A Comprehensive Assessment of Carbapenem Use across 90 Veterans Health Administration Hospitals with Defined Stewardship Strategies

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Introduction

- Antimicrobial stewardship (AS) principles can be promoted in a programmatic manner through a variety of AS strategies or through the individual decisions of prescribers, like Infectious Disease (ID) consultants
- The effect of AS and ID consultation on carbapenem-prescribing and their interaction has only been assessed in single center studies or studies addressing one AS strategy

Study Objective

- To describe carbapenem use across all Veterans Health Administration (VHA) hospitals, including the frequency of carbapenem use, variability in carbapenem use across institutions and stated indications for carbapenem use
- To assess whether AS and ID consultation were both associated with better carbapenem-prescribing in a national cohort

Materials and Methods

Study Design

Retrospective cohort of all acute-care patient-admissions between 1/1/2016 and 12/31/2016 at VHA hospitals

Hospital-level risk-adjusted analysis for inpatient carbapenem use

- Hospitals were categorized into 1 of 3 carbapenem-specific AS strategy
  - **No strategy (NS)**
  - **Restrictive policies (RP)**
  - **Prospective audit and feedback (PAF)**
- Hospitals that provided an incomplete response or used a variety of strategies were excluded
- Antibiotic use and time at risk for antibiotic exposure were summarized as days of therapy (DOT) and days-present
- Volume of carbapenem use was compared between AS strategies with a generalized estimating equation model for proportion outcomes and negative binomial generalized estimating equation models for inpatient DOTs

Cases with ≥ 5 consecutive days of inpatient carbapenem-prescribing

Manual chart review of randomly-selected cases for appropriateness of carbapenem-prescribing

- NS: 100 patients, RP: 225 patients, PAF: 100 patients were randomly selected
- Two ID physicians, blinded to the AS strategy, performed manual chart reviews to assess appropriateness on day 4 of carbapenem-prescribing
- Appropriateness was summarized as an assessment score
- Median ranked assessment scores were compared with the Kruskal-Wallis test

Assessment scores

1. Appropriate
2. Acceptable
3. Suboptimal
4. Unnecessary
5. Inappropriate

Better

Results

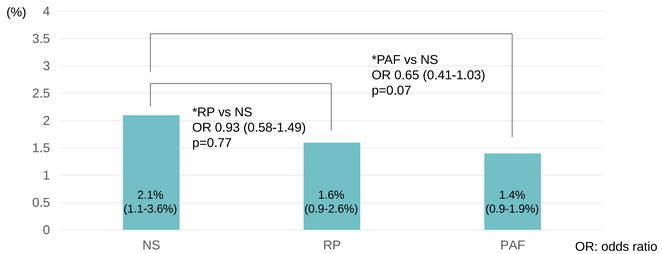
- ***Hospital-level risk-adjusted analysis for inpatient carbapenem use***
  - There were 429,602 patient admissions during 2016 across 90 hospitals (NS: 24, RP: 58, PAF:8)
  - At least one inpatient carbapenem dose was administered during 9,114 patient admissions (2.1%)

- Characteristics of 90 hospitals

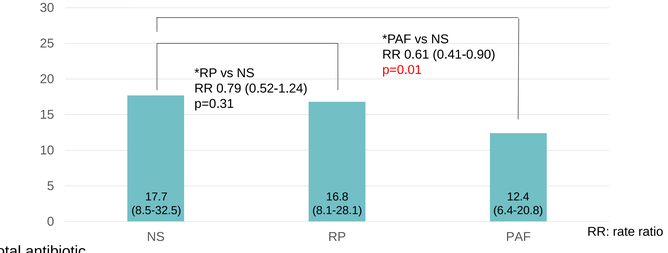
	NS, n, %	RP, n, %	PAF, n,%
Mean annual admissions (standard deviation)	2,738 (1,689)	5,657 (3,242)	4,646 (2,457)
Hospital complexity			
1 (most complex)	15 (62.5)	48 (82.8)	7 (87.5)
2	6 (25.0)	6 (10.3)	0 (0)
3	3 (12.5)	4 (6.9)	1 (12.5)
On-site intensive care unit	21 (87.5)	54 (93.1)	7 (87.5)
On-site microbiology lab	21 (87.5)	57 (98.3)	8 (100)
ASP policy	23 (95.8)	53 (91.4)	8 (100)
Inpatient ID consultation on site	15 (62.5)	54 (93.1)	8 (100)
ID fellowship program	7 (29.2)	35 (60.3)	6 (75.0)
ID pharmacist training program	1 (4.2)	12 (20.7)	2 (25.0)

ASP: antimicrobial stewardship program

- Median (IQR) proportion of patient-admissions exposed to carbapenems



- Median (IQR) inpatient carbapenem DOTs exposed in 1,000 patient-admissions



Total antibiotic DOTs (IQR)	402.4 (358.8-450.5)	389.9 (355.8-434.7)	378.5 (339.1-414.3)

* Risk-adjusted model included patient demographics, severity of illness, comorbidity, facility complexity and clustering of observations within hospitals

- ***Manual chart review of randomly-selected cases for appropriateness of carbapenem-prescribing***

- 4,398 patient-admissions with ≥ 5days of carbapenem-prescribing (NS: 566, RP: 2,568, PAF: 202)

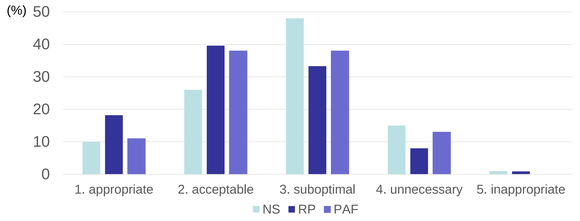
- Characteristics of randomly-selected 425 patients for manual chart review

	Total n, %	NS, n, % (N=100)	RP, n, %(N=225)	PAF, n, % (N=100)
Age, median (IQR)	68 (63-77)	69 (61-77)	68 (63-77)	68 (61-76)
Male	393 (92.5)	91 (91)	206 (91.6)	96 (96)
Comorbidities				
Diabetes mellitus	225 (52.9)	55 (55)	122 (54.2)	48 (48)
COPD	197 (46.4)	50 (50)	102 (45.3)	45 (45)
Renal failure	165 (38.8)	39 (39)	93 (41.3)	33 (33)
CHF	161 (37.9)	29 (29)	95 (42.2)	37 (37)
Obesity	133 (36.2)	37 (41.1)	74 (38.1)	22 (26.5)
Malignancy	115 (27.1)	21 (21)	68 (30.2)	26 (26)
Liver disease	75 (17.7)	9 (9)	46 (20.4)	20 (20)
Paralysis	52 (12.2)	12 (12)	28 (12.4)	12 (12)
HIV/AIDS	6 (1.4)	0 (0)	1 (0.4)	5 (5)
Immunosuppressive medication	50 (11.8)	9 (9)	26 (11.6)	15 (15)
Type of treatment				
Definitive therapy	337 (79.3)	81 (81)	179 (79.6)	77 (77)
Empiric therapy	88 (20.7)	19 (19)	46 (20.4)	23 (23)
Type of carbapenem				
Meropenem	263 (61.9)	63 (63)	134 (59.6)	66 (66)
Ertapenem	97 (22.8)	19 (19)	65 (28.9)	13 (13)
Imipenem-cilastatin	65 (15.3)	18 (18)	26 (11.6)	21 (21)
Carbapenem indication				
Pneumonia	131 (30.8)	28 (28)	62 (27.6)	41 (41)
Urinary	78 (18.4)	16 (16)	47 (20.9)	15 (15)
Abdominal/pelvis	68 (16.0)	19 (19)	40 (17.8)	9 (9)
Osteoarticular	58 (13.7)	12 (22)	35 (15.6)	11 (11)
SSTI	30 (7.1)	8 (8)	16 (7.1)	6 (6)
Others	60 (14.1)	17 (17)	25 (11.1)	18 (18)
Other conditions				
Modified APACHEIII median (IQR)	34 (25-42)	33 (23.5-40)	34 (26-42)	35.5 (23.5-45)
ID consult*	194 (45.6)	29 (29)	113 (50.2)	52 (52)

* ID consultations were more common at RP/PAF sites than NS sites (51% vs 29%; p<0.01)

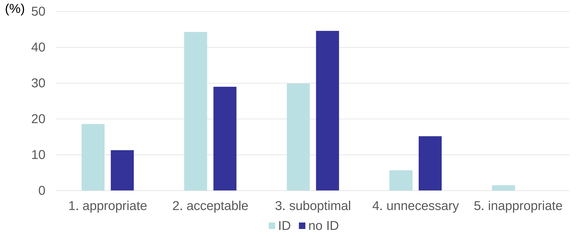
IQR: Interquartile range, COPD: Chronic obstructive pulmonary disease, CHF: Congestive heart failure, HIV: Human immunodeficiency virus, AIDS: Acquired immunodeficiency syndrome, SSTI: Skin and soft tissue infection, APACHE: Acute physiology and chronic health evaluation

- Assessment scores of carbapenem-prescribing across three carbapenem-stewardship strategies



	NS	RP	PAF	RP vs NS p-value	PAF vs NS p-value
Mean assessment score (SD)	2.7 (0.9)	2.3 (0.9)	2.5 (0.9)		
Median assessment score (IQR)	3 (2-3)	2 (2-3)	3 (2-3)	<0.01	0.12

- Assessment scores of carbapenem-prescribing when ID consultation was made vs ID consultation was not made



	ID consultation present	ID consultation absent	p-value
Mean assessment score (SD)	2.3 (0.9)	2.6 (0.9)	
Median assessment score (IQR)	2 (2-3)	3 (2-3)	<0.01

SD: standard deviation

Conclusions

- PAF was associated with less carbapenem use
- RP was associated with more appropriate carbapenem-prescribing
- ID consultation was made more frequently in hospitals with carbapenem stewardship
- ID consultation was associated with better carbapenem-prescribing compared to no ID consultation
- The use of AS and ID consultations may be complementary, and hospitals could leverage both to optimize carbapenem use

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