Epidemiology of MDRO in Long Term Care Facilities

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Long Term Care Facilities: Spectrum

<u>low acuity</u> → <u>high acuity</u>

- assisted living
- mobile
- independent

- complete functional disability
- dialysis
- invasive devices

<u>Not</u> LTAC

ARO in LTCF

- high prevalence
- prolonged colonization
- some transmission in LTCF
- limited attributable morbidity/mortality

ARO in LTCF: Hong Kong

- MRSA
- VRE in geriatric wards of public hospitals
- MDRA (Acinetobacter spp)
- CRE (carbapenamase resistant Enterobacteriaceae)

Antibiotic Use and Resistance in Long Term Care Facilities

van Buul JAMDA 2012; 568.e1

Colonization Prevalence	US	Europe
MRSA	8% - 82% (1991-2000)	5% - 38%
	11% - 59% (2001-2011)	0.2% - 1.1% (Northern)
MDRGN	23% - 51%	40.5% (Ireland)
VRE	1% - 19%	4.3% (Germany)

US: MDR* Gram-negative bacteria at a LTCF

O'Fallon ICHE 2009; 1172

*MDR: resistance to ≥ 3 antimicrobial classes

most common: ESP, cflox, gent

Boston:

-161 residents; age 57 – 103 years

-nasal/rectal swabs

Prevalence:

MDRGNB:	22.8%	2 strains 5.6% 3 strains 4.3%
VRE	0.6%	
MRSA	11.1%	

US: Non-major Metropolitan SNF

Crnich 2012; 33: 1172

- Wisconsin: 6 facilities, 449 residents

	Mean	Facility range
MRSA	22.3%	13 – 33.7%
FQRGNB	21.3%	11.3 – 29.1%
Both	5%	0.5 – 7.0%
Either	38.7%	29 – 44.2%

Germany: Inguinal skin colonization

Ruscher et al Int J Med Micro 2014; 304: 1123

- 402 residents, 7 LTCF

MRSA	4.7%	(0 – 10.9%)
ESBL-E	4.0%	(0 – 7.7%)
VRE	0	
CRE	0	

Australia: Prevalence of ARO in LTCF

Stuart MJA 2011; 195: 530

- stool specimens
- 3 LTCFs, 119 residents, mean 79.2 yr

- VRE 2%
- ESBL *E. coli* 12%

Ireland: Colonization over one year

Ludden et al. BMC ID 2015; 15:168

- 64 residents, mean 80 years
  Nasal and rectal, 5 times

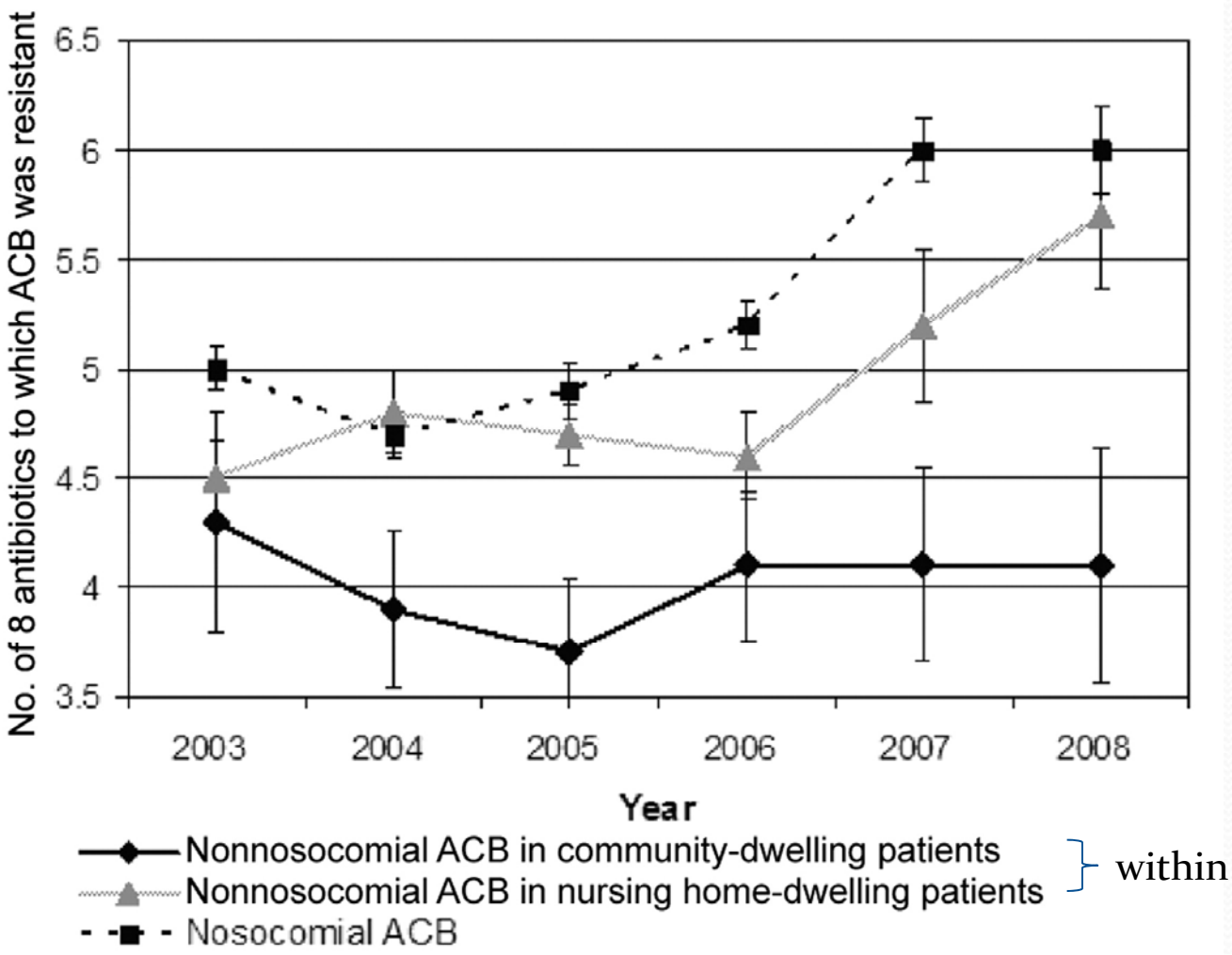
	Ever colonized	Single specimen
ESBL – EC	55%	28 – 43%
ESBL – KP	8%	0 – 4%
MRSA	27%	9 – 18%
ESBL with MRSA	39%	
CPE	0	
VRE*	3%	0 – 2%

*both also ESBL – EC and MRSA

MDR *A. baumanii* in Community and Nursing Homes

D. M. Sengstock et al. Clin Infect Dis. 2010;50:1611-1616

Michigan, patients ≥ 60 yr, admitted to 4 community hospitals



Prevalence of and Risk Factors for Multidrug-Resistant *Acinetobacter baumannii* Colonization Among High-Risk Nursing Home Residents

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on behalf of the Targeted Infection Prevention Study Team, Ann Arbor, Michigan

- 12 community based nursing homes
- MDR *A. baumannii* 15% (25/168)
  - Multiple ARO's 88% (22/25)
  - Co-colonization with other R-GNB 64% (16/25)

Chlorhexidine and mupirocin susceptibilities of MRSA in NH

McDanel 2013; 57:552

California 2008 - 2011

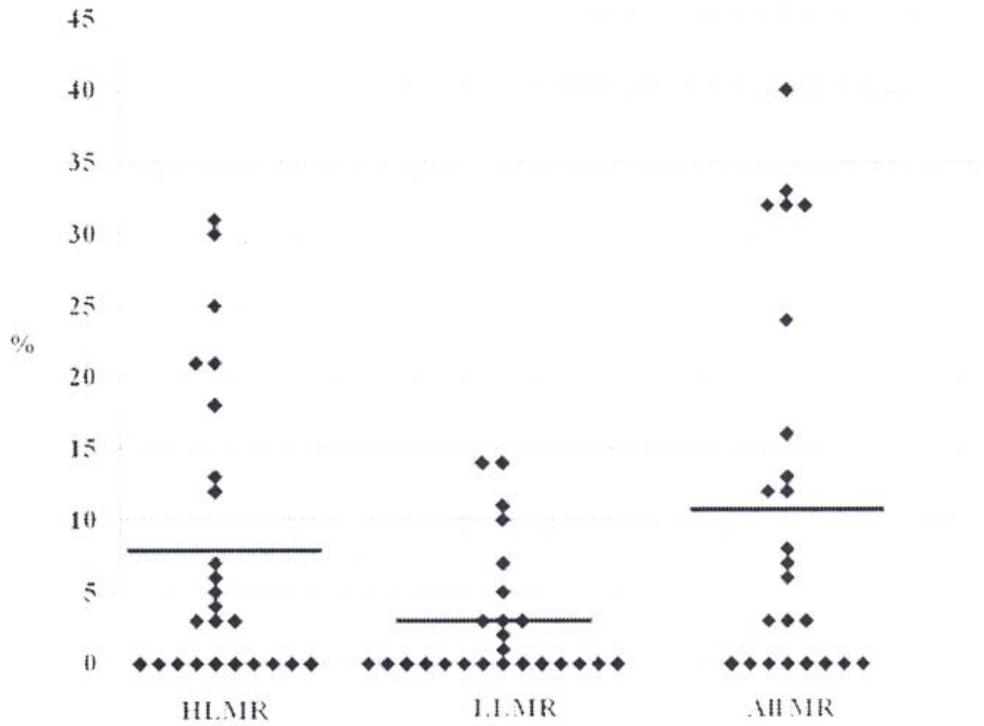


FIG 2 MRSA resistant to mupirocin (HLMR, LLMR, and all resistant [MR]) at each of 25 nursing homes in Orange County.

Residence in SNF is Associated with Tigecycline non-susceptibility in CRKp

van Duin ICHE 2015; 36: 942

Risk factors for tigecycline non-susceptibility

- US acute care facilities

	OR	95% CI	*P* Value
Admission from skilled nursing facility	2.52	1.51–4.24	.0004
CRKP present on admission	1.77	1.03–3.08	.038
Receipt of tigecycline within 14 d	4.41	1.36–17.24	.012

Shanghai: Faecal ESBL – Enterobacteriaceae

Zhao, Epidemiol Infect 2015;

- 390 residents, 7 NH, median age 84 yr
- rectal swabs

ESBL – Enterobacteriaceae: 47%

E. coli 80%, *P. mirabilis* 9%, *K. pneumoniae* 5%

CTX-M 99%

Carbapenamase 1%

Natural History of Colonization with Resistant Organisms

Pacio, ICHE, 2003

New York
1998-2000
Organisms:
- VRE
- MRSA
- AcB
- Paer

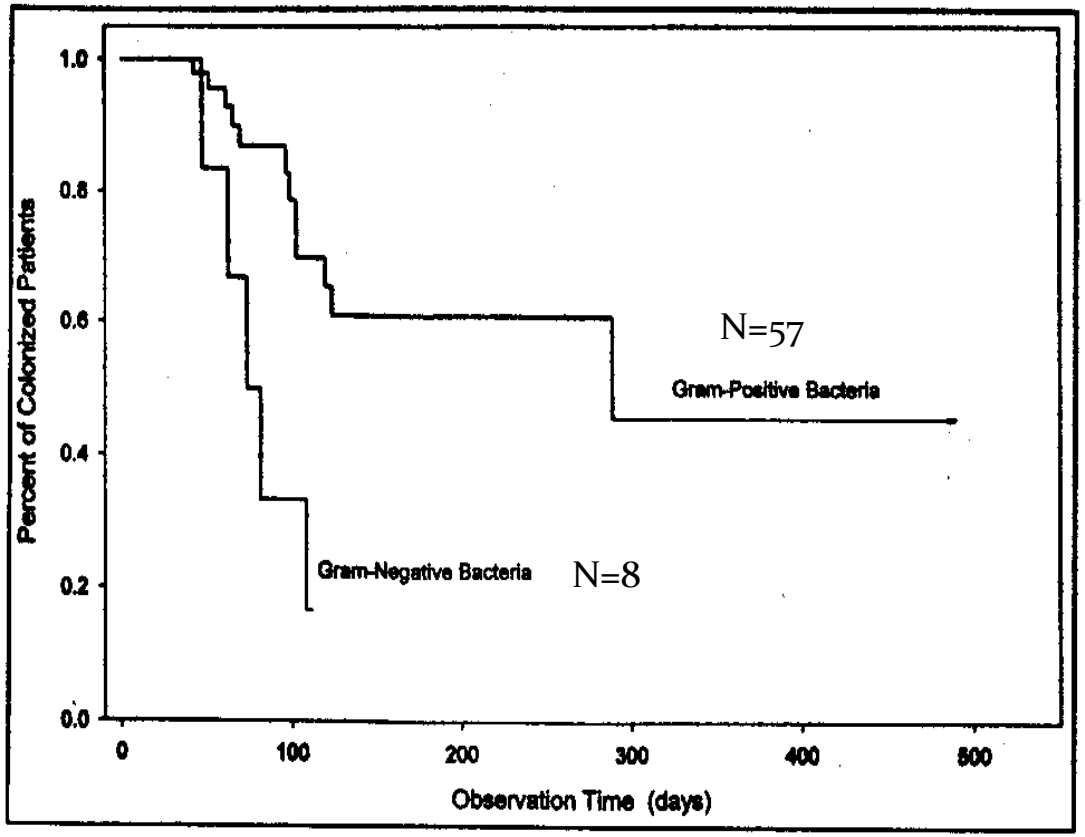


FIGURE. Kaplan–Meier curve depicting clearance of gram-positive bacteria (methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci) versus resistant gram-negative bacteria over time. Colonization with resistant gram-negative bacteria is more likely to clear than colonization with resistant gram-positive bacteria (P = .007).

Colonization with MDR GN bacteria; Prolonged Duration and Frequent Colonization

O'Fallon CID 2009; 48: 1375

Boston
MDR
≥ 3 resistant
Enterobacteriaceae

33 patients
57 MDRGNR
7 species

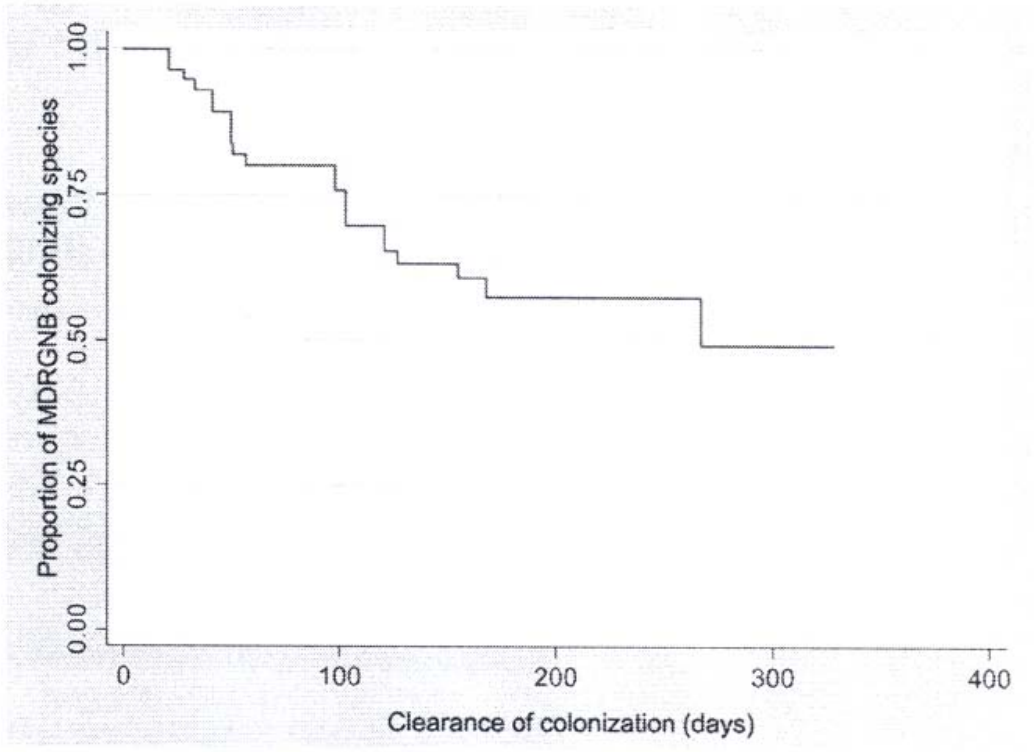


Figure 1. Kaplan-Meier curve showing days to clearance of colonization for all colonizing species of multidrug-resistant gram-negative bacteria (MDRGNB).

Which residents have ARO's?

How often are ARO's Acquired in the LTCF?

Antimicrobial Resistance in LTCF Patient Risk Factors

van Buul JAMDA 2012

Colonization or Infection (Number Reports)	
Antimicrobial use	35
Lower functional status	26
Invasive devices	29
Decubitus ulcers/wounds	15/14
Prior ARO colonization	10

Equivocal: prior hospitalization, comorbidities, length of stay

Antimicrobial Resistance in LTCF Facility Factors

van Buul JAMDA 2012

Lack of infection control policy	review only
Higher patient/staff ratio	review only
Frequent staff turnover	review only
Staffing with nonprofessional personnel	review only
Higher number residents per bedroom	multivariate
Facility size – medium vs large	multivariate

ESBL-E Faecal Carriage in NH in Shanghai

Zhao Epidemiol Infect 2015

Multivariate analysis: Risk Factors	**OR**	**CI**
Invasive procedures	2.38	1.31, 4.31
Narrow spectrum cephalosporins (3 mo)	1.63	1.05, 2.56
Broad spectrum cephalosporins (3 mo)	3.28	1.28, 8.40

Carbapenem-resistant Klebsiella pneumoniae in post-acute-care facilities in Israel

Ben-David et al ICHE 2011; 32:845-843

Cross-sectional prevalence survey

TABLE 2. Risk Factors for Carbapenem-Resistant *Klebsiella pneumoniae* (CRKP) Carriage among the Cohort of 1,004 Patients with No Prior History of Colonization

			Univariate analysis		Multivariable analysis	
Characteristic	CRKP-noncolonized patients (n = 883)	CRKP-colonized patients (n = 121)	OR (95% CI)	P	Adjusted OR (95% CI)	P
Mean (SD) age, years	73.0 (15.5)	72.8 (17.6)	1 (0.99–1.01)	.94		
Male sex	401 (45.8)	51 (42.1)	1.16 (0.79–1.71)	.44		
Median (IQR) days before screening	33 (119)	138 (549)	1.001 (1.001–1.001)	<.001	1.001 (1.001–1.001)	<.001
Sharing a room with a known CRKP carrier	28 (3.2)	14 (11.6)	3.98 (2.04–7.80)	<.001	3.09 (1.52–6.23)	<.001
Average prevalence of known CRKP carriers in ward (SD)	8.72 (12.7)	13.3 (15.5)	1.02 (1.01–1.04)	.08	1.02 (1.004–1.033)	.013
Type of ward						
Chronic mechanical ventilation	111 (12.6)	15 (12.4)	1	<.001		
Skilled nursing care	215 (24.3)	75 (62)	2.58 (1.42–4.7)			
Rehabilitation	350 (39.6)	9 (7.4)	0.19 (0.08–0.45)			
Subacute	207 (23.4)	22 (18.2)	0.79 (0.39–1.58)			
Cohort policy	139 (15.7)	22 (18.2)	1.19 (0.72–1.95)	.5		
Screening policy	95 (10.8)	7 (5.8)	0.51 (0.23–1.16)	.08	0.41 (0.18–0.93)	.03

Carbapenem-resistant Klebsiella pneumoniae in post-acute-care facilities in Israel

Ben-David et al ICHE 2011; 32:845-843

Nested case-control study

TABLE 3. Individual Risk Factors for Carbapenem-Resistant *Klebsiella pneumoniae* (CRKP) Carriage among the Nested Case-Control Study Patients with No Prior History of Colonization

Characteristic	CRKP-noncolonized patients (n = 149)	CRKP-colonized patients (n = 118)	Univariate analysis		Multivariable analysis	
			OR (95% CI)	P	Adjusted OR (95% CI)	P
Mean (SD) age, years	74.4 (15.9)	72.6 (18.3)	0.99 (0.99–1.007)	.41		
Male sex	70 (47.0)	47 (39.8)	1.15 (0.77–1.71)	.50		
Bedridden	89 (59.7)	86 (76.7)	0.65 (0.38–1.16)	.12		
Charlson comorbidity index score (SD)	3.89 (2.4)	3.79 (2.4)	1 (0.92–1.09)	.99		
Norton score (SD)	11.28 (3.4)	9.8 (2.9)	0.931 (0.86–1.09)	.08		
Decubitus ulcer	49 (34.0)	60 (51.3)	1.342 (0.9–2.001)	.15		
Nasogastric tube	48 (32.2)	62 (52.5)	1.42 (0.93–2.16)	.10		
Urinary catheter	69 (46.3)	73 (61.9)	1.34 (0.89–2.01)	.15		
Tracheostomy	34 (22.8)	39 (33.1)	1.53 (0.88–2.64)	.13		
Colonized with other MDRO	25 (16.8)	40 (33.9)	1.79 (1.16–2.76)	.008	1.64 (1.06–2.55)	.03
Antibiotic exposure during prior 3 months	87 (58.4)	94 (79.7)	1.8 (1.13–2.86)	.01	1.66 (1.04–2.66)	.03
Receipt of amoxicillin-clavulanate during prior 3 months	24 (16.1)	35 (29.7)	1.5 (0.95–2.37)	.08		
Receipt of fluoroquinolone during prior 3 months	31 (20.8)	35 (29.7)	1.4 (0.92–2.14)	.12		
Receipt of cephalosporin during prior 3 months	55 (36.9)	54 (45.8)	1.31 (0.87–1.96)	.20		
Receipt of piperacillin-tazobactam during prior 3 months	0 (0)	2 (1.7)	2.49 (0.54–11.60)	.11		

Nursing home characteristics associated with MRSA Burden and Transmission

Murphy, BMC ID, 2012; 12: 269

- 26 NH, 30 – 208 beds

	Prevalence	
	Mean	Median (Range)
MRSA admit	16%	16% (3 – 31)
MRSA point prevalence	25%	26% (0 – 52)
MRSA transmission risk	16%	15% (0 – 30)

Prevalence risk: higher admission prevalence, indwelling devices
Transmission risk: higher proportion diabetes, lower levels social engagement

MRSA Nasal Carriage in Residents of VA LTCF: Role of Antimicrobial Exposure and MRSA Acquisition

Stone et al, ICHE 2012; 33:551

TABLE 4. Multivariable Analysis of Risk Factors Predictive of Methicillin-Resistant *Staphylococcus aureus* Acquisition among Long-Term Care Facility Residents ($n = 195$)

Risk factor	RR (95% CI)	*P*
Antimicrobial use during study	7.76 (2.1–28.56)	**.002**
Hospitalization during study	1.51 (0.48–4.72)	.48
Intravenous line during study	3.44 (0.87–13.58)	.08
Charlson index	1.20 (0.98–1.47)	.08

NOTE. CI, confidence interval; RR, risk ratio. Boldface indicates results that met statistical significance of $P \leq .05$.

New Acquisition of AROs in SNF

Fisch, JCM 2012; 50-1698

TABLE 4 Average time to new acquisition of AROs

	Days to acquisition (avg ± SD) for residents:			
Organism(s)	All (n = 82)	Without indwelling device (n = 61)	With indwelling device (n = 21)	P value (without device vs with device)
→ MRSA	126.6 ± 79.1	143.8 ± 78.1	75.0 ± 60.0	0.03
VRE	186.0 ± 108.4	176.3 ± 113.9	225.0 ± 106.1	0.60
CAZ^r GNB	176.0 ± 94.1	182.3 ± 90.4	135.0 ± 148.5	0.53
CIP^r GNB	75.5 ± 65.7	74.4 ± 66.0	80.0 ± 70.1	0.85

Acquisition of MDR GNB: Incidence and Risk Factors

O'Fallon ICHE 2010; 31: 1148

TABLE 3. Factors Associated with Acquisition of Multridrug-Resistant Gram-Negative Bacteria among Case Patients and Control Patients Matched According to Duration of Follow-up

Variable	Case patients (n = 29)	Control patients (n = 29)	Unadjusted OR (95% CI)	P
Age, >85 years	24 (83)	22 (76)	1.7 (0.4–6.97)	.48
Female sex	24 (83)	27 (93)	0.4 (0.08–2.06)	.27
White race	28 (97)	27 (93)	2 (0.42–5.31)	.53
ADL score, ⩾1	14 (48)	12 (41)	1.5 (0.08–2.06)	.27
GDS score, ⩾6	19 (66)	19 (66)	1 (0.29–3.45)	>.99
Presence of pressure sore	4 (14)	2 (7)	3.1 (0.51–19.5)	.22
Fecal incontinence	25 (86)	20 (69)	3.5 (0.72–16.85)	.12
Urinary incontinence	28 (97)	22 (76)	7 (0.86–56.9)	.07
Diabetes mellitus	8 (28)	6 (21)	1.7 (0.39–6.97)	.48
Charlson comorbidity index score, >2	14 (48)	14 (48)	1 (0.29–3.45)	>.99
Interval hospitalization[a]	2 (7)	1 (3)	2.0 (0.2–22.1)	.50
→ Interval antibiotic exposure[a]	13 (45)	9 (31)	5.5 (1.2–24.8)	.03

NOTE. Data are no. (%) of residents, unless otherwise indicated. ADL, activities of daily living; CI, confidence interval; GDS, global deterioration scale; OR, odds ratio.

[a] Interval antibiotic and hospital exposure were assessed during the interval between baseline and follow-up culture sampling.

rectal cultures q4mo

P. mirabilis >> Mm > E.c = Kpn

? Urinary catheter

Comparison of the Methicillin-Resistant *Staphylococcus aureus* Acquisition among Rehabilitation and Nursing Home Residents

Jon P. Furuno, Simone M. Shurland, Min Zhan, J. Kristie Johnson, Richard A. Venezia, Anthony D. Harris, Mary-Claire Roghmann

Infect Control Hosp Epidemiol 2011; 32:244-249

Infection control practices:

- MRSA admission surveillance
- MRSA ⊕: modified contact gowns and gloves
  - placement: single > cohort > low risk negative

Hand hygiene: alcohol/hand rinse

MRSA among Rehabilitation and Nursing Home Residents

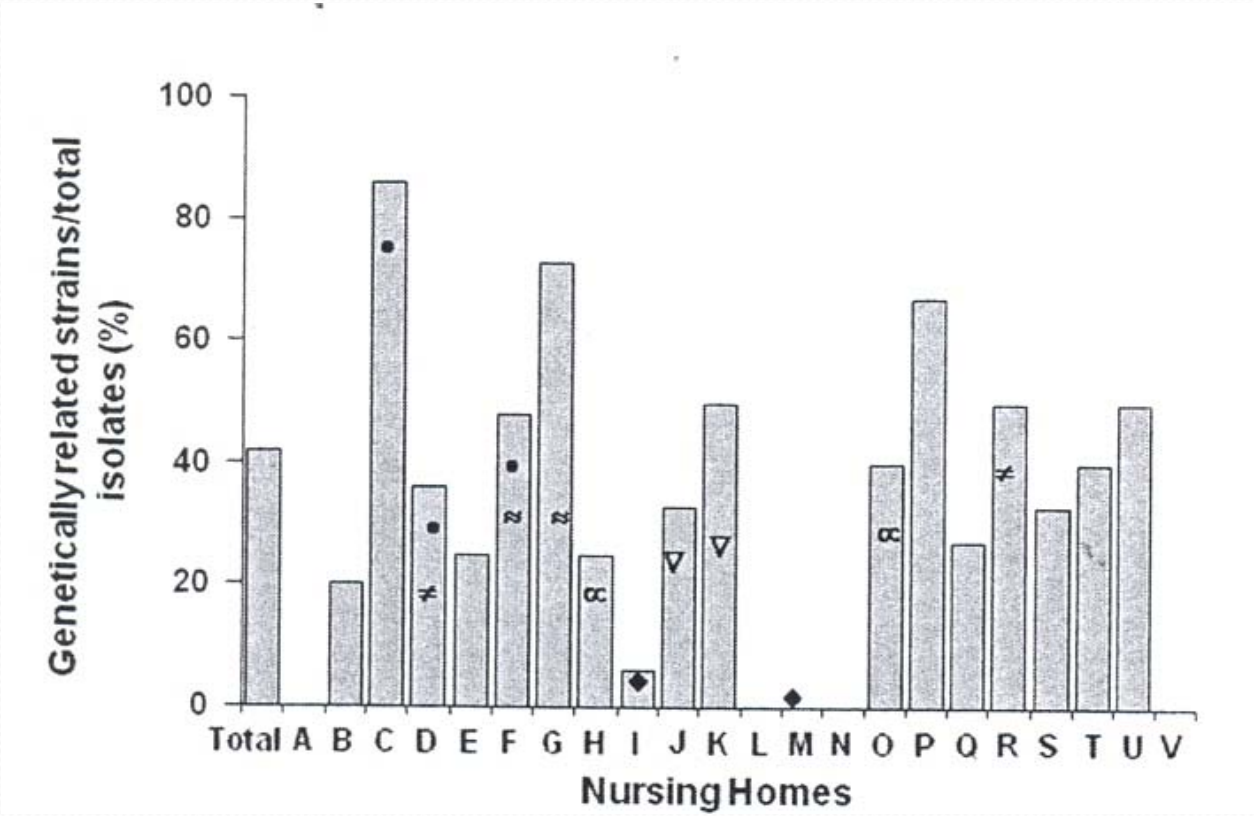
Furuno et al 2011; 32:244 ICHE

TABLE 3. Adjusted Hazard Ratios (aHRs) for Methicillin-Resistant *Staphylococcus aureus* (MRSA) Acquisition in MRSA-Negative Residents of Extended Care Facilities, Using Cox Proportional Hazards Models

Variable	aHR (95% CI)
Residential (n = 286)	
→ Antibiotic therapy during study cycle	3.75 (1.43–9.88)
→ Bedbound	4.28 (1.50–12.16)
Room placement with MRSA-positive resident	1.42 (0.51–3.93) ←
Rehabilitation (n = 157)	
Limited mobility	2.59 (0.80–8.45)
→ Bedbound	4.81 (1.24–18.68)
Room placement with MRSA-positive resident	0.47 (0.10–2.16)

MDR GNB: Inter and Intradissemination among NHs of Residents with Advanced Dementia

D'Agata ICHE 2015; 36: 930



What is the role of the LTC Environment?

Rapid environmental contamination of a new nursing home with ARO's

Ludden JHI 2013; 83: 327

Table II
Detection of meticillin-resistant *Staphylococcus aureus* (MRSA) in old and new nursing homes

Environmental sites	Old occupied nursing home		New unoccupied nursing home		New occupied nursing home	
	No. of tests	No. with MRSA	No. of tests	No. with MRSA	No. of tests	No. with MRSA
Door handles ($N = 92$)	18	1	18	0	56	13
Floor surfaces ($N = 26$)	6	4	6	1	14	11
Tables ($N = 23$)	6	2	3	1	14	5
Bedside lockers ($N = 26$)	6	4	6	0	14	10
Bed frames ($N = 26$)	6	2	6	0	14	11
Toilet seats ($N = 36$)	6	1	9	0	21	7
Arm chairs ($N = 23$)	6	3	3	0	14	6

Monitoring during 11 weeks as resident transferred.

VRE in LTCF

Benenson ICHE 2009; 30: 786

TABLE 2. Risk Factors Associated With Vancomycin-Resistant Enterococci Colonization

Risk factor	Univariate analysis OR (95% CI)	Multivariate analysis OR (95% CI)
Male sex	1 (0.6–1.77)	…
Age (10-year increase)	0.60 (0.2–1.6)	…
Length of residence in long-term care facility		
<1 month	1	1
1–6 months	0.54 (0.27–1.13)	0.50 (0.23–1.09)
>6–12 months	0.12 (0.04–0.35)	0.28 (0.09–0.88)
>1 year	0.08 (0.06–0.16)	0.18 (0.04–0.47)
Morbidities		
Diabetes mellitus	1.79 (1.06–3.0)	1.14 (0.63–2.06)
Renal failure	1.20 (0.53–2.46)	…
Procedures or treatments		
Use of percutaneous endoscopic gastrostomy tube	0.84 (0.37–1.71)	…
Use of urinary catheter	1.71 (0.97–2.94)	0.78 (0.37–1.6)
Use of endotracheal tube	1.21 (0.41–2.97)	…
Antibiotic treatment in previous 3 months	5.21 (2.72–10.8)	4.15 (1.9–8.9)
Hospitalization in previous 6 months	6.75 (3.89–11.99)	2.92 (1.5–5.7)
Dependency (Barthel index)		
Slight	1	1
Moderate	0.46 (0.07–3.49)	0.11 (0.02–0.68)
Severe	0.55 (0.13–3.31)	0.20 (0.04–0.94)
Total	0.67 (0.19–3.68)	0.25 (0.06–1.05)

NOTE. CI, confidence interval; OR, odds ratio.

?cohort effect

Methicillin-Resistant *Staphylococcus aureus* Burden in Nursing Homes Associated with Environmental Contamination of Common Areas

Courtney R. Murphy, MS,[*] Samantha J. Eells, MPH,[†] Victor Quan, BA,[‡] Diane Kim, BS,[‡] Ellena Peterson, PhD,[§] Loren G. Miller, MD, MPH,[†] and Susan S. Huang, MD, MPH[‡]

JAGS 2012; 60: 1012

Table 2. Multivariate Analysis of Methicillin-Resistant *Staphylococcus aureus* (MRSA)-Positive Objects and Nonremoval of Cleaning Marks

Variable	Odds Ratio (95% Confidence Interval)	*P*-Value
MRSA-positive culture		
High MRSA delta prevalence group[a]	2.8 (1.4–5.9)	.005
Less time spent cleaning per room (per 10 minute reduction)	2.9 (1.5–5.4)	<.001
Lower frequency of common room cleaning	1.5 (1.1–2.0)	.01
Nonremoval of cleaning mark		
Object type		
Tables	Reference	
Hallway objects	4.2 (2.4–7.4)	<.001
Chairs	3.5 (1.6–7.3)	.001
Rehabilitation equipment	2.4 (1.4–4.3)	.002
Counters	0.9 (0.4–1.9)	.77
MRSA admission prevalence[b]	1.2 (1.0–1.4)	.04

Nursing home characteristics associated with MRSA burden and transmission

Murphy, BMC ID 2012; 12:269

Table 4 Multivariate Linear Regression Analysis of Factors Associated with Nursing Home MRSA Point Prevalence and MRSA Transmission Risk

Outcome: Facility MRSA Point Prevalence		
Variable	**Absolute Change in MRSA Point Prevalence per absolute increase of 10% in variable(95% CI)**	**p-value**
High MRSA Admission Prevalence[a]	13.0 (4.3, 21.7)	0.005
% Residents with Indwelling Device[b]	1.8 (0.1,3.5)	0.04
Outcome: Facility MRSA Transmission		
Variable	**Absolute Change in MRSA Transmission per absolute increase of 10% in variable(95% CI)**	**p-value**
→ % Residents with High Social Engagement[c]	−2.0 (−3.8,-0.2)	0.03
% Residents with Diabetes[d]	3.6 (1.1,6.0)	0.01

[a] MRSA admission prevalence was dichotomized at the median value (15%).
[b] The presence of an indwelling device was collinear with the proportion of residents with fecal incontinence.
[c] High social engagement score was defined as greater than or equal to 3 out of 6.
[d] In the transmission model, the percentage of residents with diabetes was collinear with the percent of residents with less than a high school education.

Morbidity from ARO in LTC

- limited direct morbidity despite high colonization and high risk residents
- ? not increased relative to non-ARO colonized risk stratified

Australia: Elderly and Community

Xie Int Med J 2011;e157

- Retrospective microbiology study

	NH	Community
Blood isolates: (N=638)		
MRSA (%SA)	38.5%	9.6%
Sputum: N=425		
MRSA (%SA)	88.9%	38.1%
Urine: N=4044		
MRSA (%SA)	77.3%	40.2%
MDR Enterobacteriaceae	12.4%	6.1%

Infections with Resistant Organisms

Pacio, ICHE, 2003

TABLE 2
INFECTIONS THAT DEVELOPED IN RESIDENTS COLONIZED WITH VANCOMYCIN-RESISTANT ENTEROCOCCI, METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS*, OR RESISTANT GRAM-NEGATIVE BACILLI

Organism	No. of Residents Colonized	No. of Residents Infected*	Site of Infection
MRSA	30	4	Symptomatic UTI
		4	Soft tissue infection
		3	Primary bacteremia
		3	Tracheobronchitis
		2	Pneumonia
		1	Lung abscess
VRE	27	6	Symptomatic UTI
R-GNB	8	1	Pneumonia
		1	Symptomatic UTI

UTI = urinary tract infection; MRSA = methicillin-resistant *Staphylococcus aureus*; VRE = vancomycin-resistant enterococci; R-GNB = resistant gram-negative bacilli.
*Residents may have an infection at more than one site.

Risk Factors for Infection with *E. coli* in NH residents colonized with FQREC

Mannings ICHE 2015; 36: 575

Infections: 11/94 (12%) colonized

		OR (95% CI)
→	Diabetes mellitus	7.80 (1.45 – 77.2)
	Urinary catheter	10.4 (1.80 – 54.9)
	Tracheostomy	30.4 (2.0 – 1612)
	TMP/SMX < 30 days prior	10.7 (1.90 – 56.3)

Bivariate analysis $p < 0.01$

Risk factors for clinical infection with CRKp in colonized hospital patients

Borer AJIC 2012; 40: 421

- Israel; rectal colonization, acute hospital admission
- 42/464 (9.1%) developed infection

Table 2
Multivariate analysis of risk factors for CRKP colonization

	P value [OR (CI 95%)]
Bedridden status	.021 [3.09 (1.184-8.063)]
Nursing home residence	.013 [2.67 (1.84-7.345)]
Aminopenicillin use	.004 [7.753 (1.95-30.692)]
Previous antibiotic therapy	<.0001 [5.76 (2.351-11.338)]

Risk factors for clinical infection with CRKp in colonized hospital patients

Borer AJIC 2012; 40: 421

Table 1
Multivariate analysis of risk factors for CRKP infections in patients initially only colonized with CRKP

	P value [OR (95% CI)]
Previous invasive procedure	.021 [5.737 (1.3-25.171)]
→ Diabetes mellitus	.017 [4.362 (1.297-14.671)]
Solid tumor	.025 [3.422 (1.166-10.04)]
Tracheostomy	.042 [4.978 (1.063-23.315)]
Urinary catheter insertion	.037 [4.696 (1.097-20.109)]
Antipseudomonal penicillin	<.0001 [23.09 (3.951-134.789)]

MDR GNB Bloodstream Infections among Residents of LTCF

Venkatachalam ICHE 2014; 35:519

Singapore: two tertiary care facilities

TABLE 4. Adjusted Odds Ratios (ORs) for Multidrug Resistance Status among All Patients with Gram-Negative Bloodstream Infection

Characteristic	Adjusted OR (95% CI)[a]	*P*
* LTCF	5.1 (2.2–11.9)	<.01
Age, years	1.0 (1.0–1.0)	.15
Urinary tract infection	0.8 (0.6–1.2)	.38
ICU stay	2.2 (1.2–3.9)	.01
Previous positive culture	1.8 (1.3–2.7)	<.01
Previous antibiotic use	1.8 (1.2–2.6)	<.01
LTCF (interaction with previous antibiotic use)	0.3 (0.1–0.9)	.03

NOTE. CI, confidence interval; ICU, intensive care unit; LTCF, long-term care facility.

[a] Variables in regression model: age and LTCF were fixed; concomitant urinary tract infection, previous ICU stay, previous antibiotic use within the preceding 30 days, and previous culture growing multidrug-resistant bacteria within the preceding 90 days, included on the basis of model selection criteria. Hosmer-Lemeshow for goodness-of-fit test = 0.87, indicating good fit of the final model.

* antibiotics not used past 30 days

Carbapenem Resistance and Mortality in Institutionalized Elderly with UTI

Marinosci JAMDA 2013; 14: 513

- CR bacteria: 39/196 (20%)
  (Enterobacteriaceae, Enterococcus, Pseudomonas, Acinetobacter)
- 6 month mortality, CR 30.8% vs 15.9% (p=0.08)

	Multivariate	
	OR	P
polymicrobial infection	0.35 (.13 - .96)	0.42
carbapenem resistance	2.79 (1.17 – 6.7)	0.021

AROs in LTCFs

- ARO's are common in LTCF's
  - multiple strains
  - prolonged carriage
- consistent risk factors for prevalence and transmission
  - antimicrobial use
  - functional status
- limited morbidity/attributable mortality
- ?what can be modified