MDROs: Defining High Risk Populations

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MDRO Colonization in US Nursing homes

- MDRO colonization: 1/3rd of the 1.6 m
- Cross sectional data:
  - MRSA: 10 – 50 %
  - R-GNB: 20%
  - VRE: 4 - 9.6% (2015 data, new admits into inner city NHs: 33%)
- Prospective data, new acquisition:
  - MRSA: 10 - 29 %
  - R-GNB: 25 - 39%
  - VRE: 4 - 5% (2015 data, new admits from inner city NHs: 10-15%)

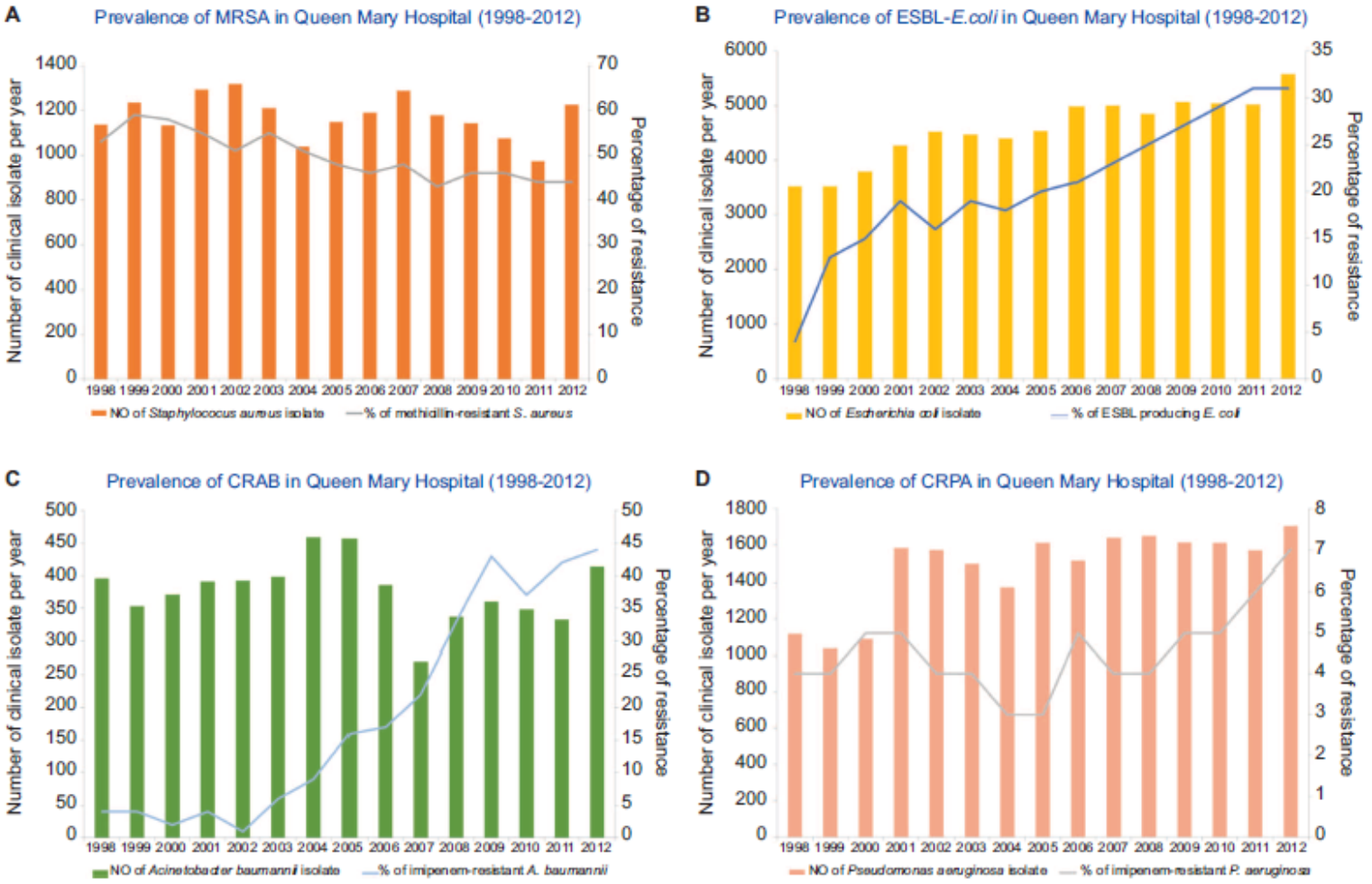
Fisch J, et al. *J Clin Microbiol* 2012;50:1698-1703.
Mody L, et al. Pathways study (ongoing).

MDRO Emerging Issues

- Prevalence of MDR GNB carriage and VRE exceeding that of MRSA (US NHs)
- Mainland China and Hong Kong in past decade:
  - Shanghai Bacterial Resistance Surveillance Project (23 hospitals, 1989-) & CHINET (15 hospitals, 2005-)
  - MRSA prevalence increased from <10% to over 50-70%
  - MDR *A. baumannii* incidence increased by 6-fold
  - ESBL-producing *E. coli* increased from 30% to 60%
  - VRE endemic in many hospitals

Fisch J, et al. *J Clin Microbiol* 2012;50:1698-1703.
Cheng VC, et al. *J Hosp Infect* 2011;79:206-210.
Ho PL, et al. *Int J Antimicrob Agents* 2010;36:469-471.
Cheng V, et al. *Emerg Microbes Infect* 2015.

MDRO Trends: Hong Kong



CRAB = Carbapenem resistant *Acinetobacter baumannii*, CRPA = Carbapenem-resistant *Pseudomonas aeruginosa*

Cheng V, et al. *Emerg Microbes Infect* 2015.

Impact of MDROs

- One of the greatest healthcare challenges
- Prevalence is increasing
- Responsible for
  - over 12,000 deaths
  - 3.5 billion dollars (in US)
- New antibiotics → Resistance
- New antibiotics not the only solution, need effective infection prevention strategies

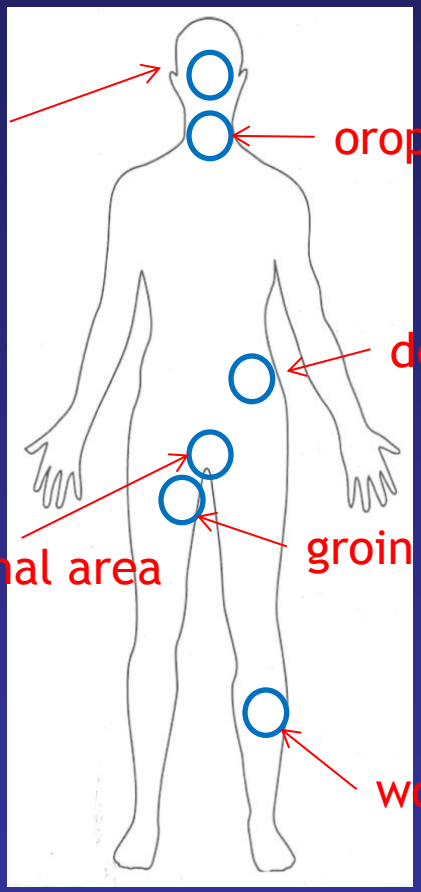
Cassone M, et al. *Curr Geriatr Rep* 2015;4:87-95
Mody L, et al. *Clin Infect Dis* 2011;52:654-661.

Risk Factors for MDROs

- Use of indwelling devices
- Functional disability
- Presence of wounds
- Prior antimicrobial usage
- Prior hospitalization

Move from pathogen-based to risk-factor based infection prevention programs?

Total cohort 178 patients; 88 no-device, 90 with urinary catheter, feeding tube or both; total follow-up visits: 907



Enterococcus spp.

Vancomycin

Gram negatives

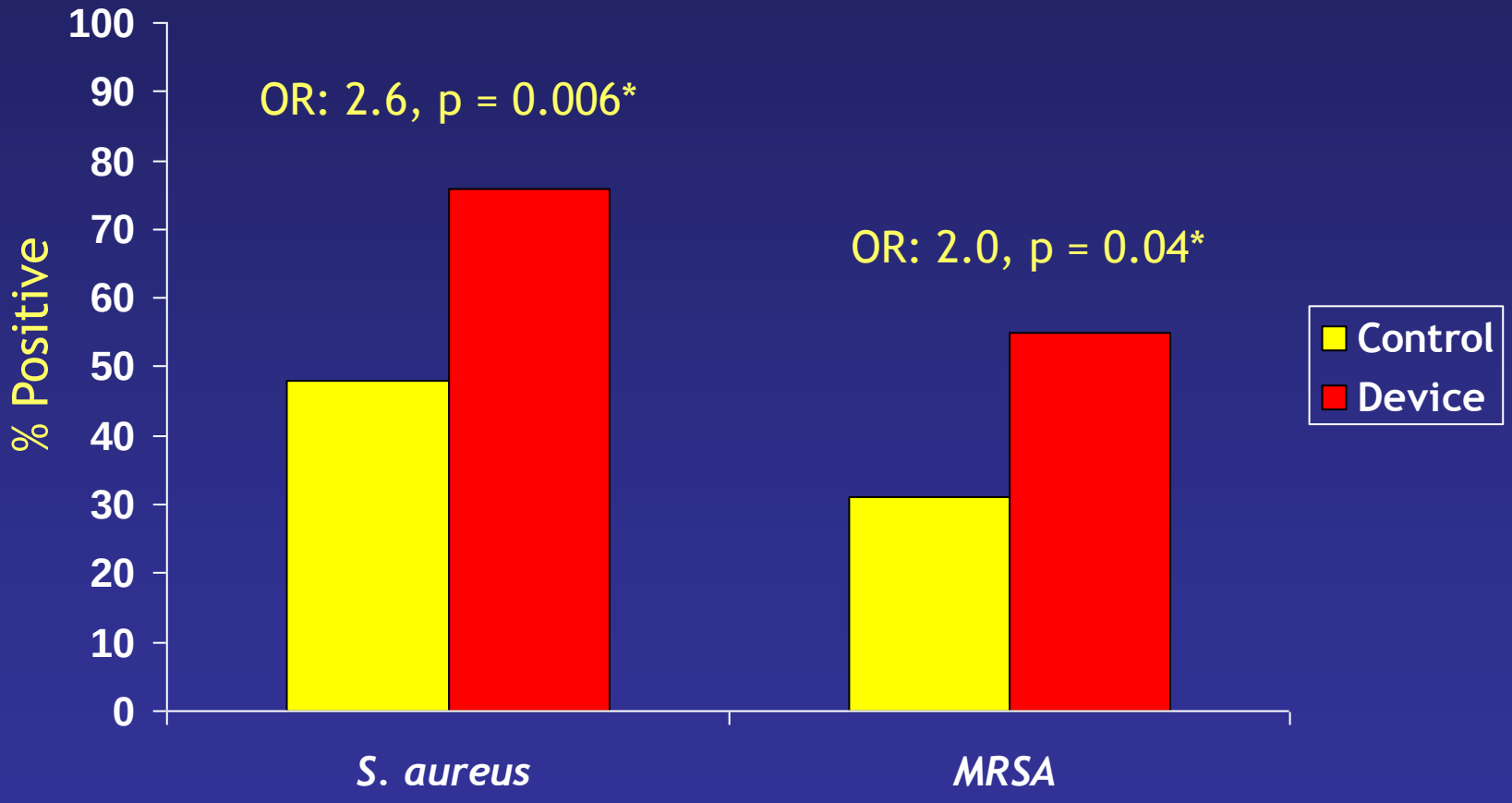
Ceftazidime, Ciprofloxicin

Staphyloccocus aureus

Methicillin

Outcome measure = site-level & patient-level colonization, infections

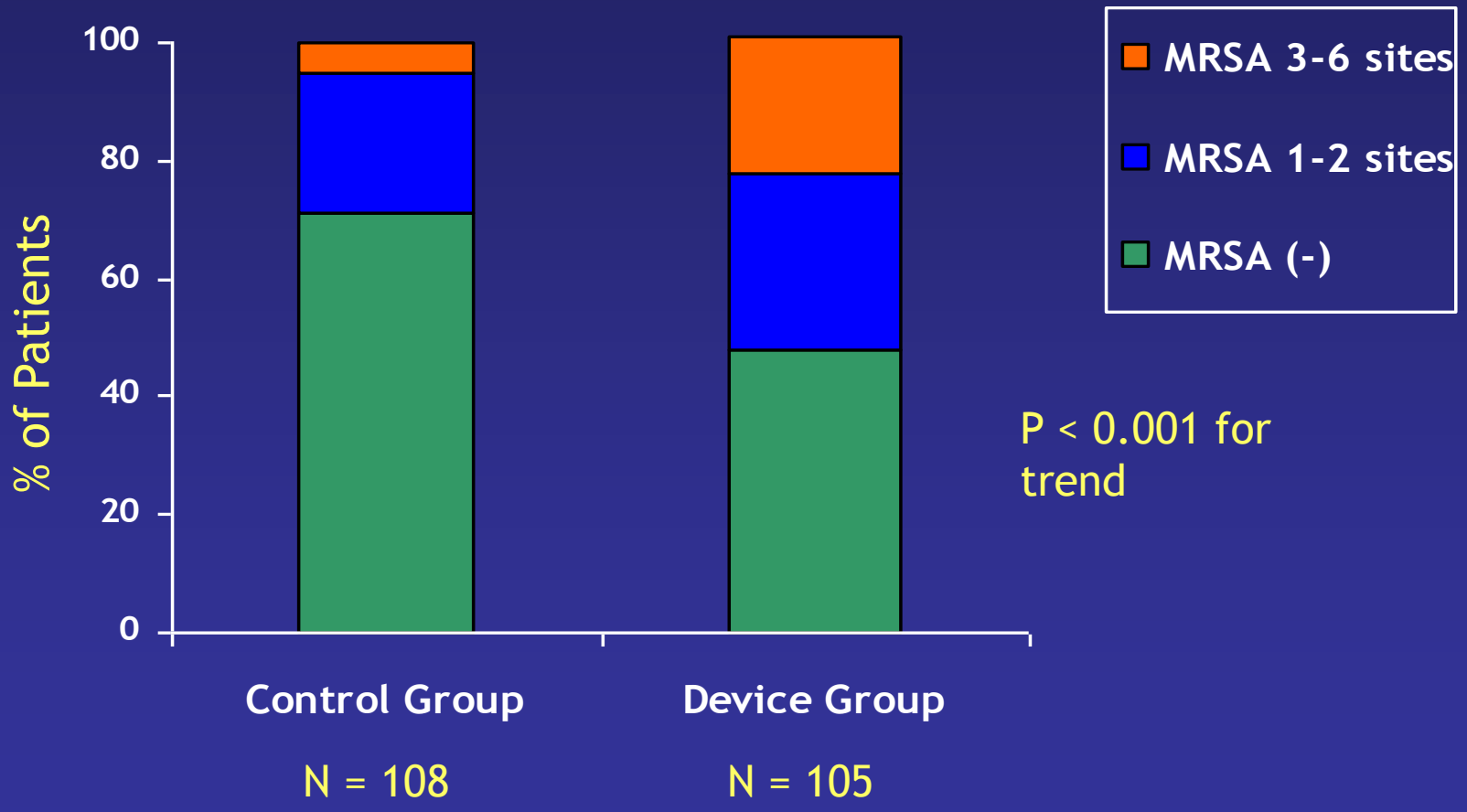
Indwelling Devices, Cross-sectional: Added risk of *S. aureus* & MRSA



* Adjusted for age, function, comorbidities

Mody L, et al. *Clin Infect Dis* 2008;46:1368-1373.

Indwelling Devices, Cross-sectional: Added risk of Multi-Site Colonization



Mody L, et al. *Clin Infect Dis* 2008;46:1368-1373.

Indwelling Devices, prospective cohort: Added risk of Infection

	No. of residents with infection	Follow-up time (resident-days)	Rate (per 1000 resident-days)
No Device (n=88)	50	19,320	2.6
Feeding tube (n=30)	17	3,000	5.7
Urinary catheter (n=48)	34	3,840	8.9
Feeding tube and urinary catheter (n=12)	10	1,050	9.5

Wang L, et al. *Eur J Clin Microbiol Infect Dis* 2012; 31:1797-804.

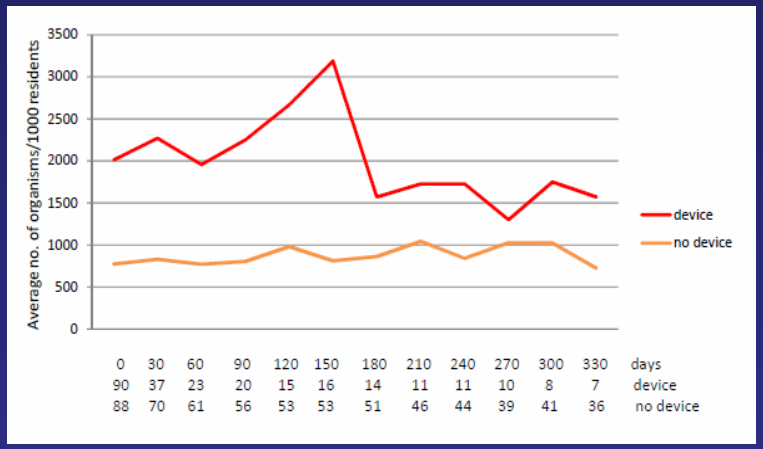
Indwelling Devices: Added risk of MDROs

	No. of Organisms Isolated (per 1000 resident-days of follow-up)			
	Total MDRO	MRSA	VRE	R-GNB
No Device	29	7.4	1.2	20
Feeding Tube	63	25	4.3	33.7
Urinary Catheter	68	19.8	3.6	44.8
Feeding Tube & Urinary Catheter	91	28.5	14.3	48.6

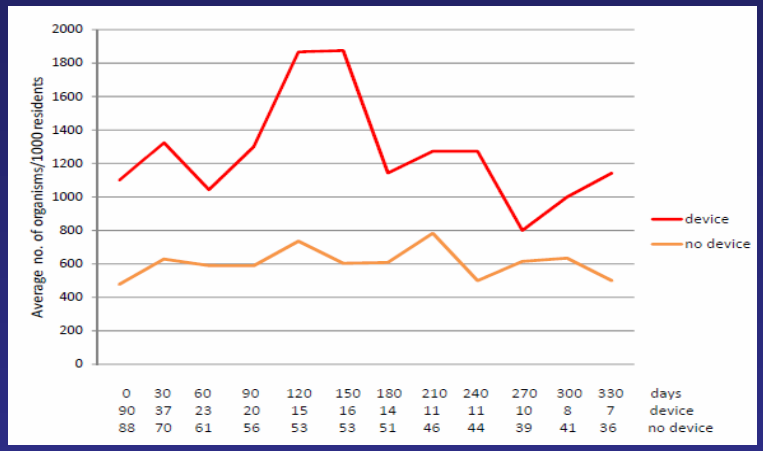
Wang L, et al. *Eur J Clin Microbiol Infect Dis* 2012; 31:1797-804.

Indwelling Devices: Added Burden of MDROs

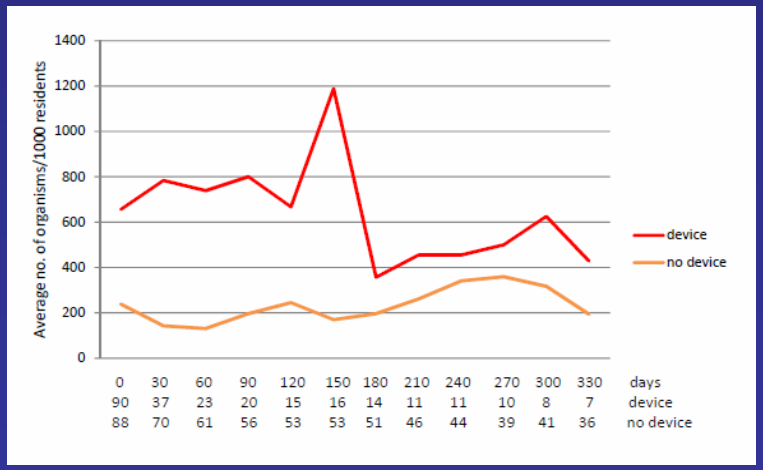
All MDROs



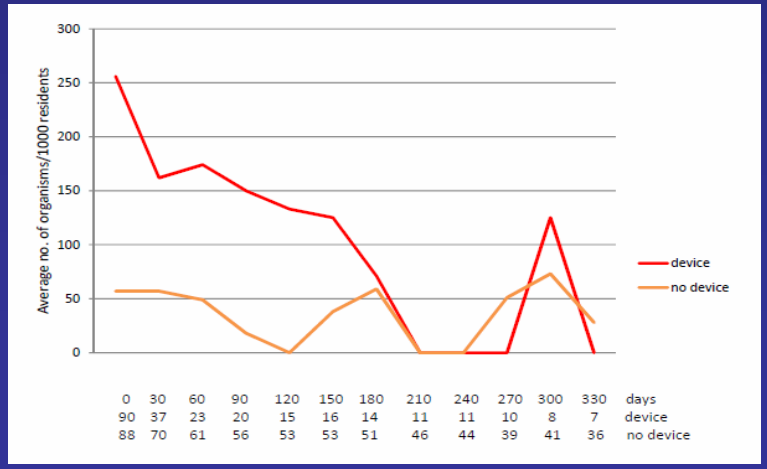
R-GNB



MRSA



VRE



Wang L, et al. *Eur J Clin Microbiol Infect Dis* 2012; 31:1797-804.

Indwelling Devices: Shorter time to New MRSA Acquisition

	Days to Acquisition, Avg ± SD			
Organism	**All (n=82)**	**Without indwelling device (n=61)**	**With indwelling device (n=21)**	**P (without vs. with)**
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

Fisch J, et al. *J Clin Microbiol* 2012;50:1698-1703.

Indwelling Devices: Numbers of NH residents with Persistent CIP-R GNB colonization, by species

No. and name(s) of species present		Preexisting Colonization (n=27)	New Acquisition (n=19)
1	*Escherichia coli*	10	3
	Proteus mirabilis	2	4
	Pseudomonas aeruginosa	1	0
	Providencia stuartii	2	0
	Morganella morganii	1	4
2	*E. coli, P. mirabilis*	7	4
	E. coli, P. stuartii	0	1
	P. mirabilis, P. stuartii	0	1
	P. mirabilis, P. fluorescens	1	0
3	*E. coli, P. mirabilis, M. morganii*	0	1
	E. coli, P. mirabilis, K. pneumoniae	1	0
≥4		1	0

Fisch J, et al. *J Clin Microbiol* 2012;50:1698-1703.

Indwelling Devices: Added risk of MRSA/VRE Cocolonization

	Overall		Device		Non-device		
	EV	IR	EV	IR	EV	IR	IRR[a]
MRSA/VRE Cocolonization	22	2.4 (1.6-3.6)	17	6.5 (3.9-10)	5	0.8 (0.2-1.7)	5.2 (1.5-18.1)*
MRSA only	189	21 (18-24)	77	29 (23-36)	112	18 (14-21)	1.7 (1.2-2.6)*
VRE only	22	2.4 (1.6-3.6)	10	3.8 (1.9-6.8)	12	1.9 (1.0-3.2)	2.5 (0.9-6.2)

EV = Resident-Months Colonized, IR = Incidence Rate/100 resident-months, IRR=Incidence Rate Ratio

[a] IRR for device vs. non-device adjusted for repeated measures using GEE

* p-value <0.01

Flannery E, et al. *Clin Infect Dis* 2011; 53:1215-1222.

Indwelling Devices: Added risk of MDR *A. baumannii*

	No. of Residents (row %)		
	Cases	Controls	P
Feeding Tube (n=54)	3 (6)	51 (94)	0.02
Urinary Catheter (n=87)	12 (14)	75 (86)	0.68
Feeding Tube & Urinary Catheter (n=27)	10 (37)	17 (63)	<0.001

Mody L, et al. *Infect Control Hosp Epidemiol* 2015;36:1155-1162.

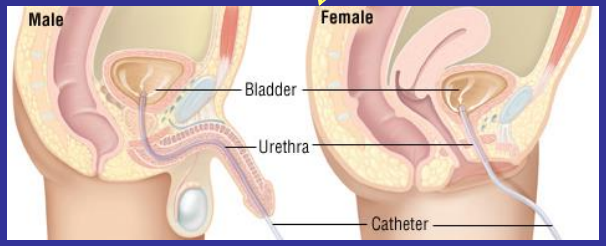
Indwelling Devices: New acquisition at of Extra-nasal sites

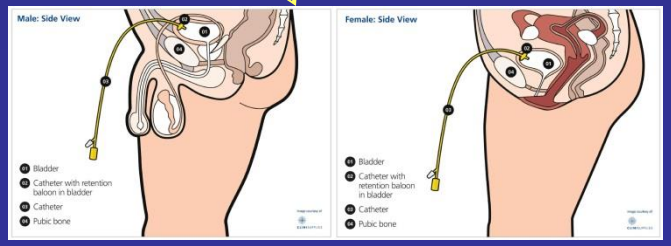
	No. residents (column %)		
Anatomic site of acquisition	Persistent carrier (n=11)	Transient carrier (n=39)	Total (n=50)
Nares	6 (55)	10 (26)	16 (32)
Extranasal site	5 (45)	29 (74)	34 (68)

Gibson KE, et al. *Infect Control Hosp Epidemiol* 2014;35:1458-1465.

MDRO differences in Device Type

	No. of MDRO positive samples No. Positive Samples/No. Samples Collected (%)		
Organism	**Urethral Catheter**	**Suprapubic Catheter**	**P**
MRSA	158/1795 (8.8)	60/686 (8.8)	.97
VRE	97/1795 (5.4)	28/686 (4.1)	.18
CTZ-R GNB	89/1795 (5.0)	46/686 (6.7)	.09
CIP-R GNB	**326/1795 (18.2)**	**168/686 (24.5)**	**<0.001**





Gibson KE, et al. 2016 (not yet submitted).

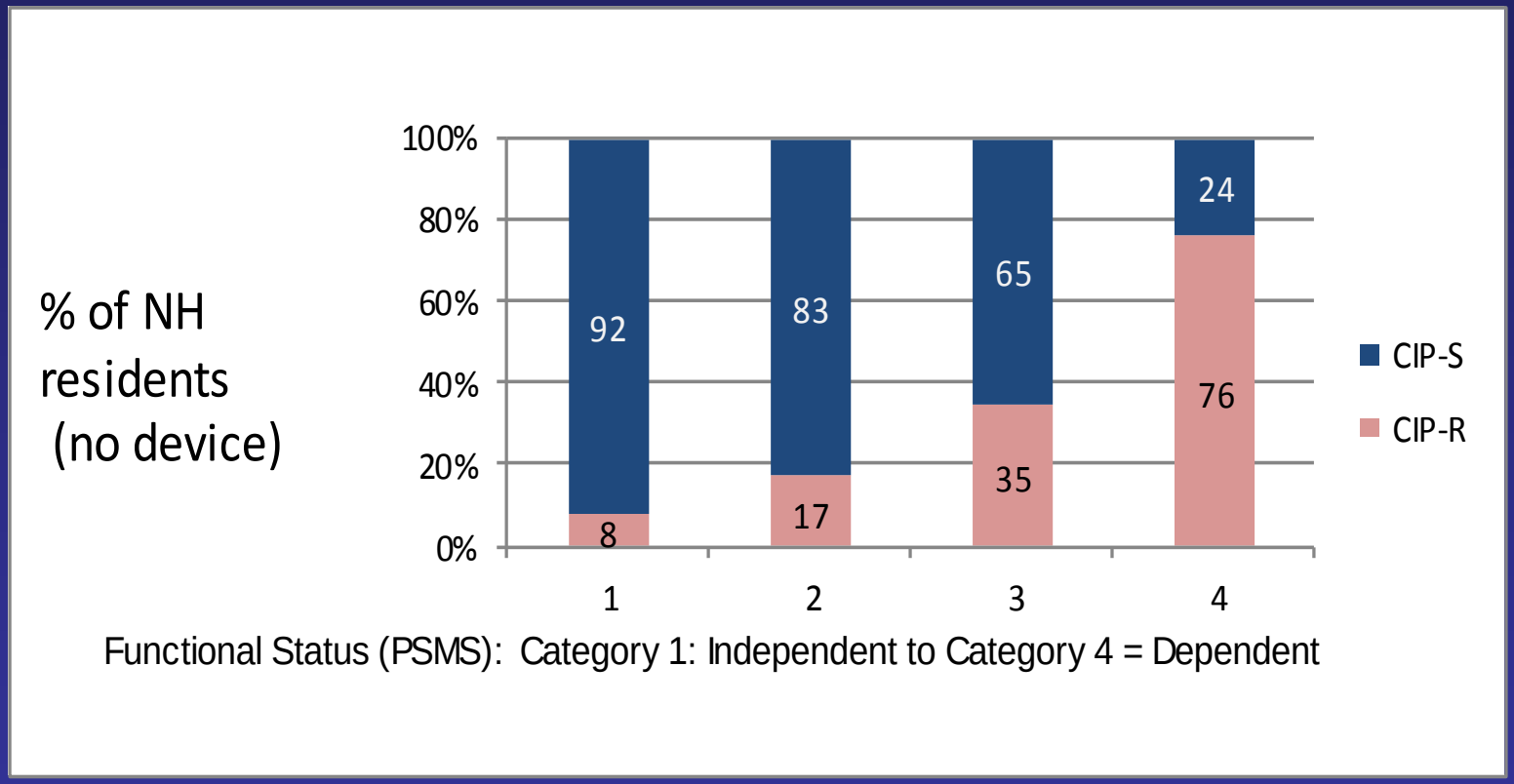
Take-Home Messages (2-18)

- Device residents at a heightened risk
  - Overall MRSA prevalence, new acquisition
  - MRSA acquisition at extra-nasal sites
  - Greater burden of colonization (>1 anatomic sites)
  - MRSA/VRE co-colonization
  - MDR *A. baumannii* colonization
  - Persistence in GNB colonization

Risk Factors for MDROs

- Use of indwelling devices
- Functional disability
- Presence of wounds
- Prior antimicrobial usage
- Prior hospitalization

Functional Disability, Cross sectional: Added risk of CIP-R GNB



Dommeti P, et al. *Infect Control Hosp Epidemiol* 2011;32:177-180.

Functional Disability, Prospective: Added risk of new MDRO acquisition

	Value for residents	
Risk factor	Not colonized with any MDRO (n=11)	Having new acquisition of any MDRO (n=57)
PSMS, mean ± SD	15.9 ± 5.6	20.9 ± 5.4[a]
Comorbidity score	2.4 ± 2.3	2.5 ± 1.5
Any hospital visit, no./total (%)	1/11 (9)	16/57 (28)
Any antibiotic use, no./total (%)	6/11 (55)	42/57 (74)
Device use, no./total (%)	1/11 (9)	14/57 (25)

[a] $P \leq 0.05$

Fisch J, et al. *J Clin Microbiol* 2012;50:1698-1703.

Functional Disability, Prospective: Added risk of MRSA/VRE Cocolonization

Characteristic	MRSA/VRE co-colonization (n=17)	No co-colonization (n=246)	Rate Ratio (95% CI)
Functional disability, mean	**26.3**	**22**	**1.3 (1.1, 1.4)*****
Male, No. (%)	13 (76)	103 (42)	3.1 (0.9, 10.4)
Wound, No. (%)	**8 (53)**	**62 (27)**	**3.4 (1.4, 8.6)****
Antibiotics, No. (%)	9 (53)	82 (33)	3.0 (1.0, 9.1)
Hospitalization, No. (%)	6 (38)	69 (30)	1.6 (0.3, 9.9)

**P < .01
*** P < .001

Flannery E, et al. *Clin Infect Dis* 2011; 53:1215-1222.

Functional Disability: Added risk of MDR *A. baumannii*

Risk Factor	Adjusted OR (95% CI)	P
PSMS > 24	5.1 (1.8, 14.9)	<0.004
Prior colonization with *P. mirabilis*	5.8 (1.9, 17.9)	<0.003
Diabetes	3.4 (1.2, 9.9)	<0.03

Mody L, et al. *Infect Control Hosp Epidemiol* 2015;36:1155-1162.

Gown & Glove Study

- Objective: Estimate the frequency of MRSA transmission to gowns & gloves worn by healthcare personnel interacting with NH residents
- Setting: Residents & HCP from 13 NHs
- Methods: MRSA on residents, HCP G&G after care
- Results: 113/403 (28%) residents with MRSA

INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY SEPTEMBER 2015, VOL. 36, NO. 9

ORIGINAL ARTICLE

Transmission of Methicillin-Resistant *Staphylococcus aureus* (MRSA) to Healthcare Worker Gowns and Gloves During Care of Nursing Home Residents

Mary-Claire Roghmann, MD, MS;[1] J. Kristie Johnson, PhD;[2] John D. Sorkin, MD, PhD;[3] Patricia Langenberg, PhD;[1] Alison Lydecker, MPH;[1] Brian Sorace, BS;[1] Lauren Levy JD, MPH;[1] Lona Mody, MD, MSc[4,5]

OBJECTIVE. To estimate the frequency of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission to gowns and gloves worn by

Roghmann MC, et al. *Infect Control Hosp Epid* 2015;36:1050-1057.

Odds of Gown or Glove Contamination, by Type of Care

		Gown		Glove	
Type of Care	N	OR (95% CI)	*P*	OR (95% CI)	*P*
Dressing	138	2.3 (1.5, 3.6)	<0.01	1.8 (1.3, 2.5)	<0.01
Transfer	167	2.1 (1.4, 3.1)	<0.01	1.3 (0.9, 1.7)	0.19
Hygiene	106	2.0 (1.2, 3.3)	<0.01	1.6 (1.1, 2.3)	0.02
Change linens	129	1.8 (1.2, 2.8)	<0.01	1.8 (1.1, 2.8)	0.01
Diaper	108	1.7 (1.0, 2.7)	0.04	1.5 (1.1, 2.1)	0.02

Roghmann MC, et al. *Infect Control Hosp Epid* 2015;36:1050-1057.

Pathway from Functional Disability to Antimicrobial Resistance in NH residents

- Aim 1:
  - Develop and examine a risk-stratification model utilizing resident-, HCW (caregiver)-, and environmental-level factors to identify three categories of NH residents:
    (1) never acquire an MDRO
    (2) intermittently acquire an MDRO
    (3) newly acquire an MDRO and remain persistently colonized
- Aim 2:
  - Design and evaluate the effectiveness of a multi-component intervention to reduce new acquisition of MDROs in the functionally-disabled NH residents at highest risk.

Mody L. Pathways Study, 2013-current.

Pathways Study Design

- Design: First 2 years- prospective, longitudinal study; Second 2 years- cluster randomized trial
- Facilities: 6 NHs in SE MI
- Population: Residents newly admitted to the facility (within 10 days of admission)
- Study Duration: 2013-2018 (ongoing)
- Inclusion: New admission, Informed consent
- Exclusion: Readmits, Hospice care

Mody L. Pathways Study, 2013-current.

PATHWAYS ENROLLMENT

- 652 NH residents from 6 facilities enrolled

Facility	Sum of Eligible	Sum of Enrolled	% Enrolled	Sum of Visits
1	260	133	51.2	269
2	195	82	42.1	251
3	356	169	47.5	402
4	290	137	47.2	338
5	132	55	41.7	139
6	151	76	50.3	208
Total	1384	652	47.1	1607

Mody L. Pathways Study, 2013-current.

PATHWAYS ENROLLMENT

- 652 NH residents from 6 facilities enrolled

Location	Total samples No. swabs	% Positive swabs	Any MDRO No. swabs	VRE No. swabs	MRSA No. swabs	RGNB No. swabs
Nares	1129	13	151	9	132	12
Oral	1097	12	136	55	61	41
Groin	1139	22	252	175	29	114
Perirectal	796	**40**	317	229	23	143
Hand	1139	24	278	152	127	35
Wound	23	**43**	10	3	7	3
FT site	50	28	14	5	7	7
SP cath site	14	**86**	12	4	7	4
Total	**5387**	**22%**	**1170 (22)**	**632 (12)**	**393 (7)**	**359 (6)**

Mody L. Pathways Study, 2013-current.

Early Findings of Pathways Study

	Environmental visit positive for MDROs, No. visits positive (%)			
Resident Visits	**MRSA**	**VRE**	**R-GNB**	**Any MDRO**
MRSA				
Positive (n=110)	**74/110 (67)**	55/110 (50)	28/110 (25)	92/110 (84)
Negative (n=448)	**68/448 (15)**	186/448 (42)	87/448 (19)	259/448 (58)
VRE				
Positive (n=181)	57/181 (31)	**136/181 (75)**	45/181 (25)	158/181 (87)
Negative (n=337)	85/337 (23)	**105/377 (28)**	70/377 (19)	193/377 (51)
R-GNB				
Positive (n=135)	32/135 (24)	63/135 (47)	**40/135 (30)**	93/135 (69)
Negative (n=423)	110/423 (26)	178/423 (42)	**75/423 (18)**	258/423 (61)
Any MDRO				
Positive (n=303)	98/303 (32)	169/303 (56)	74/303 (24)	**232/303 (77)**
Negative (n=255)	44/255 (17)	72/255 (28)	41/255 (16)	**119/255 (47)**

Mody L. Pathways Study, 2013-current.

Take-Home Messages (19-31)

- Functional disabled residents at a heightened risk

  - Ciprofloxacin-resistant GNB colonization
  - MDRO acquisition
  - MRSA/VRE co-colonization
  - MDR *A. baumannii* colonization
  - Resident MDRO colonization and environmental contamination

Risk Factors for MDROs: Wounds

- Use of indwelling devices
- Functional disability
- Presence of wounds
- Prior antimicrobial usage
- Prior hospitalization

Presence of Wounds, Prospective: Added risk of MRSA/VRE Cocolonization

Characteristic	MRSA/VRE co-colonization (n=17)	No co-colonization (n=246)	Rate Ratio (95% CI)
Functional disability, mean	26.3	22	1.3 (1.1, 1.4)***
Male, No. (%)	13 (76)	103 (42)	3.1 (0.9, 10.4)
Wound, No. (%)	8 (53)	62 (27)	3.4 (1.4, 8.6)**
Antibiotics, No. (%)	9 (53)	82 (33)	3.0 (1.0, 9.1)
Hospitalization, No. (%)	6 (38)	69 (30)	1.6 (0.3, 9.9)

**P < .01
*** P < .001

Flannery E, et al. *Clin Infect Dis* 2011; 53:1215-1222.

Presence of Wounds: Cheng 2015, Hong Kong study

	GI colonization by CRAB	
	OR (95% CI)	P
Age, years	1.0 (1.0, 1.1)	<.001
Male	2.2 (1.4, 3.3)	<.001
Resident of elderly home[a]	7.0 (4.4, 11.2)	<.001
Presence of chronic wound or ulcer	3.5 (1.9, 6.4)	<.001
Use of beta-lactam/beta-lactamase inhibitors[b]	2.3 (1.5, 3.6)	<.001
Use of cephalosporin[b]	3.4 (1.6, 7.2)	.002
Use of carbapenem[b]	3.3 (1.8, 6.0)	<.001
Use of fluoroquinolones[b]	1.8 (1.1, 3.2)	.027

GI = Gastrointestinal, CRAB = Carbapenem-resistant Acinetobacter baumannii, CI = Confidence interval, OR = Odds ratio

[a]Persons living in long-term care facilities for elderly people in Hong Kong

[B]in preceding 6 months before identification of CRAB

Cheng VC, et al. *Eur J Clin Microbiol Infect Dis* 2015;34:2359-2366.

Presence of Wounds: Added risk of Post-discharge MRSA, US

Variable	Adjusted mOR (95% CI)	Prevalence of Risk Factor among Case patients, %
MRSA colonization[a]	7.71 (3.60-16.51)	63
CVC at discharge	2.16 (1.13-4.11)	33
Discharge to NH	2.65 (1.41-4.99)	49
Chronic wound during post-discharge period	**4.41 (2.14-9.09)**	**35**
Discharge with non-CVC invasive device	3.03 (1.24-7.39)	15

CI = Confidence interval, CVC = Central Venous Catheter, mOR = Matched odds ratio, MRSA = methicillin-resistant Staphylococcus aureus.

[a]MRSA colonization was defined as (1) MRSA recovered from a nonsterile site during the hospitalization or (2) MRSA infection/colonization in the prior 12 months.

Epstein L, et al. *Clin Infect Dis* 2016;62:45-52.

Presence of Wounds: Added risk of VRE, US

	No. (%) of cultures yielding the organism				
Organism	Rectum	Nares	Wound	CVC insertion site	PEG entry site
MRSA	99 (6)	33 (6)	112 (7)	6 (1)	10 (3)
VRE	**615 (38)**	20 (4)	**275 (18)**	19 (2)	26 (8)
ESBL-producing GNB	146 (9)	8 (2)	85 (6)	9 (1)	13 (4)
KPC-producing GNB	3 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)
IMP-R *P. aeruginosa*	46 (3)	4 (1)	33 (2)	5 (0.5)	6 (2)
IMP-R *A. baumannii*	97 (6)	19 (4)	104 (7)	10 (1)	16 (5)
IMP-S MDR *A. baumannii*	13 (1)	2 (0.4)	21 (1)	6 (1)	4 (1)
Other IMP-S MDR GNB	66 (4)	4 (1)	34 (2)	4 (0.4)	6 (2)
IMP-S MDR *P. aeruginosa*	11 (1)	0 (0)	6 (0.4)	2 (0.2)	1 (0.3)
IMP-R *Enterobacter*spp.	2 (0.1)	0 (0)	2 (0.1)	0 (0)	0 (0)
Other IMP-R GNB	2 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)
Total no. of cultures	1,629	521	1,518	926	328

Munoz-Price L, et al. *Infect Control Hosp Epidemiol* 2010;31:59-63.

Presence of Wounds:

Organism	No. (%) of wound cultures yielding the organism
TIP Study (n=91 wound cultures)	
MRSA	19 (21)
VRE	6 (7)
CTZ-R GNB	36 (40)
CIP-R GNB	53 (58)
Any MDRO	63 (69)
Pathways study (n=26 wound cultures)	
MRSA	8 (31)
VRE	5 (19)
CTZ-R GNB	2 (8)
CIP-R GNB	4 (15)
Any MDRO	12 (46)

Mody L, et al. *JAMA Intern Med* 2015;175:714-723.
Mody L. Pathways Study, 2013-current.

Antibiotic Use in LTCFs

- On any given day: 3-15% on antibiotics
- 50-80% receive at least one course per year
- 25-75% do not meet clinical guidelines

http://i.huffpost.com/gen/1081927/images/r-HIGHEST-ANTIBIOTIC-PRESCRIPTION-RATE-large570.jpg

Eke-Usim A, et al. *J Am Geriatr Soc* 2016 (In revision).

Antibiotic Use: Added risk of MDROs

Characteristic	Residents (n=176)	Adjusted[a] Hazard ratio (95% CI)
Any use of antibiotics	65 (37)	NA
Any use of quinolones	32 (18)	1.89 (1.28-2.81)
Any use of third- or fourth-generation cephalosporins	12 (6.8)	1.57 (1.03-2.40)

[a]Adjusted for clustering at the facility level in the generalized estimating equations and for whether the resident had a foley catheter and a hospitalization in the prior 90 days

Mitchell SL, et al. *JAMA Intern Med* 2014;174:1660-1667.

High Antibiotic Use in Facilities: Added risk for Antibiotic-related harms

	Antibiotic Use, No (%)		
Characteristic	Low (n=33,822)	Medium (n=31,425)	High (n=24,943)
Any antibiotic complication (primary composite outcome)	11.4%	12.4%	13.3%
Any antibiotic complication w/ potential for indirect harms to non-recipients (secondary composite outcome)	11.2%	12.1%	13.0%

Daneman N, et al. *JAMA Intern Med* 2015;175:1331-39.

High Antibiotic Use in Facilities: Added risk for Antibiotic-related harms

Characteristic	Adjusted Odds Ratio (95% CI)	*P* Value
Nursing home tertile of antibiotic use		
Low	1 [Reference]	
Medium	1.08 (0.97-1.21)	.18
High	**1.24 (1.07-1.42)**	**.003**
Nursing home assessment		
Recent hospital admission w/in 90 days	0.97 (0.90-1.05)	.44
Years in long-term care (per yr)	0.95 (0.94-0.97)	<.001
Do-not-resuscitate order	0.85 (0.80-0.90)	<.001
Health care system use		
Prescription drugs in past 12 months (per drug)	1.03 (1.03-1.04)	<.001
Emergency department visit w/in 12 months	1.18 (1.13-1.23)	<.001
Inpatient admissions in past 12 months	1.42 (1.31-1.54)	<.001

Daneman N, et al. *JAMA Intern Med* 2015;175:1331-1339.

Antibiotic Use: Added risk of VRE

Variable	Hazard Ratio (95% CI)	*P*
Age of ≥ 65 yr	1.89 (1.09-3.30)	.025
Non-home residence	2.03 (1.14-3.60)	.010
Diabetes	2.83 (1.56-5.14)	.001
PVOD	2.41 (1.21-4.78)	.012
Cephalosporin exposure in past 3 mo	3.01 (1.51-6.01)	.002
Fluoroquinolone exposure in past 3 mo	2.80 (1.16-6.78)	.022
Immunosuppressive status	3.69 (1.87-7.23)	<.001

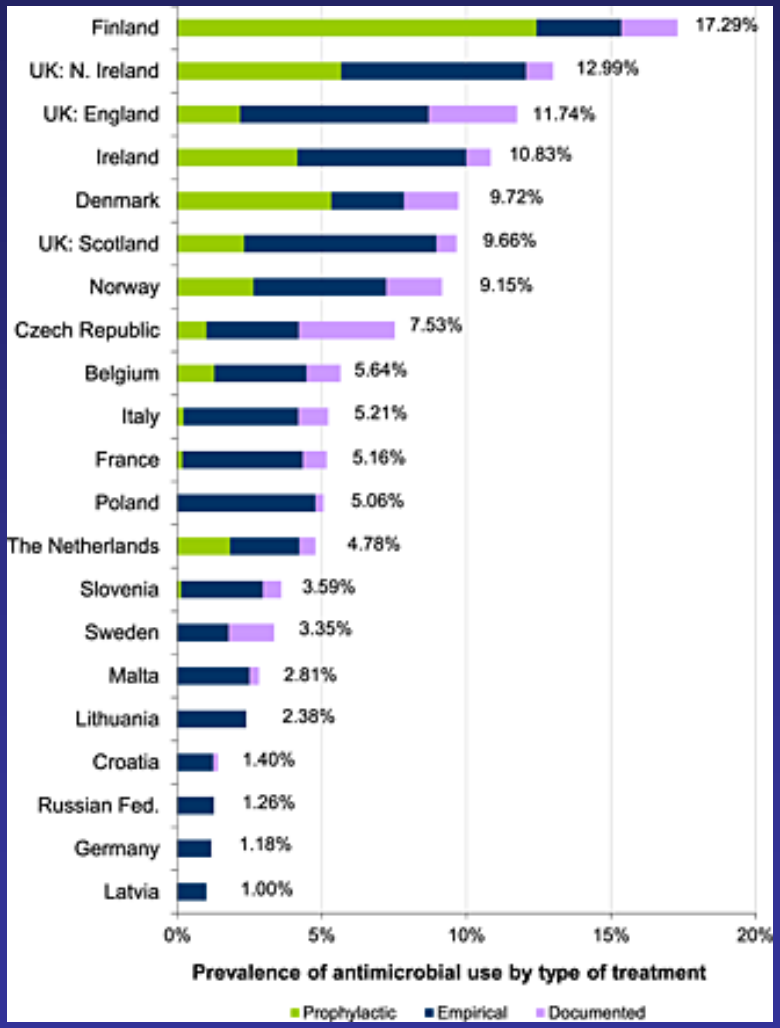
Hayakawa K, et al. *Antimicrob Agents Chemother* 2013;57:49-55.

Antibiotic Use: Highly Variable Across SE MI NHs

	Facility						
	1	2	3	4	5	6	Total
No. follow-up visits	96	177	100	93	107	122	695
Clinically-defined Infection, %	14%	32%	21%	26%	41%	28%	28%
Infection rate, per 1000 device-days	4.6	16.3	8.9	9.5	16.6	10.5	11.7
Antibiotic days with UTI or pneumonia	10.5	10.9	10.5	8.5	13.1	12.5	11.3

Eke-Usim A, et al. *J Am Geriatr Soc* 2016 (In press).

Antibiotic Use: Highly Variable Across European NHs



Latour K, et al. *Pharmacoepidemiol Drug Saf* 2012;21:937-944.

Prior Hospitalization: Added risk for all MDROs, Germany

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Multidrug-resistant bacteria in geriatric clinics, nursing homes, and ambulant care – Prevalence and risk factors

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ABSTRACT

Colonization/infection with multidrug-resistant bacteria (MDRB) such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), and extended-spectrum beta-lactamase (ESBL) producing Enterobacteriaceae, is an increasing problem not only in hospitals but also in long-term care facilities. The aim of this study was to determine the prevalence as well as the risk factors of colonization/infection with MRSA, VRE, and ESBL producing Enterobacteriaceae in geriatric clinics, nursing homes, and ambulant care in Frankfurt am Main, Germany. 288 patients from 2 geriatric clinics (n = 46), 8 nursing homes (n = 178), and 2 ambulant care facilities (n = 64) as well as 64 staff members were screened for MDRB in the time period from October 2006 to May 2007. 58 patients (20.1%) and 4 staff members (6.2%) were colonized with MDRB. Among patients, 27 (9.4%) were colonized with MRSA, 11 (3.8%) were screened positive for VRE, and 25 (8.7%) were found to be colonized with ESBL producing Enterobacteriaceae. Prevalence of MDRB in geriatric clinics, nursing homes, and ambulant care facilities were 32.6%, 18.5%, and 15.6%, respectively. Significant risk factors for MDRB were immobility (OR: 2.7,

Gruber I, et al. *Int J Med Microbiol* 2013;303:405-409.

Prior Hospitalization: Added risk for all MDROs, Germany

	Any MDRO	
	OR (95% CI)	P
Age ≥ 85 years	1.69 (0.94-3.01)	.079
Previous hospital stay	2.06 (1.06-3.97)	.033
Immobility	2.67 (1.45-4.89)	.002
Urinary catheter	3.13 (1.67-5.85)	<.001
Stoma	2.08 (0.68-6.33)	.193
Percutaneous endoscopic gastrostromy	2.01 (0.81-4.9)	.125
Decubitus/wound	2.27 (1.45-4.91)	.033
Diabetes	0.83 (0.41-1.67)	.729
Presence of a care level	1.25 (0.63-2.47)	.615
History of MRSA	2.08 (0.68-6.33)	.193

Gruber I, et al. *Int J Med Microbiol* 2013;303:405-409.

Prior Hospitalization: Added risk of ESBL producing Enterobacteriaceae, Germany

	ESBL	
	OR (95% CI)	P
Age ≥ 85 years	1.8 (0.79-4.19)	.21
Previous hospital stay	4.7 (1.36-15.92)	.008
Immobility	3.0 (1.22-7.47)	.02
Urinary catheter	4.6 (1.99-10.72)	<.001

Gruber I, et al. *Int J Med Microbiol* 2013;303:405-409.

Prior Hospitalization: Added risk of MRSA colonization, Hong Kong

Cheng *et al. BMC Infectious Diseases* 2013, **13**:205
http://www.biomedcentral.com/1471-2334/13/205

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

Transmission of methicillin-resistant *staphylococcus aureus* in the long term care facilities in Hong Kong

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Abstract

Background: The relative contribution of long term care facilities (LTCFs) and hospitals in the transmission of methicillin-resistant *Staphylococcus aureus* (MRSA) is unknown.

Methods: Concurrent MRSA screening and *spa* type analysis was performed in LTCFs and their network hospitals to estimate the rate of MRSA acquisition among residents during their stay in LTCFs and hospitals, by colonization pressure and MRSA transmission calculations.

Cheng VC, et al. *BMC Infectious Disease* 2013;13:1-10.

Prior Hospitalization: Added risk of MRSA colonization, Hong Kong

	MRSA carrier (n=436)	Non-MRSA carrier (n=1584)	P
Hospital stay, past year	315 (72%)	851 (54%)	<0.001
Total no. of hosp. days, past year	18.8	9.8	<0.001
Nasogastric tube	83 (19%)	193 (12%)	<0.001
Urinary catheter	80 (18%)	153 (9%)	<0.001
Wound or ulcer	41 (9.4%)	39 (2.5%)	<0.001

Cheng VC, et al. *BMC Infectious Disease* 2013;13:1-10.

Take-Home Messages (slides 33-45)

- Residents with a wound, antibiotic use or recent hospitalization at a heightened risk
  - MRSA/VRE co-colonization
  - Invasive MRSA infection
  - Carbapenem-resistant *A. baumannii*
  - VRE colonization
  - Antibiotic-related harms
  - ESBL *Enterobacteriaceae* colonization

Summary

- Risk factors for MDROs:
  - Use of indwelling devices
  - Functional disability
  - Presence of wounds
  - Prior antimicrobial usage
  - Prior hospitalization
- Strategies:
  - Identify high risk groups, common infections, MDROs
  - QA programs to implement strategies to reduce MDROs, infections
  - Hand hygiene, enhanced barrier precautions, environmental cleaning, antimicrobial stewardship, staff education