part II, Vol I, pp 1-2

Siler JF, Typhoid and the parathyroid fevers. In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 17



## U.S. Army

- An autopsy documented the Ileal perforation due to Typhoid fever



Bollet AJ, Civil War Medicine, Challenges and Triumphs, Galen Press, Tucson AZ, 2002, pp 288, 365

Smart C, The Medical and Surgical History of the War of the Rebellion. Part III, Vol. I, Medical History, Government Printing Office, Washington, DC, 1888, pp 382-383

# U.S. Army

- “That whole damned war business is about 999 parts diarrhea to one part glory”

Walt Whitman

Nurse, Union hospital

Washington D.C.

Schmidgall G, Selections from Walt Whitman's conversations with Horace Troubel 1888-1892, U Iowa Press, Iowa City, IA, 2001, p 187

Reef C, Walt Whitman, New York: Clarion Books, 1995, p 90

## U. S. Army

- Unlike the British Army, during the Spanish American war there were massive Typhoid outbreaks in Army bases within the U.S.
- Between June and November, 1898, 20,738 American soldiers were diagnosed with Typhoid fever and 2,192 died

Cirillo VJ, Bullets and Bacilli, The Spanish American War and American Medicine, Rutgers Univ Press, New Brunswick, NJ 2004, pp 57-90

Siler JF, Typhoid and the paratyphoid fevers. In: Lynch C, The Medical Department of the United States Army in the World War. Government Printing Office, Washington, 1928, p 17



# U.S. Army

- As a result of the American experience prior to deployment, routine preventive and sanitation efforts were not considered adequate
- Compulsory Typhoid vaccination for all U.S. soldiers was instituted in 1911

Siler JF, Typhoid and the paratyphoid fevers. In: Lynch C, The Medical Department of the United States Army in the World War. Government Printing Office, Washington, 1928, p 21





# Typhoid Vaccination

- In Great Britain, there was significant civilian resistance to compulsory vaccination. The opposition argued that compulsory Typhoid vaccination would deter recruiting
- The Medical Times wrote that the “supposed benefit of the anti-typhoid serum was a delusion”

Hardy A, Bull Hist Med 2000;74-265-290

Harrison M, The Medical War, British Military Medicine in the First World War, Oxford University Press, Oxford, 2010, pp 142-50

## Will the War Office put a stop to Military Tyranny in the Interests of Recruiting?

Letter to J. DOBSON, Esq., Sept. 14, 1874.

Circular Letter from the PARLIAMENTARY  
RECRUITING COMMITTEE,  
November 23, 1914.

Reply by Mr. TENDAMT, Under Secretary of State for War, to Mr. H. G. CHAMBERLAIN, M.P., on November 14, 1914.

Reply by Vincent SALDANO to Lord THURSDAY in the House of Lords  
on January 7, 1914.

"All efforts are made to persuade them, at the same time preserving the rights of the nonbelievers also here."

**How the Military Antitrust Unit broke back with the courts.**

A. R. Anderson, Jr., Virginia Center,

<sup>22</sup>As the risk of controversy is twofold (even in much increased in the industry and outside



**QUESTIONS:** Is bloodshed in the name of a just cause a justifiable epidemic? Is it safe for anybody to stand by?

National Jewish Agricultural Center,  
 Thursday, Aug. 24.

(b) It is needed for reformation of all roads that, in future, transportation agencies and the State will be charged with an important responsibility in the reformation. If (a) is, G.D.'s for prevention, it also for Company and governmental, payment. (c) Also for road money.

17th. Officers representing Companies are to render to District Messrs. by the 1st and 15th of each month a return showing the number of N. C. S. and men on strength of their Companies.

Are you being loved, or are about to be, intensely?

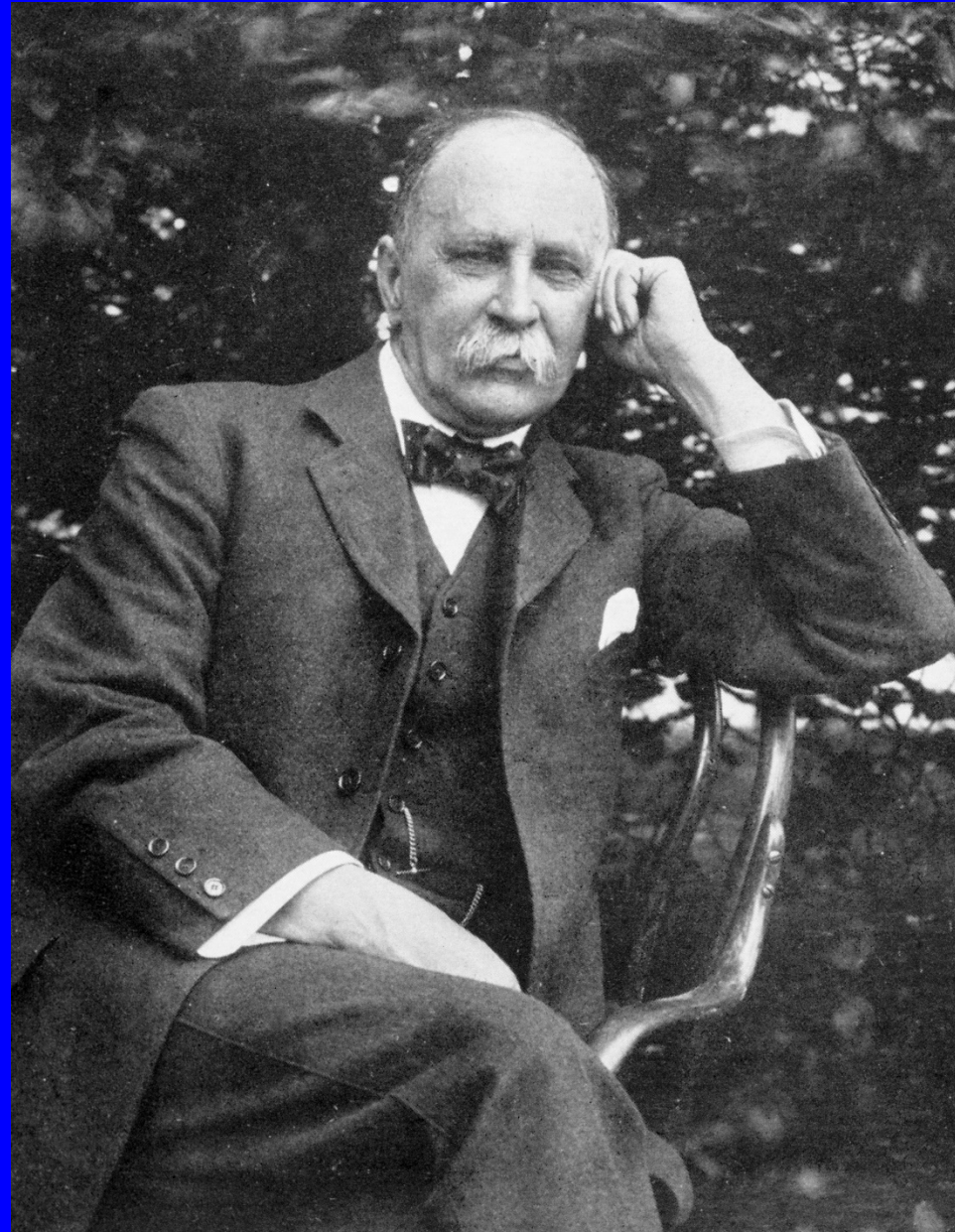
[He never had been and was unwilling to be deceived].

J. F. APPLAND,  
Attorney

Harrison M, The Medical War. British Military Medicine in the First World War, Oxford Univ Press, Oxford, 2010, p 149



# Sir William Osler



# Sir William Osler

- In 1914, Osler of the University of Oxford strongly supported Typhoid vaccination of British troops
- Osler warned that without vaccination, any expeditionary force on the continent had more to “fear from the bacillus of Typhoid fever than bullets or bayonets”
- Osler cautioned soldiers not to be misled by the “misguided cranks who are playing into the enemy’s hands”

Osler W, Br Med J 1914;2(2805):569-70

Hardy A, Bull Hist Med 2000;74:265-290

# Typhoid Vaccination

- The Medical Officer journal stated “we cannot find the words strong enough to describe the opponents of vaccination.” They were described as in the same class as those who would arm soldiers with defective weapons or ammunition
- In 1914, William Leishman told the Royal Sanitary Institute that to send uninoculated men to the front was “little short of murder”

Hardy A, Bull Hist Med 2000;74:265-290

- The British Army continued voluntary Typhoid vaccination. The British Expeditionary Force arrived in France with only 25-30% immunized against Typhoid

Harrison M, The Medical War, British Military Medicine in the First World War, Oxford University Press, Oxford, 2010, pp 147

- Between August and December, 1914 in France and Flanders, 466 British and Dominion soldiers were admitted for Typhoid fever resulting in 57 deaths
- During 1915 this increased to 3,462 admissions and 153 deaths

Mitchell TJ, History of the Great War based on Official Documents, Medical Service, Casualties and Medical Statistics of the Great War. Imperial War Museum, London, 1931, p 66

- By the end of 1915, 90% of British troops were vaccinated
- In 1915, triple vaccines for Typhoid, Paratyphoid A and Paratyphoid B were instituted

Hardy A, Bull Hist Med 2000;74:265-290

Harrison M, The Medical War, British Military Medicine in the First World War, Oxford University Press, Oxford, 2010, pp 142-50

MacPherson WG (ed), History of the Great War based on Official Documents, Medical Services, Diseases of the War, Volume 1, HM Stationery Office, London, 1921, p 56

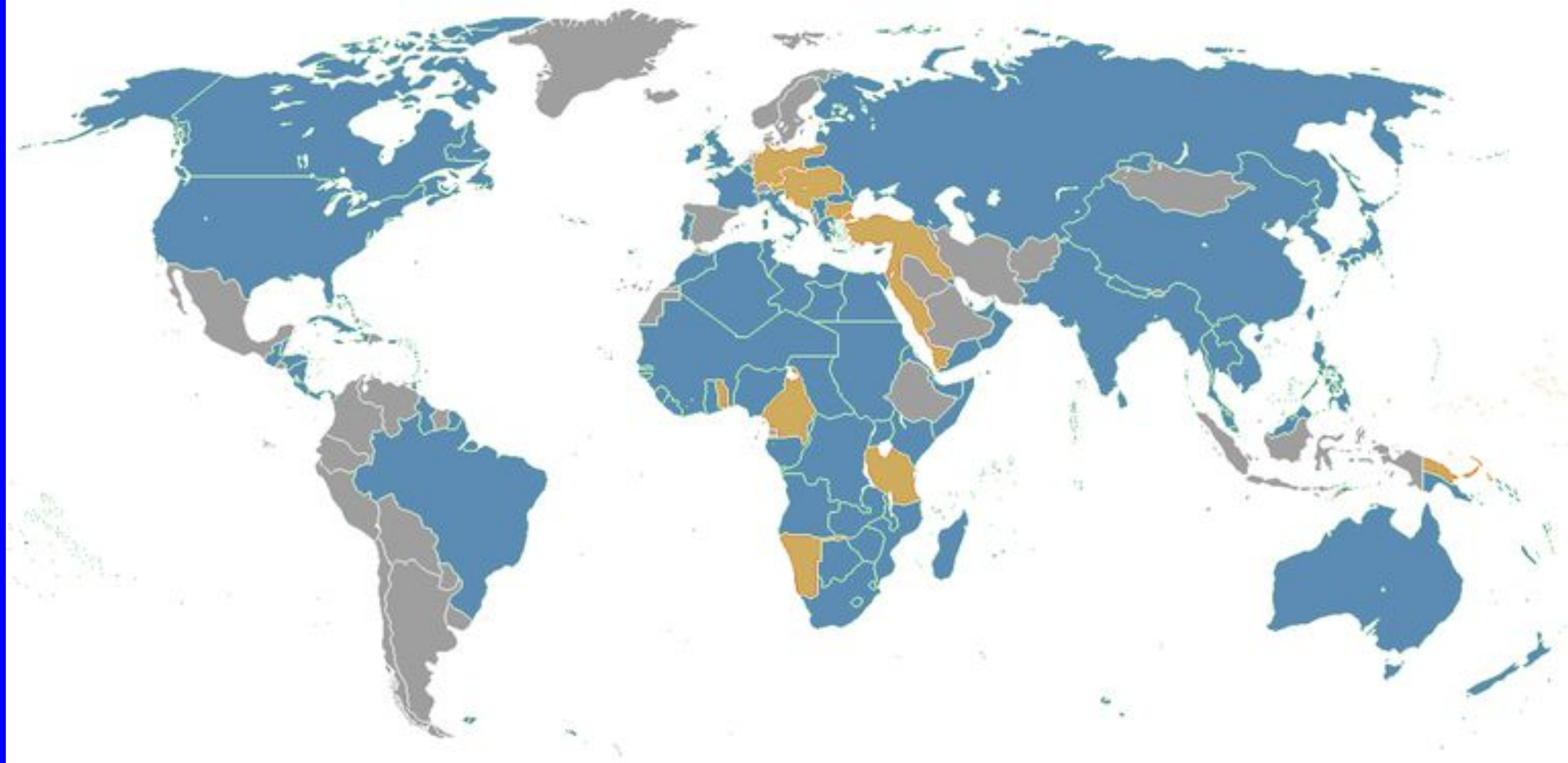
- The British experience was superior to the French Army which reported over 100,000 soldiers with Typhoid fever and 14,482 deaths in 1914-1915

Harrison M, The Medical War, British Military Medicine in the First World War, Oxford University Press, Oxford, 2010, p 152

# Medical Risk of Deployment

- The medical risk and prevalence of enteric diseases were clearly different between the U.S. and British Army
- From 1914-18, the British Army served throughout the Empire and fought in France, Flanders, Africa, Dardanelles, Palestine, Mesopotamia, Italy, Macedonia, North Russia and Siberia





■ Allies (at one point or another)

■ Central Powers

■ Neutral countries

# Medical Risk of Deployment

- From 1917-18 U.S. Army primarily deployed to Great Britain and France with small contingents assigned to North Russia and Siberia.

# British Army and Dominion troops: Dysentery

	<u>Hospitalizations</u>	<u>Deaths</u>
• France and Flanders:	26,432	160
• East and Southwest Africa:	26,956	834
• Dardanelles	29,728	811
• Egypt and Palestine	14,844	484

Mitchell TJ, History of the Great War based on Official Documents, Medical Service, Casualties and Medical Statistics of the Great War. Imperial War Museum, London, 1931, p 81

# British Army and Dominion troops: Dysentery

	<u>Hospitalizations</u>	<u>Deaths</u>
• Mesopotamia	42,995	622
• Italy	901	17
• Macedonia	24,245	480
• North Russia	14	0
• <u>United Kingdom</u>	2,049	5
All theatres	169,164	3,413

Mitchell TJ, History of the Great War based on Official Documents, Medical Service, Casualties and Medical Statistics of the Great War. Imperial War Museum, London, 1931, p 81

# Diarrhea at Gallipoli

- “Some battalions were almost 75% ineffective within weeks of landing
- “Virtually no one escaped some form of enteric infection”
- By September, 1915, 800 evacuations per day for diarrhea and dysentery
- Of 110,000 evacuations due to disease, 40,000 were due to diarrhea and dysentery

Harrison M, The Medical War. British Military Medicine in the First World War. Oxford, Oxford University Press, 2010, pp 178,195

# Dysentery in Mesopotamia

- Major Carter described barges carrying British and Indian casualties at Basra in 1915
- What he thought were ropes on the side of the barges were “dried stalactites of human fæces”
- The stench was “quite definite”
- He described men huddled in a 30 foot square pool of dysentery and generally “covered from head to foot”

Mesopotamia Commission, Report of the Commission Appointed by Act of Parliament to Enquire into the Operations of War in Mesopotamia, together with a Special Report by Commander J Wedgwood, DSO, MP, and Appendices. London: HMSO, 1917, pp 76-7

Wilcox R, Battles on the Tigris. The Mesopotamian campaign of the First World War, South Yorkshire, UK, Pen and Sword, 2005, pp 69-70

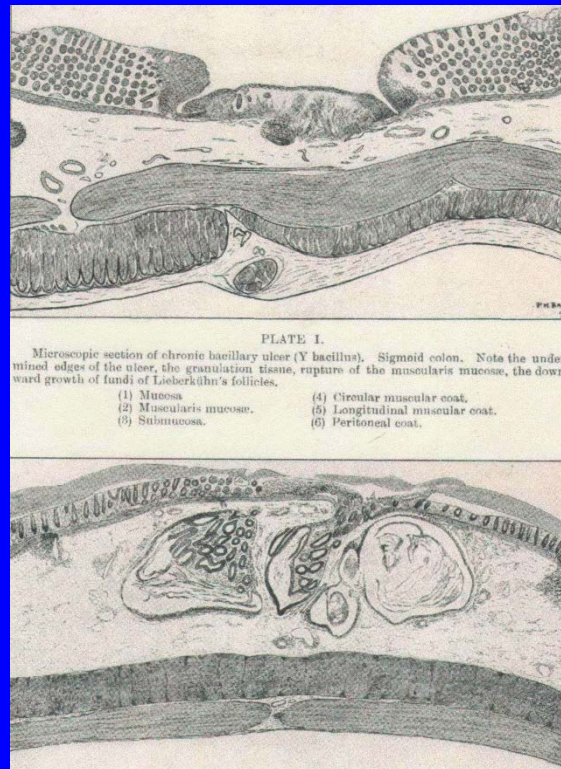
# Dysentery treatment

- Bismuth Carbonate
- Intravenous injection of saline
- Oral rehydration , “albumen water” from egg whites, beef tea, chicken tea
- Emetine - antiprotozoal action

Cowan JM, J R Army Med Corps 1918;31:277-95

Hurst AF, Medical Diseases of the War. London: Edward Arnold 1918, pp159-64

# Autopsy images of sigmoid colon and rectal ulceration in patients with Shigella



Manson-Bahr P, The correlation of the Pathology and Bacteriology of Bacillary Dysentery: A dissertation on some of the Laboratory problems arising in connexion with this disease in the Eastern Theatres of War, J Royal Army Med Corps 1919;33:117-139

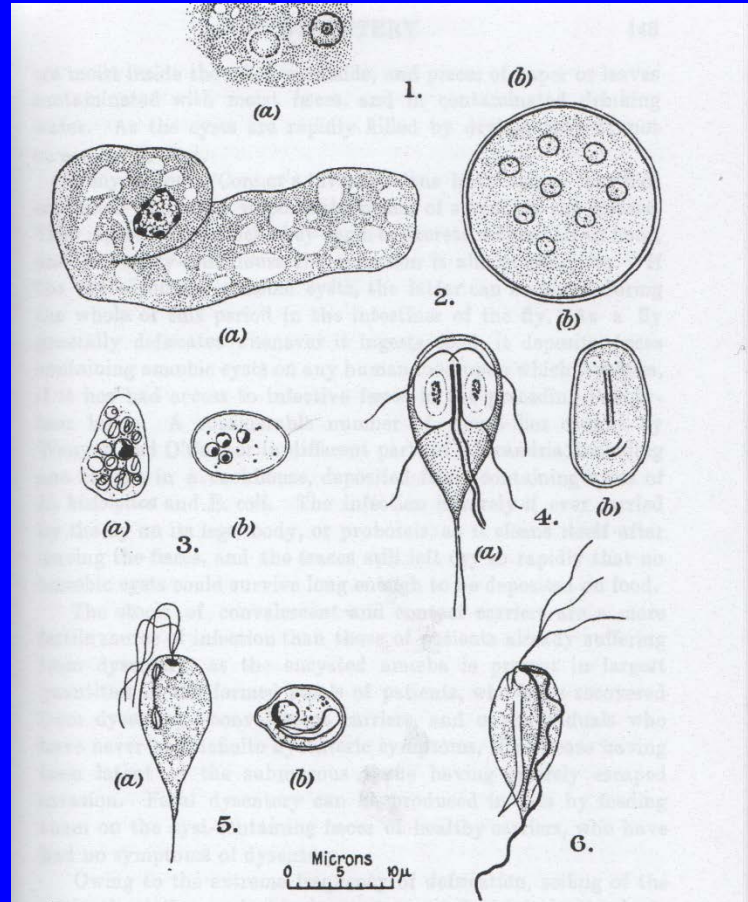


# Dysentery ward, Port Said, Egypt, 1917

## Imperial War Museum



# Amoebic Dysentery



Hurst AF, Medical Diseases of the War. London: Edward Arnold 1918, p 141

# Amoebic Dysentery

## Role of Amoebic infection as a cause of Dysentery

- France and Flanders 2.8%
- Dardenelles 10
- Egypt and Palestine 7
- Mesopotamia 20-40

MacPherson WG (ed), History of the Great War based on Official Documents, Medical Services, Diseases of the War, Volume 1, HM Stationery Office, London, 1921, pp 92-94

# British Army and Dominion troops: Enteric Fevers/Typhoid

	<u>Hospitalizations</u>	<u>Deaths</u>
• France and Flanders:	8,317	286
• East and Southwest Africa:	565	26
• Dardanelles	9,423	330
• Egypt and Palestine	4,118	148

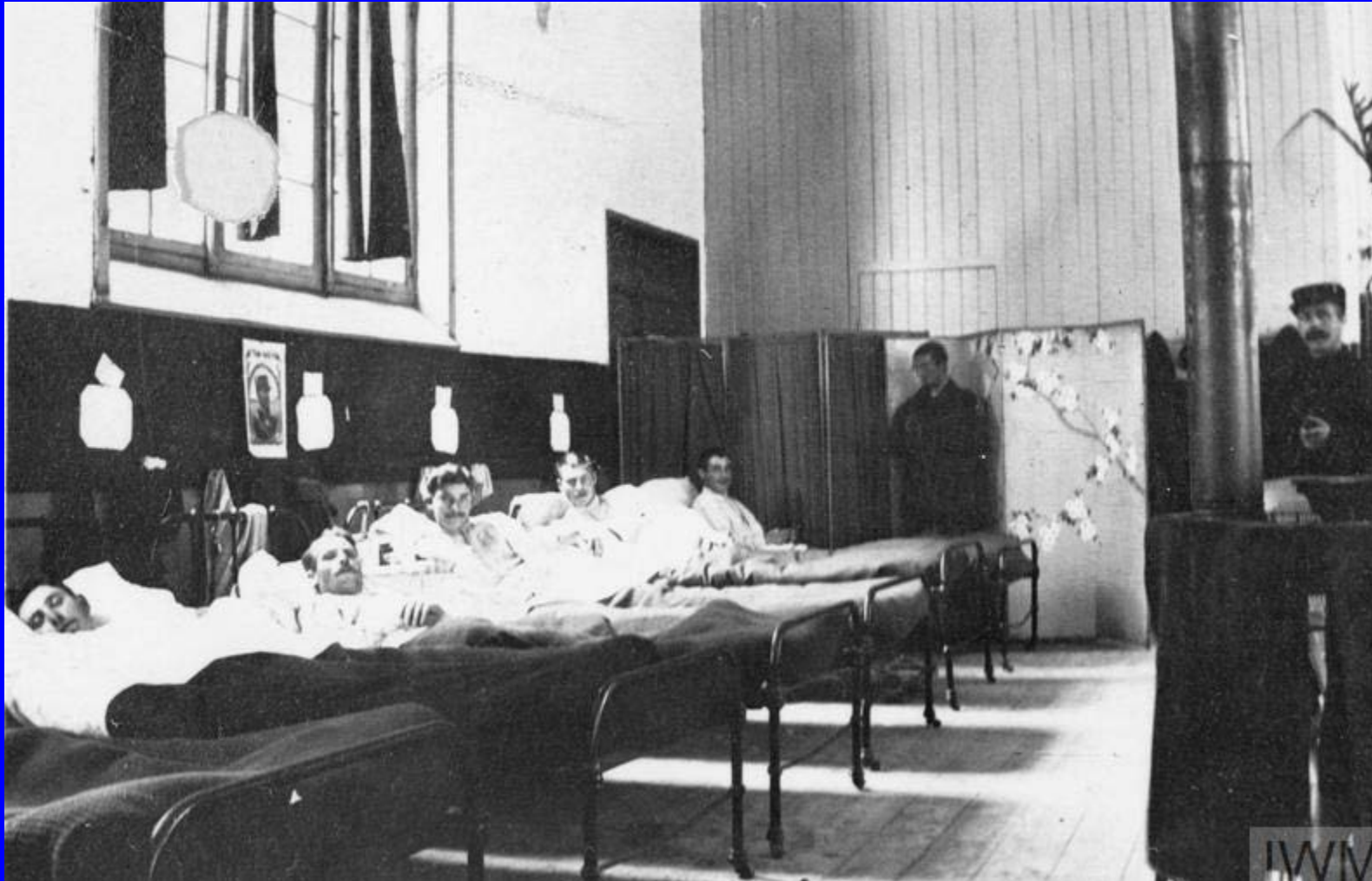
Mitchell TJ, History of the Great War based on Official Documents, Medical Service, Casualties and Medical Statistics of the Great War. Imperial War Museum, London, 1931, p 66

# British Army and Dominion troops: Enteric Fevers/Typhoid

	<u>Hospitalizations</u>	<u>Deaths</u>
• Mesopotamia	5,862	305*
• Italy	142	14
• Macedonia	1,939	60
• North Russia	24	0
• <u>United Kingdom</u>	<u>208</u>	<u>26</u>
• All theatres	30,598	1,095

\*Incomplete data, Mitchell TJ, History of the Great War based on Official Documents, Medical Service, Casualties and Medical Statistics of the Great War. Imperial War Museum, London, 1931, p 66

# Typhoid Ward, Lamark Hospital, Calais, France Imperial War Museum





# Royal Army Medical Corps, Salonika, Macedonia



United States Army  
342<sup>nd</sup> Infantry Regiment marching to the docks in  
Southampton





# U.S. Army parasitic infections

- 126,140 soldiers were examined for hookworm
- 19,640 (15.5%) were positive
- Highest rates of infection among Southern soldiers

Koford CA, Intestinal parasites. In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 541

## U.S. Army

	<u>Examined</u>	<u>Hookworm Ova present</u>
• Georgia	3,872	32.6%
• Florida	3,778	31.8
• Alabama	2,223	29.4
• Louisiana	7,348	27.3
• Mississippi	8,684	27.1
• Kentucky	2,301	16.3
• Tennessee	9,722	12.6

Koford CA, Intestinal parasites. In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX Communicable and other diseases, Washington DC, 1928, p 541

# U.S. Army Total: 1917-1919

	<u>Hospitalizations</u>	<u>Deaths</u>
• Diarrheal disease	92,512	267
• Typhoid fever	1,529	227

Hall MW, Diarrheal Diseases In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 320

Siler JF, Typhoid and the parathyroid fevers. In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 23

# U.S. Army Europe: 1917-1919

	<u>Hospitalizations</u>	<u>Deaths</u>
• Diarrheal disease	48,202	208
• Typhoid fever	885	148

Hall MW, Diarrheal Diseases In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 320

Siler JF, Typhoid and the parathyroid fevers. In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 23

# U.S. Army Disability discharges 1917-1919

• Typhoid Fever	24
• Diarrheal Diseases	198

Hall MW, Diarrheal Diseases In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 320-1

Siler JF, Typhoid and the parathyroid fevers. In: Lynch C (ed), The Medical Department of the United States Army in the World War. Vol IX, Washington DC, 1928, p 23-4

- Both the British and U.S. Armies had significant reduction in deaths from enteric infections in World War I compared to previous conflicts

# How are we still learning from World War I?

- Genetic analysis of bacteria from the Western Front
- Chronic complications of Enteric infections
- Post-infectious Irritable Bowel Syndrome
  - Reactive arthritis
  - Ophthalmological complications

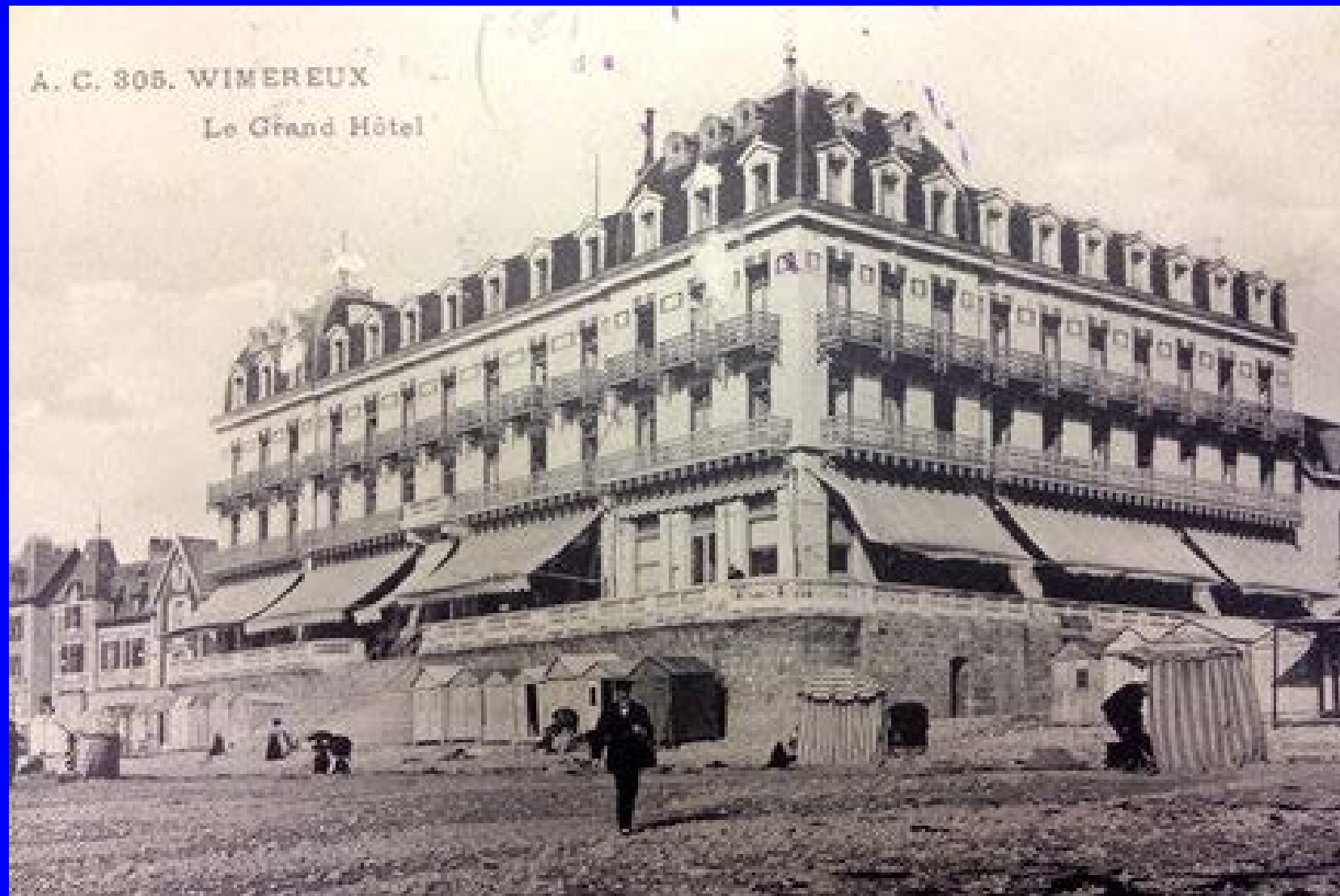
# UK National Collection of Type Cultures (NCTC) 1.

- Private Ernest Cable
- 2<sup>nd</sup> Battalion, East Surrey Regiment
- Age 28
- Hospitalized for dysentery at the Number 14 Stationary Hospital in Wimereux, France
- A culture was obtained which was called the Cable strain
- Died on 13 March 1915

Mather AE, Lancet 2014;384:1720



# No 14 Stationary Hospital, Wimereux, France



# UK, Army Registers of Soldiers' Effects, 1901-1929

163528	6/68/13/11	Gable Ernest	2nd Bn: C. Hursey Private 9108	13-3-15 Hounslow 4/15 Hedley: HP Wimerease	13	13	9	13	13	9	M.O. 9/15	16. 9. 15	Sole Legatee George Norman	13	13	9
		A & W 5070 sent														
		10 APR 1919														

**WAR GRATUITY.**  
 19/20  
 Transfer 4081 2/5.9  
 Regd. Papers 2/467 Enc 6  
 Serial No. 1572

2-7-19  
 Sole Legatee  
 George Norman

# Wilmereux Cemetery









# Private Ernest Cable, vial and memorial plaque



# UK National Collection of Type Cultures (NCTC) 1.

- This specimen was subcultured from a stock culture on Dorset egg medium
- The culture was freeze dried since 1951. As part of the research, the bacterium was grown on a 5% blood agar at 37<sup>0</sup> C
- The bacterium was *Shigella flexneri* serotype 2a

Mather AE, Lancet 2014;384:1720

Baker KS, Lancet 2014;384:1691-7

# UK National Collection of Type Cultures (NCTC) 1.

- Despite being isolated prior to the discovery of antibiotics, the bacterium was resistant to Penicillin and Erythromycin.
- The bacteria contained antimicrobial resistance genes
- A century after the war, such specimens continue to provide medical insight into the enteric infections of the Western Front

# Post-infectious Irritable Bowel Syndrome

- After resolution of the acute infection, Hurst described alternating diarrhea and constipation
- He described bloating, mucus discharge and dyspepsia
- Absence of Amoebic infection or Paratyphoid bacteria
- “Post-dysenteric diarrhoea”
- May last months to years after initial infection

Hurst AF, Medical Diseases of the War. London: Edward Arnold 1918, pp 167-170



# Post-infectious Irritable Bowel Syndrome

- 63% of troops deployed to Afghanistan or Iraq reported at least one episode of diarrhea in 2004
- Irritable Bowel Syndrome has been described after military deployments
- Incidence of Post-infectious Irritable Bowel Syndrome estimated to be 5.4-10%

Brown JA, Travel Med Infect Dis 2009;7:337-43

Scwille-Kiuntke J, Aliment Pharmacol Ther 2015;41:1029-37

Trivedi KH, Dig Dis Sci 2011;56:3602-9

Porter CK, J Travel Med 2015;22:237-41

Thabane M, Aliment Pharmacol Ther 2007;26:535-44

# Reactive Arthritis

- First described by Sydenham in 1672
- Reiter's Syndrome
- Described by British Medical Officers in Egypt, Malta, Salonika, and Mesopotamia
- Graham described 33 patients evacuated to Malta with dysentery and polyarticular arthritis in 1916
- Arthritis began 6-23 days after onset of dysentery
- 13 of 33 patients had Ophthalmological complications

Graham G, Proceedings of the Royal Society of Medicine. 1920;13:23-42

Cowan JM, J R Army Med Corps 1918;31:277-295

**Arthritis in Dysentery: Its Causation, Prognosis and  
Treatment.<sup>1</sup>**

By GEORGE GRAHAM, M.D.

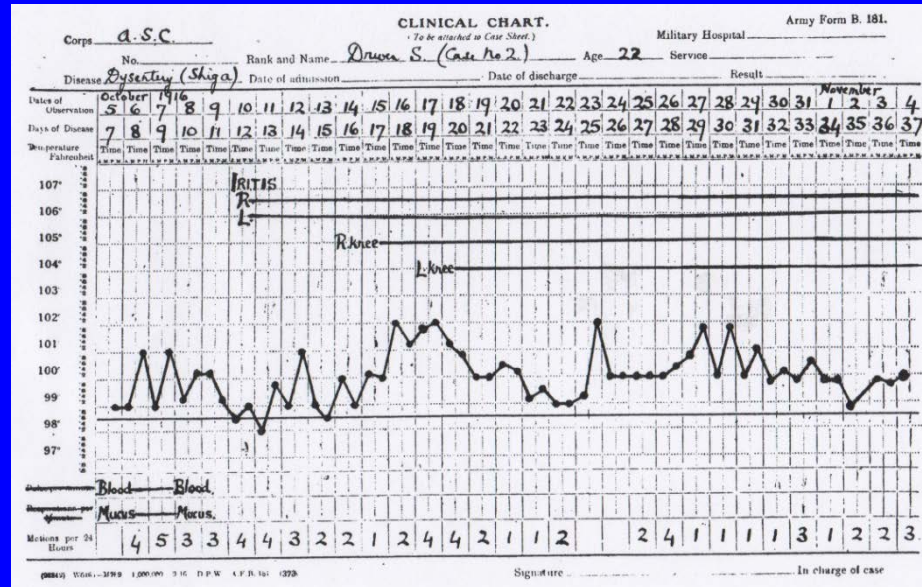
Graham G, Proceedings of the Royal Society of Medicine  
1920;13:23-42

# Reactive Arthritis

- 1,753 active duty U.S. military with diarrhea
- Campylobacter 728, Salmonella 624, Shigella 376,
- Yersinia enterocolitica 17
- 6 (0.3%) developed reactive arthritis
- 67% required care > one year

# Ophthalmological complications

- British Medical Officers described six patients with dysentery, iritis and cyclitis treated in 1916-17



Maxwell EM, Br J Ophthalmol 1918;2:71-79

# Disability

- Between 1919 and 1929 there were 20,822 British soldiers on disability for complications of dysentery

Mitchell TJ, History of the Great War based on Official Documents, Medical Service, Casualties and Medical Statistics of the Great War. Imperial War Museum, London, 1931, pp 335 -338

# Conclusions

- There were significant differences between the British Army and U.S. Army pre-war experiences, resistance to vaccination and deployment to endemic areas
- Modern analysis of stored bacterial specimens from World War I provide new insight on the enteric infections

# Conclusions

- Controversies regarding mandatory vaccinations
  - Enteric infections during deployment
  - Chronic sequelae of gastrointestinal infections
- remain military medical challenges a century after  
World War I









In Memory of  
Private  
**E Cable**

9108, 2nd Bn., East Surrey Regiment who died on 13 March 1915

Remembered with Honour  
**Wimereux Communal Cemetery**



Commemorated in perpetuity by  
the Commonwealth War Graves Commission





# Wimereux Communal Cemetery

