CAMB705: Advanced Topics in Bacterial-Host Interactions
Wednesday 3:30-5pm from January 27, 2021 until April 7, 2021 (no class March 10)
Location: Virtual- https://bluejeans.com/698318318

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Course Description: This course will delve into specific topics in general area of bacterial pathogenesis and bacteria-host interactions. We will explore key historical and current papers on topics related to bacterial invasion of and replication within host cells, bacterial interference with host cell signaling pathways, bacterial interactions with host mucosal tissues, and the role of bacterial colonization in shaping and instructing host immune responses. Each week, a student will lead the class in the discussion of a published paper on a specific topic. The format of each class will be a 10-15-minute introduction of the key background and underlying questions to be presented by a student, followed by a student-led analysis of the data presented in the research article involving participation by all members of the class. Students will be graded based on their presentation and active participation in the paper discussions.

Prerequisites: Strong background in cell biology, immunology and/or bacteriology fulfilled by 1st year CAMB courses. Course is limited to 2nd year and above doctoral students or advanced undergraduates with course director's permission.

The class will meet once per week for 1.5 hours, and will discuss 1-2 key papers for each topic, as well as relevant background.

Topics to be discussed:

Jan 27: General course background and introductory lecture on bacterial:host interactions

Background reading:

Falkow, S. (1988). Molecular Koch's postulates applied to microbial pathogenicity. Reviews of Infectious Diseases, 10 Suppl *2*, S274–6.

Falkow, S. (2004). Molecular Koch's postulates applied to bacterial pathogenicity--a personal recollection 15 years later. Nature Reviews Microbiology, *2*(1), 67–72.

Feb 3: Bacterial survival within the host cell: hijacking the host cytoskeleton

Discussion Paper:

L. monocytogenes-induced actin assembly requires the actA gene product, a surface protein. Kocks C, Gouin E, Tabouret M, Berche P, Ohayon H, Cossart P. Cell. 1992 Feb 7;68(3):521-31.

Background Paper:

Listeria monocytogenes: towards a complete picture of its physiology and pathogenesis. Radoshevich L, Cossart P. Nat Rev Microbiol. 2018 Jan;16(1):32-46.

Actin-based motility and cell-to-cell spread of bacterial pathogens. Lamason RL, Welch MD. Curr Opin Microbiol. 2017 Feb;35:48-57.

Feb 10: Bacterial secretion systems: intra-kingdom communication devices – Type III secretion

Discussion Paper:

Global Mapping of the Inc-Human Interactome Reveals that Retromer Restricts Chlamydia Infection. Mirrashidi KM, Elwell CA, Verschueren E, Johnson JR, Frando A, Von Dollen J, Rosenberg O, Gulbahce N, Jang G, Johnson T, Jäger S, Gopalakrishnan AM, Sherry J, Dunn JD, Olive A, Penn B, Shales M, Cox JS, Starnbach MN, Derre I, Valdivia R, Krogan NJ, Engel J. Cell Host Microbe. 2015 Jul 8;18(1):109-21.

Background Paper:

Chlamydia cell biology and pathogenesis. Elwell C, Mirrashidi K, Engel J. Nat Rev Microbiol. 2016 Jun;14(6):385-400.

Feb 17: Bacterial secretion systems: intra-kingdom communication devices – Type IV secretion

Discussion Paper:

Carey et al. (2011). The Coxiella burnetii Dot/Icm system delivers a unique repertoire of type IV effectors into host cells and is required for intracellular replication. PLOS Pathogens. May;7(5):e1002056.

Background:

Darbari and Waksman (2015). Structural Biology of Bacterial Type IV Secretion Systems. Annual Review of Biochemistry, 84:603-29.

Protein-Injection Machines in Bacteria. Galán JE, Waksman G. Cell. 2018 Mar 8;172(6):1306-1318 (read section pertinent to type IV secretion)

Feb 24: Escaping the Host

Discussion Paper:

Ruhl et al. (2020) Mycobacterium tuberculosis Sulfolipid-1 Activates Nociceptive Neurons and Induces Cough. Cell. 181(2):293-305.

Background paper:
Mycobacterium tuberculosis pathogenicity viewed through the lens of molecular Koch's postulates.
Ramakrishnan L. Curr Opin Microbiol. 2020 Apr;54:103-110. doi: 10.1016/j.mib.2020.01.011.

March 3: Bacterial toxins and cell-surface receptors

Discussion Paper:

CCR5 is a receptor for Staphylococcus aureus leukotoxin ED. Alonzo F 3rd, Kozhaya L, Rawlings SA, Reyes-Robles T, DuMont AL, Myszka DG, Landau NR, Unutmaz D, Torres VJ. Nature. 2013 Jan 3;493(7430):51-5.

Background Papers:

The effects of Staphylococcus aureus leukotoxins on the host: cell lysis and beyond. Yoong P, Torres VJ. Curr Opin Microbiol. 2013 Feb;16(1):63-9.

Bacterial survival amidst an immune onslaught: the contribution of the Staphylococcus aureus leukotoxins. Alonzo F 3rd, Torres VJ. PLoS Pathog. 2013 Feb;9(2):e1003143

March 10: No class (spring break)

March 17: Setting up a persistent bacterial infection

Discussion Paper:

Salmonella-Driven Polarization of Granuloma Macrophages Antagonizes TNF-Mediated Pathogen Restriction during Persistent Infection. Pham THM, Brewer SM, Thurston T, Massis LM, Honeycutt J, Lugo K, Jacobson AR, Vilches-Moure JG, Hamblin M, Helaine S, Monack DM.
Cell Host Microbe. 2020 Jan 8;27(1):54-67.e5.

Background Papers:

Helicobacter and salmonella persistent infection strategies. Monack DM. Cold Spring Harb Perspect Med. 2013 Dec 1;3(12):a010348. (Read the section on Salmonella)

March 24: Bacterial invasion and spread: crossing the blood-brain barrier.

Discussion Paper:

Blocking Neuronal Signaling to Immune Cells Treats Streptococcal Invasive Infection. Pinho-Ribeiro FA, Baddal B, Haarsma R, O'Seaghdha M, Yang NJ, Blake KJ, Portley M, Verri WA, Dale JB, Wessels MR, Chiu IM.
Cell. 2018 May 17;173(5):1083-1097.e22.

Background Papers:

Pain and immunity: implications for host defence. Baral P, Udit S, Chiu IM. Nat Rev Immunol. 2019 Jul;19(7):433-447.

March 31: Immune detection of bacterial virulence activity- Effector-triggered immunity

Discussion Paper:

Functional degradation: A mechanism of NLRP1 inflammasome activation by diverse pathogen enzymes. Sandstrom A, Mitchell PS, Goers L, Mu EW, Lesser CF, Vance RE.
Science. 2019 Apr 5;364(6435).

Background Paper:

The NLRP1 inflammasome: new mechanistic insights and unresolved mysteries. Mitchell PS, Sandstrom A, Vance RE. Curr Opin Immunol. 2019 Oct;60:37-45

Effector-triggered immunity and pathogen sensing in metazoans. Lopes Fischer N, Naseer N, Shin S, Brodsky IE. Nat Microbiol. 2020 Jan;5(1):14-26

April 7: Interbacterial competition within the inflamed gut

Discussion Paper:

Microcins mediate competition among Enterobacteriaceae in the inflamed gut. Sassone-Corsi M, Nuccio SP, Liu H, Hernandez D, Vu CT, Takahashi AA, Edwards RA, Raffatellu M. Nature. 2016 Dec 8;540(7632):280-283.

Background Paper:

Control of pathogens and pathobionts by the gut microbiota. Kamada N, Chen GY, Inohara N, Núñez G. Nat Immunol. 2013 Jul;14(7):685-90.

G.I. pros: Antimicrobial defense in the gastrointestinal tract. Chung LK, Raffatellu M. Semin Cell Dev Biol. 2019 Apr;88:129-137.