Factors Associated with Multidrug-Resistant Organisms (MDROs) Persistence in Nursing Homes

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Background

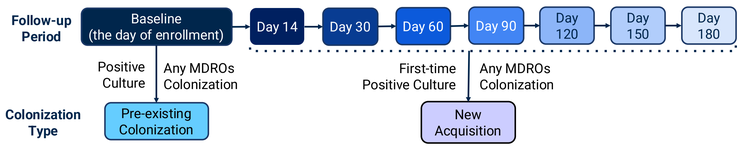
- Nursing home (NH) residents experience high rates of MDRO colonization
  - 3 out of 10 NH residents experience methicillin-resistant *Staphylococcus aureus* (MRSA) colonization
  - Resistant gram-negative bacteria (RGNB) colonization rates are between 11.2%-59.1% (Aliyu, 2017)
  - 33.2% are colonized with vancomycin-resistant *enterococci* (VRE) upon NH admission (Mody et al, 2018)
- NH residents with prolonged MDRO colonization are at risk of infection and transmission to non-colonized residents
- Yet, studies for identifying risk factors of MDRO persistence among NH residents are limited (Lin et al, 2017)

Objectives

- Describe persistence and clearance of pre-existing and newly acquired MDROs (RGNB, MRSA, VRE) colonization.
- Identify the patient-related and environmental risk factors associated with the persistence of MDROs in NHs.

Method

- Newly admitted residents at 6 nursing facilities in Michigan
- Samples collected from patients' hands, nares, oropharynx, enteral feeding tube insertion site, suprapubic catheter site, groin, perianal area, and room surfaces
- Of 651 NH residents recruited, analyses limited to 244 residents with ≥ 3 study visits



Outcome Definitions

- **Persistence:** 2 or more positive cultures separated by < 2 neg cultures
- **Intermittent Carriage:** single positive culture followed by ≥ 2 negative cultures
- **Clearance:** For persistent colonization, clearance is indicated by ≥ 2 neg cultures.

Results

Pre-Existing MDRO Colonization

- **Rate of Persistence**
  MRSA=75% (33/45); RGNB=73% (64/88); VRE=79% (75/95)
- **Factors Correlated with Persistence** (p-value < 0.1)
  VRE: Age (younger), # Patient Sites Colonization (≥ 2), Device Use, COPD
  MRSA: # Patients Sites Colonization (≥ 2), Diabetes, Length of Hospitalization (<14 days), Congestive Heart Failure
  RGNB: Cognitive Sum Score (higher), Dementia (No)
- **Rate of Clearance** (sample limited to residents with ≥ 5 study visits)
  MRSA=50% (2/4); **RGNB**=36% (5/14); **VRE**=71% (10/14)
  Mean days to clearance: MRSA=19; RGNB=90; VRE=57

Newly Acquired MDRO Colonization

- **Rate of Persistence**
  MRSA=83% (10/12); **RGNB**=61% (20/33); **VRE**=50% (10/20)
- **Factors Correlated with Persistence** (p-value < 0.1)
  RGNB: Age (younger), Device Use, Length of Hospitalization (<14 days)
  *Rate of Clearance not calculated due to small denominators

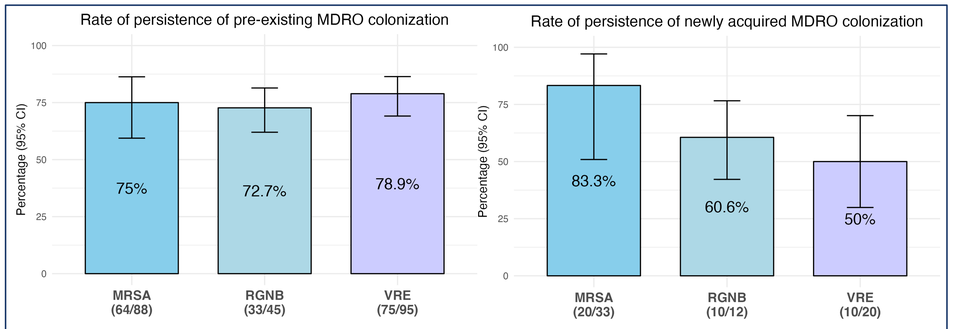


Figure 1. Rate of Persistence of Pre-existing and Newly Acquired MDRO Colonization

Characteristic (p-value < 0.1)	Unadjusted OR (95% CI)[1]	P value
	Pre-Existing VRE Colonization (N=95)	
Age	0.95 (0.90-1.00)	0.063
Number of Patient Sites Colonization		**0.003**
< 2 (49)	1 [Reference]	
>= 2 (46)	5.09 (1.68-19.1)	
Device Use		**0.02**
No (40)	1 [Reference]	
Yes (55)	3.3 (1.20-9.74)	
Chronic Obstructive Pulmonary Disease (COPD)		0.057
No (71)	1 [Reference]	
Yes (24)	3.74 (0.97-24.8)	
	Pre-Existing MRSA Colonization (N=44)	
Number of Patient Sites Colonization		0.094
< 2 (27)	1 [Reference]	
>= 2 (17)	3.75 (0.81-27.2)	
Length of Hospitalization		0.082
< 14 (12)	1 [Reference]	
>= 14 (31)	0.19 (0.01-1.20)	
Diabetes		0.066
No (26)	1 [Reference]	
Yes (18)	4.24 (0.92-30.7)	
Congestive Heart Failure		0.043
No (30)	1 [Reference]	
Yes (14)	6.5 (1.05-127)	
	Pre-Existing RGNB Colonization (N=88)	
Cognitive Sum Score	1.11 (0.99-1.24)	0.071
Dementia		0.02
No (67)	1 [Reference]	
Yes (21)	0.29 (0.10-0.82)	
	Newly-Acquired RGNB Colonization (N=33)	
Age	0.93 (0.83-1.01)	0.093
Device Use		**0.001**
No (20)	1 [Reference]	
Yes (13)	18 (2.73-362)	
Length of Hospitalization		**0.037**
< 14 (12)	1 [Reference]	
>= 14 (21)	0.18 (0.02-0.90)	

[1] OR = Odds Ratio, CI = Confidence Interval

Table 1. Risk Factors associated with Persistence of Pre-Existing and Newly-Acquired MDRO Colonization

Candidate risk factors assessed included: Age, Sex, Race, Number of Patients Sites Colonized, Number of Room Surfaces Colonized, Cognitive Sum Score, Antibiotic Use, Device Use, Wound, Functional Disability (PSMS Total Score), Charlson Comorbidity Index Score, Length of Hospitalization, Individual Comorbidities

Pre-existing Colonization				
Variable	**Number of Residents with Clearance**	**Mean**	**Min**	**Max**
RGNB	5	19.20	13.00	29.00
MRSA	2	90.00	56.00	124.00
VRE	10	57.30	14.00	125.00

Table 2. Duration (days) of MDRO Persistence for Residents with Pre-existing MDRO Colonization

Discussion

- **High rate of persistence** of both pre-existing colonization and newly acquired MDROs
- **Devise Use, Length of Hospitalization, Number of Body Sites Colonized** were significantly increased the risk of MDRO persistence
  - Few patient comorbidities (COPD, Diabetes, Congestive Heart Failure, Dementia) and environmental factors were associated with MDRO persistence
- Among NH residents with pre-existing colonization, many achieved clearance during NH stay
  - **Many residents had prolonged persistence (≥ 4 months)** and failed to achieve clearance

Fast Clearance VS. Long Persistence & No Clearance

- No significant differences in patient risk factors between the two groups
- **MDRO strain differences may partly account for persistence.**
- Genome Sequencing needed to further understand MDRO Persistence

	#	Days of VRE Colonization
Residents with **Clearance** (<1 month)	1	14
	2	14
	3	27
	4	28
Residents with **No Clearance** (≥ 4 month)	5	123
	6	148
	7	175
	8	182

	#	Days of RGNB Colonization
Residents with **Clearance** (<1 month)	1	14
	2	14
	3	26
	4	27
Residents with **No Clearance** (≥ 4 month)	5	180
	6	183
	7	187
	8	188

- **Limitations**:
  - All nursing facilities in metropolitan Detroit -> limited generalizability
  - Small sample size -> reduced power to detect significant associations
  - Inconsistent data collection intervals -> affect accuracy of duration of persistence

Conclusions

- **Identified risk factors** can help development of **Targeted Interventions**
- Enhancing infection control interventions (e.g., improved hand hygiene practices, environmental cleaning, and antibiotic stewardship), particularly for patients with **multiple colonization sites and frequent device use.**
- The need for **consistent follow-up intervals and a larger sample size** to enhance the robustness of the findings.

Acknowledgements & References

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Reference

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