

Burden of *Clostridium difficile* Infection (CDI) Across Hospital Inpatient, Nursing Home, and Home Settings

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Abstract

Background: *Clostridium difficile* infection (CDI) is the main cause of healthcare-related infectious diarrhea, with worse effects among the elderly. The settings of recurrent and index CDI may differ, posing challenges to CDI management and leading to greater burden. We followed CDI patients transitioning between hospital, nursing home, and home settings to identify the burden of CDI across the healthcare system.

Methods: We conducted a retrospective cohort study in linked Medicare, Medicaid, and Minimum Data Set data among CDI patients >65 years old from Jan 2008 to Dec 2010. Index CDI was defined as ICD-9-CM code 008.45, with no CDI in prior 84 days. Settings of interest were hospital inpatient (IP); nursing home, including skilled nursing and long-term-care facilities (NH); and home – outpatient, home health, or other (H). Patients were followed for 12 months for recurrent CDI (rCDI, ≤84 days) and transitions between settings.

Results: A cohort of 60,828 patients that was 31% male, with a mean age of 81 years, had index CDI distributed as 45,465 (75%) IP, 2,959 (5%) NH, and 12,404 (20%) H. Home had a lower Charlson Comorbidity Index (3.2) compared to NH (4.3) or IP (4.4). Most patients were hospitalized in the previous year or 90 days (IP 81%, 69%; NH 95%, 93%; H 61%, 42%). Overall, 29% had rCDI, observed in 29% of IP, 41% of NH, and 23% of H. The number of rCDI (1, 2, >2) were IP (18%, 6%, 5%), NH (22%, 8%, 11%), and H (14%, 5%, 5%). Mean number of transitions was 3.1 ± 3.5 for IP, 3.0 ± 3.1 for NH, and 1.8 ± 3.6 for H. Transitions from IP included 38% to NH by 10 days (median), with 58% of them returning to IP after 23 days at NH. Similarly, 50% of IP were discharged home by day 8, with 51% readmitted by day 36 at home. Fifty-six percent of NH had a first transition to IP by day 31. H transitioned to IP by day 65 (37%) or NH by day 12 (20%).

Conclusions: Burden may be substantial for subsequent CDI across care settings. NH patients in particular were observed to have more prior hospitalization and rCDI, as well as more transition to IP. Over 50% of home patients were admitted for care, and more than half of IP discharges were readmitted at second transition. Further work is needed to determine whether transitions were due to rCDI. Future studies should consider the possible role of rCDI across settings on overall healthcare system burden.

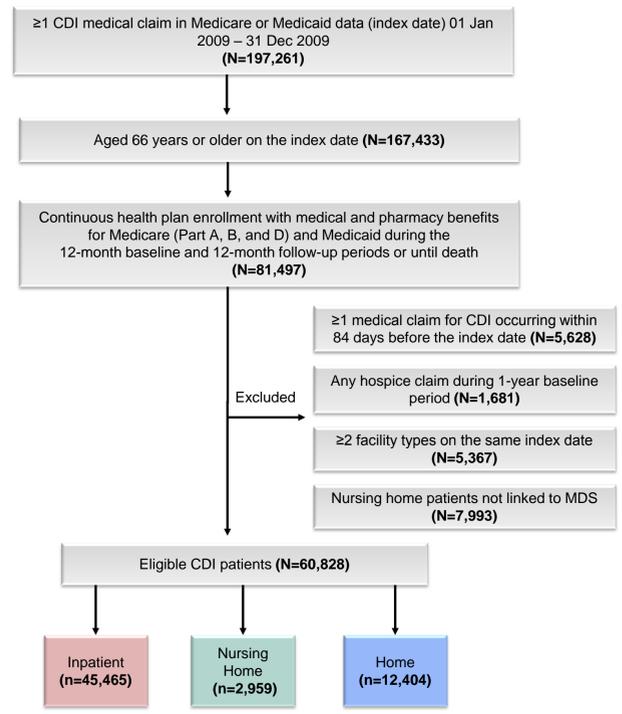
Background

- Clostridium difficile* infection (CDI) is the leading cause of nosocomial infectious diarrhea in the United States, particularly affecting older adults aged ≥65 years, accounting for most disease mortality and morbidity¹⁻³
 - Recurrence of CDI is the major problem in CDI management. Several studies suggest that upon completion of treatment with vancomycin or metronidazole, 18%-25% of patients experience a recurrent CDI (rCDI) episode leading to greater use of various healthcare resources⁴⁻⁶
 - Incidence of CDI can vary by setting, and the setting in which the CDI is identified may differ from the setting in which it is acquired, posing challenges to CDI as well as rCDI management and leading to greater burden⁷⁻¹⁴
 - Therefore, to understand the potential burden of CDI, this study followed CDI patients through their course of care to evaluate rCDI and transitions between healthcare settings
- Objective:** To assess burden of CDI across the healthcare system by describing recurrent CDI and transitions in settings following an index CDI episode

Methods

Data

- Study design: Retrospective cohort study
- Data source: Linked Medicare, Medicaid, and Minimum Data Set data from Jan 2008 to Dec 2010
- Patient population: CDI patients >65 years old
- Index CDI definition: ICD-9-CM code 008.45, with no CDI in prior 84 days
- Recurrent CDI (rCDI) definition: ICD-9-CM code 008.45 within 84 days of previous CDI, with a minimum 2-week claim-free period between episodes
- Setting of index CDI
 - Inpatient (IP) – Hospital inpatient
 - Nursing home (NH) – Skilled nursing and long-term-care facilities
 - Home (H) – Outpatient, home health, other
- Follow-up: 12 months for rCDI and transitions between settings



Statistical

- Descriptive analysis was undertaken to characterize the demographic and clinical characteristics among CDI patients in each setting cohort
- Differences among the cohorts were measured with hospital inpatient as the referent category, using Chi-square tests for categorical variables and student t-tests for continuous variables with P-values, confidence intervals (CI), and standardized differences

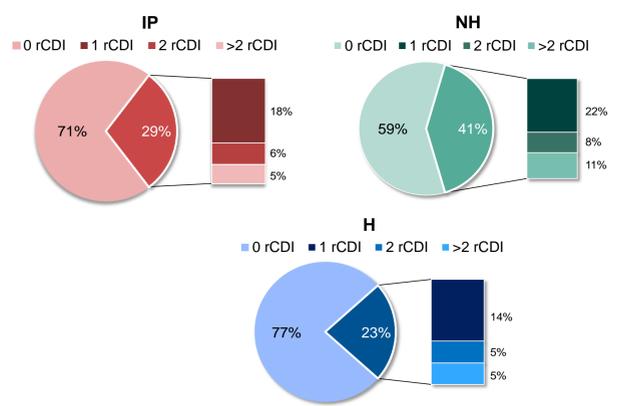
Characteristics

- The overall cohort of 60,828 patients was 31% male and had a mean age of 81 years
- Index CDI was distributed between settings as 45,465 (75%) hospital inpatient, 2,959 (5%) nursing home, and 12,404 (20%) home
- The home index setting had a lower Charlson Comorbidity Index compared to nursing home or hospital inpatient
- Most patients had been hospitalized in the previous year or 90 days

	Inpatient (IP) N=45,465	Nursing Home (NH) N=2,959	P-value	Home (H) N=12,404	P-value
Age, years mean ± SD	80.6 ± 8.0	82.4 ± 7.9	<0.0001	79.9 ± 8.2	<0.0001
Gender, male, N (%)	14,808 (32.6%)	882 (29.8%)	0.0019	3,332 (26.9%)	<0.0001
Charlson Comorbidity Index (CCI) mean ± SD	4.37 ± 3.12	4.32 ± 3.01	0.3612	3.16 ± 2.77	<0.0001
1-year baseline hospitalization, N (%)	37,035 (81.5%)	2,810 (95.0%)	<0.0001	7,589 (61.2%)	<0.0001
Prior 90-day hospitalization, N (%)	31,157 (68.5%)	2,743 (92.7%)	<0.0001	5,207 (42.0%)	<0.0001

rCDI by index healthcare setting

- Overall, 29% of the index CDI patients had recurrent CDI, observed in 29% of those from a hospital inpatient index setting (n=13,352), 41% of those from a nursing home index setting (n=1,210), and 23% of those from a home index setting (n=2,872)
- The number of rCDI (1, 2, >2) during the follow-up period was distributed as follows in each index setting: hospital inpatient (18%, 6%, 5%), nursing home (22%, 8%, 11%), and home (14%, 5%, 5%)



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Results

Transitions

- Mean number of transitions was 3.1 ± 3.5 from a hospital inpatient index setting, 3.0 ± 3.1 from a nursing home index setting, and 1.8 ± 3.6 from a home index setting

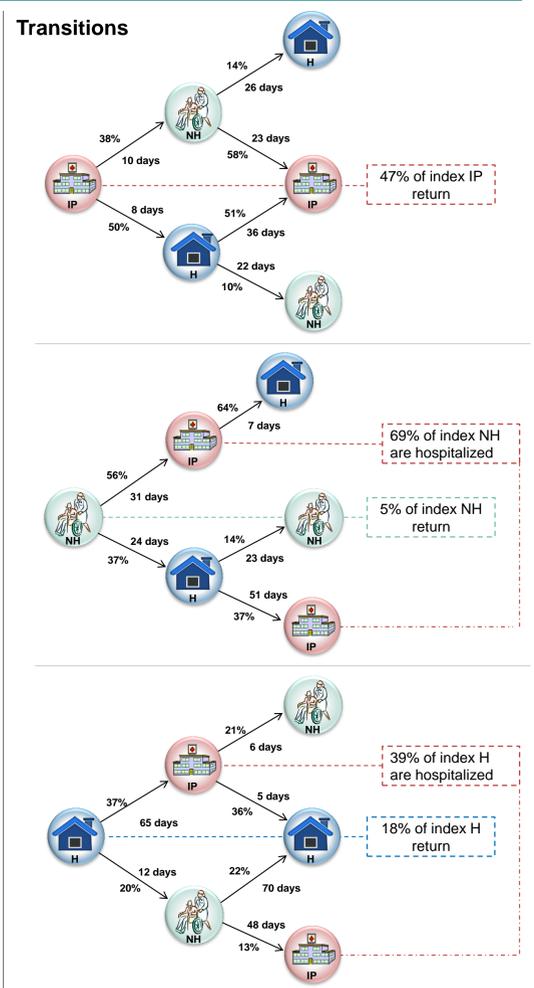
	Inpatient (IP) N=45,465	Nursing Home (NH) N=2,959	P-value	Home (H) N=12,404	P-value
Transition during 12-month follow-up					
Number of transitions per patient, mean ± SD	3.1 ± 3.5	3.0 ± 3.1	0.0257	1.8 ± 3.6	<0.0001
Median	2	2		1	
First transition, N (%)	39,994 (88.0%)	2,735 (92.4%)	<0.0001	6,988 (56.3%)	<0.0001
Time to transition (days), mean ± SD	13.3 ± 14.5	56.4 ± 76.6	<0.0001	77.8 ± 97.9	<0.0001
Second transition, N (%)	26,184 (57.6%)	1,602 (54.1%)	0.0002	3,449 (27.8%)	<0.0001
Time to transition (days), mean ± SD	59.6 ± 76.0	32.4 ± 59.9	<0.0001	31.0 ± 62.2	<0.0001

- Transitions from a hospital inpatient index setting included 38% to a nursing home setting by 10 days (median). After 23 days in a nursing home setting, 58% of these patients were rehospitalized. Similarly, 50% of the index hospital inpatients were discharged to a home setting by day 8, and after 36 days in a home setting, 51% were readmitted
- Fifty-six percent of index CDI patients in a nursing home setting had a first transition to a hospital inpatient setting by day 31
- Home index setting patients transitioned to a hospital inpatient setting by day 65 (37%) or nursing home setting by day 12 (20%)

Index Cohort [†]	First Transition	N	Time to First Transition (days), Mean	Time to First Transition (days), Median	Second Transition	N	Time to Second Transition (days), Mean	Time to Second Transition (days), Median
Inpatient (N=45,465)	Nursing home	17,459 (38.4%)	14.84	10	Inpatient	10,172 (58.3%)	47.43	23
	Home	22,535 (49.6%)	12.15	8	Home	2,362 (13.5%)	38.87	26
Nursing home (N=2,959)	Inpatient	1,643 (55.5%)	64.76	31	Inpatient	11,452 (50.8%)	78.32	36
	Home	1,092 (36.9%)	43.85	24	Nursing home	2,198 (9.8%)	41.04	22
Home (N=12,404)	Inpatient	4,553 (36.7%)	107.04	65	Home	1,047 (63.7%)	9.55	7
	Nursing home	2,435 (19.6%)	23.2	12	Nursing home	404 (37.0%)	87.56	50.5
					Home	936 (20.6%)	9.07	6
					Home	1,657 (36.4%)	7.95	5
					Inpatient	316 (13.0%)	97.69	48
					Home	540 (22.2%)	100.52	70

[†]Missing – IP (12%), NH (8%), H (44%).

Transitions



Conclusions

- Burden of CDI on the healthcare system may be substantial for subsequent recurrent episodes across different healthcare settings
- Nursing home patients with CDI may experience greater burden, as they were observed to have more prior hospitalization, more rCDI, and multiple episodes of recurrence, as well as more transitions to a hospital inpatient setting
- Over 50% of home patients with CDI were admitted for care in either nursing home or hospital inpatient settings
- Half of hospital inpatient patients with CDI were discharged to home settings, but more than half of these patients were readmitted. Similarly, among those hospital inpatient patients with CDI who were discharged to nursing home settings, more than half were rehospitalized
- The study may be subject to inherent limitations of the source administrative claims data, such as coding errors or diagnoses entered for administrative processing rather than for clinical completeness. The ability to follow patients from their index CDI setting through healthcare settings was limited to 2 transitions. Also, rCDI episodes and transitions between settings could only be described, but any relationship could not be evaluated without more data on possible confounders
- Further work is needed to determine whether transitions were due to rCDI and to understand the role recurrence plays in transitions to higher-cost healthcare settings
- Future studies concerned with the overall healthcare system burden of CDI should consider rCDI across different care settings

