

# Using Surveillance Data for Research Requires Caution: An example with *Clostridium difficile* infection ascertainment

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Bobby Warren



Photo credit: Sam Kittner '85

Sponsoring organization: Duke Infection Control  
Outreach Network (DICON)

Sponsoring supervisor: Dr. Deverick Anderson



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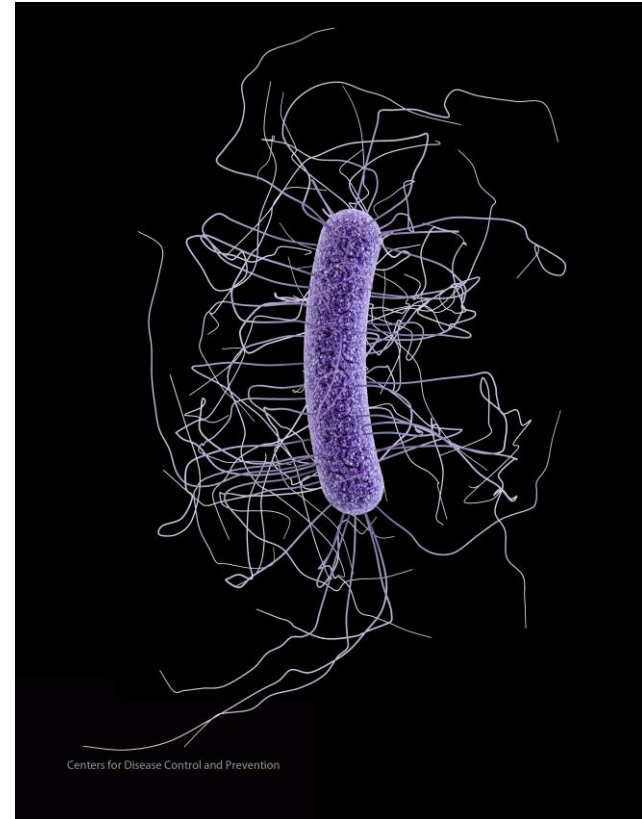
# Overview

- *C. difficile* background
- Healthcare facility-associated infections (HAIs) vs. Community-acquired Infections (CAIs)
- Acquisition definitions
- Cohort study
- Discussion
- Questions



# *Clostridium difficile*

- Anaerobic
- Spore-forming
- Persistent
- Fecal-oral route
- Colonization<sup>1</sup>



*C. difficile*. Digital image. *Centers for Disease Control*. N.p., n.d. Web. 27 Apr. 2018.

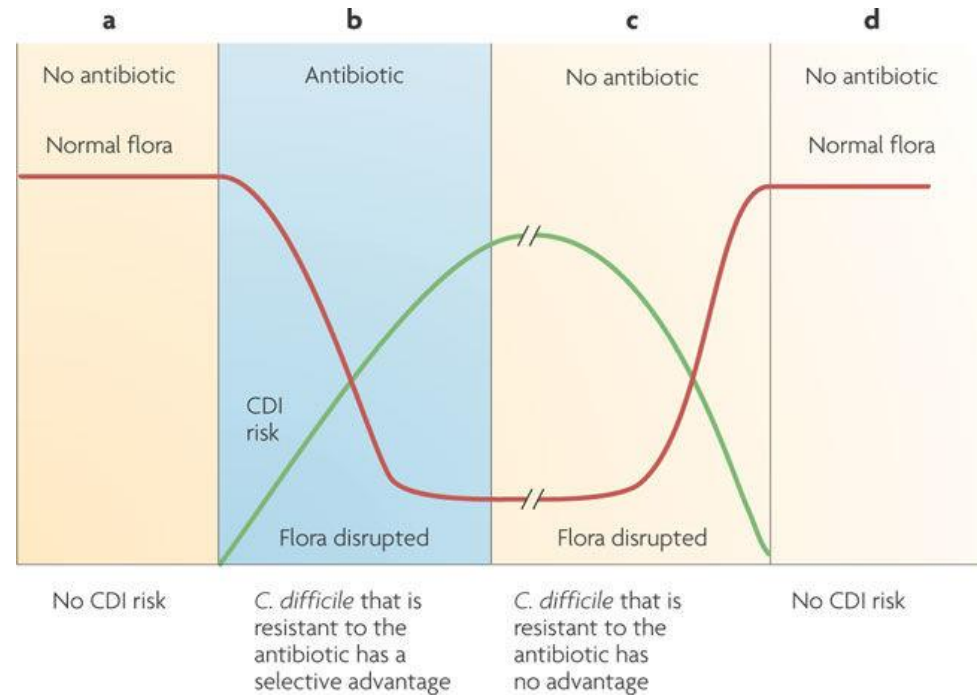


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# *C. difficile* infections (CDI)

- Antibiotics disrupt normal gut flora
- *C. difficile* proliferates, produces toxins
- Pseudomembranous colitis, severe diarrhea and dehydration<sup>2</sup>
- Can be classified as healthcare-associated or community-acquired.



Nature Reviews | Microbiology

Rupnik, Maja, Mark H. Wilcox, and Dale Gerding. The Effect of Antibiotics on the Normal Gut Flora and the Risk of Clostridium Difficile Infection (CDI). Digital image. Nature Reviews Microbiology. Nature, 01 July 2009. Web. 04 Apr. 2018.



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# Healthcare-associated infections (HAIs)

- Also known as nosocomial infections
- Acquired during treatment in healthcare setting
- *C. difficile* is the leading cause
  - 453,000 cases, 29,000 deaths in 2011<sup>3</sup>
  - Still rising



# Community-acquired infections (CAIs)

- Acquired from non-healthcare setting
- *C. difficile* infections historically understood as healthcare-associated (HAI)
  - 20-50% of CDIs are now community-acquired (CAI)<sup>4</sup>



# Research questions

- Big picture
  - CA-CDI really rising?
  - CA-CDI origin?
- Specific question
  - Are the current acquisition definitions accurately defining CDI cases?



# Laboratory Identified Event Reporting (LabID)

- Simple and efficient
- Facility-level CDI rates<sup>5</sup>
- *NOT designed for epidemiologic purposes*





# LabID Definitions

- *Community-acquired (CAI)*: Stool collected  $\leq 3$  days after admission from a patient who was not discharged from the same facility in the previous 4-weeks. <sup>6</sup>
- *Healthcare-facility associated (HAI)*: Stool collected  $\leq 3$  days after admission from a patient who was discharged from the same facility in the previous 4-weeks. <sup>6</sup>



# Proposed definitions

- *Community-acquired (CAI)*: Stool collected  $\leq 3$  days after admission from a patient who was not discharged from a healthcare facility in the previous 4-weeks.
- *Healthcare-facility associated (HAI)*: Stool collected  $\leq 3$  days after admission from a patient who was discharged from a healthcare facility in the previous 4-weeks.



# Retrospective cohort study

- CDI cases from 2011-2017 from DICON
- Duke Infection Control Outreach Network (DICON)
  - 46 hospitals in southeast US
  - Share surveillance data and consultative services
  - LabID definitions
- Deployed proposed definitions retroactively

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# Exclusion criteria

- CDI cases from 2011-2017 in DICON database
- 4-week (28 day) cutoff
  - No previous discharge date → excluded
  - Invalid entry → excluded

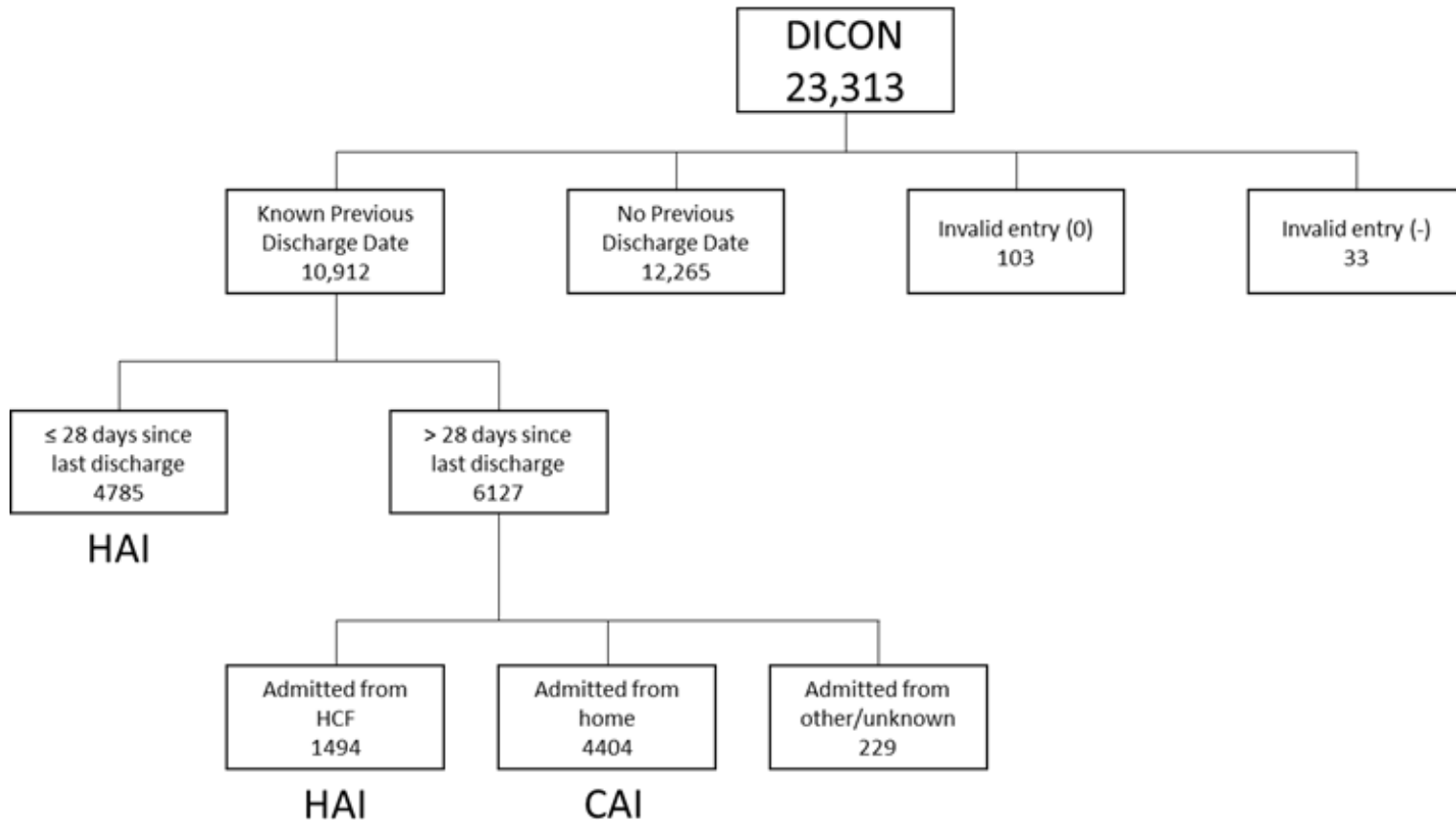


# Retroactive classification

- If  $\leq 28$  day since last admission  $\rightarrow$  HAI
- If  $> 28$  days since last admission
  - Admitted from home  $\rightarrow$  CAI
  - Admitted from healthcare facility  $\rightarrow$  HAI
    - Nursing home
    - Hospice
    - Home health
    - Etc.



# Redefining acquisition



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# Results

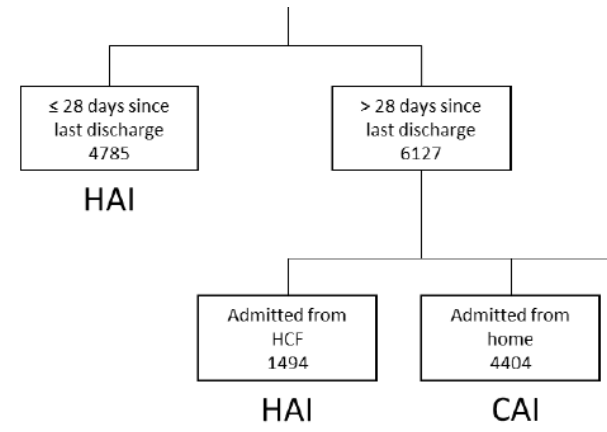
- 23,313 CDI → 10,683
  - Majority excluded for missing discharge date
- 23.6% miscategorized overall
  - **7.0% of HAIs as CAIs**
  - 43.7% of CAIs as HAIs

	Optimized Definitions		
	HAI	CAI	Total
LabID Surveillance	(n = 6279)	(n = 4404)	(n = 10683)
CAI	<b>352 (5.6)</b>	1387 (31.5)	1739 (16.3)
HAI	4659 (74.2)	<b>1075 (24.4)</b>	5734 (53.7)
Indeterminant	771 (12.3)	1620 (36.8)	2391 (22.4)
Not Followed	497 (7.9)	322 (7.3)	819 (7.6)
Miscategorized %	7	43.7	23.6



# Results

	Optimized Definitions		
	HAI (n = 6279)	CAI (n = 4404)	Total (n = 10683)
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LabID Surveillance	Optimized Definitions			
	≤ 28 days since last admission (HAI) (n = 4785)	> 28 Days but from Healthcare setting (HAI) (n = 1494)	> 28 days, from home (CAI) (n = 4404)	Total (n = 10683)
CAI	42 (0.9)	310 (20.7)	1387 (31.5)	1739 (16.3)
HAI	4223 (88.3)	436 (29.2)	1075 (24.4)	5734 (53.7)
Indeterminant	145 (3.0)	626 (41.9)	1620 (36.8)	2391 (22.4)
Not Followed	375 (7.8)	122 (8.2)	322 (7.3)	819 (7.6)
Miscatergorized %	1.0	41.6	43.7	23.6



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# Results

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## Admitted From a Healthcare Facility

LabID Surveillance	Admitted From a Healthcare Facility					Other Extended Care Facility (n = 175)	Total (1493)
	Home Health (n = 102)	Hospice (n = 6)	Hospital (n = 93)	Nursing Home (n = 1117)			
CAI	<b>17 (16.7)</b>	<b>1 (16.7)</b>	<b>30 (32.3)</b>	<b>220 (19.7)</b>	<b>41 (23.4)</b>		309 (20.7)
HAI	21 (20.6)	3 (50.0)	44 (47.3)	316 (28.3)	52 (29.7)		436 (29.2)
Indeterminant	53 (52.0)	2 (33.3)	18 (19.4)	476 (42.6)	77 (44.0)		626 (41.9)
Not Followed	11 (10.8)	0 (0)	1 (1.1)	105 (9.4)	5 (2.9)		122 (8.2)
Miscatergorized %	<b>44.7</b>	25.0	<b>40.5</b>	<b>41.0</b>	<b>44.1</b>		41.6



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# Discussion

- Frequent misclassification
- 41.6% (310 of 746) of cases that:
  - Not admitted to index hospital in past 28 days
  - Admitted from a healthcare setting
  - Likely HAIs
- LabID surveillance definitions will continue to misclassify cases unless changed.



# Discussion

- LabID definitions are ideal for single hospital surveillance.
- Heavily flawed when used for analyses that go beyond that hospital.
- Takeaway:
  - When using aggregate surveillance data know:
    - Why and how each data point is collected.



# Limitations

- Community hospitals in southeast US
  - Not generalizable
- CDIs were required to have a discharge date
  - Increased exposure to healthcare facilities
  - Higher HAIs
  - Large chunk of data lost (~50%)
- Unable to evaluate for errors in database.



# Summary

- LabID definitions
  - Underestimate HA-CDIs
  - Overestimate CA-CDIs
- Caution is needed when using LabID surveillance definitions
  - And any other surveillance data



# Research questions revisited

- Big picture
  - CA-CDI really rising?
  - CA-CDI origin?
- Specific question
  - Are the current acquisition definitions accurately defining cases?



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# References

1. Kelly, MD CP, LaMont, MD JT. *CLOSTRIDIUM DIFFICILE* INFECTION. *Annu Rev Med*. 1998;49(1):375-390. doi:10.1146/annurev.med.49.1.375
2. Clostridium difficile Infection Information for Patients. <https://www.cdc.gov/hai/organisms/cdiff/cdiff-patient.html>. Published 2015.
3. Lessa FC, Mu Y, Bamberg WM, et al. Burden of *Clostridium difficile* Infection in the United States. *N Engl J Med*. 2015;372(9):825-834. doi:10.1056/NEJMoa1408913
4. Chitnis AS, Holzbauer SM, Belflower RM, et al. Epidemiology of community-associated Clostridium difficile infection, 2009 through 2011. *JAMA Intern Med*. 2013;173(14):1359-1367. doi:10.1001/jamainternmed.2013.7056
5. Chen LF, Anderson DJ. Surveillance for Clostridium difficile Infection. 2016;36(2):125-131. doi:10.1017/ice.2014.42.A
6. Gase KA, Haley VB, Xiong K, Antwerpen C Van, Stricof RL. Comparison of 2 Clostridium difficile Surveillance Methods National Healthcare Safety Network's Laboratory-Identified Event Reporting Module versus Clinical Infection Surveillance. *Infect Control Hosp Epidemiol*. 2013;34(3):284-290. doi:10.1086/669509
7. Gerding DN, Lessa FC. The Epidemiology of Clostridium difficile Infection Inside and Outside Health Care Institutions. *Infect Dis Clin North Am*. 2015;29(1):37-50. doi:10.1016/j.idc.2014.11.004





# Questions?



Photo credit: Sam Kittner '85

<u>Demographic Characteristics</u>	<u>CDI Cases (n = 23313)</u>
<b>Ethnicity</b>	
Caucasian	11549 (49.5)
Unknown	6277 (26.9)
African American	4894 (21)
American Indian	279 (1.2)
Asian	61 (0.3)
Hispanic	142 (0.6)
Other	111 (0.5)
<b>Age Distribution</b>	
0-10	350 (1.5)
11-20	134 (0.6)
21-30	693 (3.0)
31-40	1063 (4.6)
41-50	1922 (8.2)
51-60	3383 (14.5)
61-70	4834 (20.7)
71-80	5370 (23)
81-90	4424 (19)
91-100	1117 (4.8)
100+	23 (0.1)
<b>Sex</b>	
Female	13811 (59.2)
Male	9058 (38.9)
Unknown/Blank	444 (1.9)



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