

Infection Prevention in Aging Populations Across Healthcare Spectrum: from Hospital to Community Institutions (27-28, January 2016)



MDROs in Residential Care Homes of Elderly in Hong Kong

Vincent CC Cheng MBBS (HK), MD (HK), PDipID (HK), MRCP (UK), FRCPath Infection Control Officer & Consultant, Queen Mary Hospital Hon Associate Professor, Department of Microbiology The University of Hong Kong





Population over the age of 65 (Year 2015)

1.1 million (16%) of total population

73,000 elderly (7%) of 1.1 million

Living in 547 Residential Care Homes of Elderly

http://www.apir.hk/2014/12/mpfa-retirement-planning-protection/



Evolution of MRSA in residential care homes of elderly (RCHE) in HK

Epidemiology and Genetic Diversity	Jan 2005
of Methicillin-Resistant <i>Staphylococcus aureus</i> Strains	949 residents in
in Residential Care Homes for Elderly Persons in Hong Kong	13 residential care homes
Pak-Leung Ho, FACP; Teresa K. F. Wang, MD; Patricia Ching, RN;	Nasal swab ± active skin lesions
Gannon C. Mak, MPhil; Eileen Lai, MSc; Wing-Cheong Yam, PhD; Wing-Hong Seto, MD	MRSA colonization:
Ho PL, et al. Infect Control Hosp Epidemiol. 2007 Jun;28(6):671-8.	2.8% (27/949)
Molecular epidemiology of methicillin-resistant <i>Staphylococcus aureus</i> in residential care homes for the elderly in Hong Kong Pak-Leung Ho ^{a,*} , Eileen L. Lai ^a , Kin-Hung Chow ^a , Louisa S.M. Chow ^b , Kwok-Yung Yuen ^a , Raymond W.H. Yung ^b ^a Division of Infectious Diseases, Department of Microbiology and Centre of Infection, Queen Mary Hospital, The University of Hong Kong, Hong Kong SAR, China ^b Department of Health, Infection Control Branch, Center for Health Protection, Hong Kong SAR, China Received 11 October 2007; accepted 16 December 2007 Ho PL, et al. Diagn Microbiol Infect Dis. 2008 Jun;61(2):135-42.	Jun-Dec 2005 1563 residents in 487 residential care homes Nasal swab ± active skin lesions MRSA colonization: 5.1% (80/1563)

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

Vincent CC Cheng^{1,2}, Josepha WM Tai², Zoie SY Wong³, Jonathan HK Chen¹, Kris BQ Pan³, Yizhen Hai³, Wing-Chun Ng⁴, Denise MK Chow⁵, Miranda CY Yau¹, Jasper FW Chan^{1,2}, Sally CY Wong^{1,2}, Herman Tse^{1,6}, Sophia SC Chan⁵, Kwok-Leung Tsui³, Felix HW Chan⁴, Pak-Leung Ho^{1,6} and Kwok-Yung Yuen^{1,6*}

Cheng VC, et al. BMC Infect Dis. 2013 May 6;13:205.

Jul-Dec 2011 2020 residents in 40 residential care homes Nasal swab MRSA colonization: 21.6% (436/2020)

Demographic characteristics of 2020 residents with or without MRSA colonization in 40 RCHEs in Hong Kong

	MRSA carrier	Non-MRSA carrier	p value
	(11-430)	(11-1384)	
Age (mean \pm SD)	84.1 ± 9.2	83.5 ± 9.4	0.255
Sex (male)	165 (37.8%)	563 (35.5%)	0.376
History of hospital admission in the	315 (72.2%)	851 (53.7%)	<0.001
past 12 months			
Cumulative day of hospitalization in	18.8 ± 29.5	9.8 ± 19.2	<0.001
the past 12 months			
Underlying diseases			
Chronic cerebral conditions	140 (32.1)	341 (21.5%)	<0.001
Chronic cardiac conditions	69 (15.8%)	172 (10.9%)	0.005
Chronic pulmonary conditions	35 (8.0%)	76 (4.8%)	0.009
Chronic renal failure	19 (4.4%)	35 (2.2%)	0.014
Diabetes mellitus	80 (18.3%)	196 (12.4%)	0.001
Malignancy	26 (6.0%)	48 (3.0%)	0.004
Presence of			
Nasogastric tube	83 (19.0%)	193 (12.2%)	<0.001
Urinary catheter	80 (18.3%)	153 (9.7%)	<0.001
Wound or ulcer	41 (9.4%)	39 (2.5%)	<0.001
Received antibiotics 3 months before admission (yes / no)	160 (36.7%)	307 (19.4%)	<0.001

Cheng VC, et al. BMC Infect Dis. 2013 May 6;13:205.

Risk factors of MRSA colonization among residents in residential care homes of elderly

Ref.	Region (country) / year of publication	Study subject	No. of person with MRSA colonization (positive rate)	Risk factors
(1)	Europe (Belgium) / 2007	2908 persons in 24 RCHs (121 persons per RCH)	136 (4.7%)	Multivariate analysis: hospital admission in a surgical department , antibiotic use, more than two beds per room, patient mobility, presence of a urinary catheter, presence of a pressure sore, being in the nursing home for 1–4 years and systemic disease
(2)	Europe (UK) / 2007	715 persons in 39 RCHs (18 persons per RCH)	159 (22%)	Multivariate analysis: low ratio of nurses to beds, residence in a care home in a deprived area, male sex, presence of an invasive device, and a hospitalization duration of more than 10 days during the previous 2 years
(3)	Europe (Spain) / 2008	1377 persons in 9 RCHs (153 persons per RCH)	266 (16.8%)	Univariate analysis: presence of medical devices, decubitus ulcers, previous antibiotic treatment, aged older than 85 years, a Charlson index ≥ 2, and transfer from acute care facilities
(4)	Europe (Belgium) / 2009	2953 persons in 60 RCHs (49 persons per RCH)	587 (19.9%)	Univariate analysis: hospital contact , antibiotic exposure, impaired mobility, and presence of skin lesion
(5)	Europe (Germany) / 2011	1827 persons in 32 RCHs (57 persons per RCH)	139 (7.6%)	Univariate analysis: presence of urinary catheter, wounds, preceding hospital admission , and high grade resident care

(1) Suetens C, et al. Age Ageing 2007;36:327-330; (2) Bar B, et al. Infect Control Hosp Epidemiol 2007;28:853-859.

(3) Manzur A, et al. Clin Microbiol Infect 2008;14:867-872; (4) Denis O, et al. J Antimicrob Chemother 2009;64:1299-1306.

(5) Pfingsten-Wurzburg S, et al. J Hosp Infect 2011;78:108-112.

Prevalence of MRSA colonization upon admission by universal screening

Ref.	Region (country) / year of publication	Description of hospital setting (study period)	Study subject	No. of MRSA colonization (%)	Risk factors
(1)	Europe (UK) / 2002	A district hospital, patients admitted to general surgical and orthopedic units (November 2000 to January 2001)	430	23 (5.3%)	Multivariate analysis: male sex, nursing home admission , and hospital admission within 1 year
(2)	Europe (UK) / 2010	6 acute hospitals in 3 regions in Scotland (1 August to 31 December 2008)	29690	2218 (7.5%)	Univariate analysis: older patients, admitted from care homes , and repeated admission
(3)	North America (US) / 2007	A community hospital, patients admitted to medical unit (7-week period)	401	41 (10.2%)	Multivariate analysis: admitted from nursing homes and prior MRSA infection

- 1. Samad A, et al. J Hosp Infect 2002;51:43-46.
- 2. Reilly JS, et al. Universal screening for meticillin-resistant Staphylococcus aureus: interim results from the NHS Scotland pathfinder project. J Hosp Infect 2010;74:35-41.
- 3. Haley CC, et al. Methicillin-resistant Staphylococcus aureus infection or colonization present at hospital admission: multivariable risk factor screening to increase efficiency of surveillance culturing. J Clin Microbiol 2007;45:3031-3038.

Controlling nosocomial transmission of MRSA in Queen Mary hospital, HK



Figure 3. Incidence rate of hospital-acquired MRSA per 1000 MRSA-positive-days in three different phases of intervention.

Cheng VC, et al. PLoS One. 2014 Jun 19;9(6):e100493.

Transmission dynamic of MRSA between RCHEs and hospitals in Hong Kong

RCHEs Incidence of MRSA transmission per 1000-colonization-days: 309

Hospitals (HKWC) Incidence of MRSA transmission per 1000-colonization-days: 113

Cheng VC, et al. BMC Infect Dis. 2013 May 6;13:205.

Relationship between the MRSA prevalence per RCHE and the average living area (square feet) per RCHE resident

60



Cheng VC, et al. BMC Infect Dis. 2013 May 6;13:205.

Population density of Hong Kong Special Administration Region, China (2015) 6940 people per sq. km (Rank 4th in the world) (c.f United States: 35 people per sq. km - rank 176th in the world)

How can we control MD vercrowding environment? vs Emerging MDROs Endemic

Data from Department of Economic and Social Affairs, UN (http://esa.un.org/unpd/wpp/Download/Standard/Population/)

Vancomycin resistant enterococci in HA hospitals

	2009	2010	2011	2012	2013
All enterococci in clinical specimens (no.)	14096	13848	15002	15989	16253
VRE in clinical specimens (no. / %)	14 (0.10%)	55 (0.40%)	44 (0.29%)	50 (0.31%)	205 (1.26%)

VRE bacteremia (HA 2013): 0.0007 per 1000 acute patient days

Why we care to control VRE NOW: 40 – 80 folds lower than UK

UK: VRE Bacteremia rate ranged 0.03 to 0.06 per 1000 patient bed days (2013)

Source: London Health Sciences Centre: <u>http://www.lhsc.on.ca/About_Us/Accountability/Caring_for_our_Patients/Infection_Control/VRE/index.htm</u>





Department of Microbiology, QMH, HKWC

Admission screening for silent carriers

Patient isolation in single room with contact precautions

Proactive Infection Control Measures for MDROs

Patients' Hand Hygiene "出入口管制"

Enhanced environmental cleansing

Extensive contact tracing and screening to control the spread of vancomycin-resistant *Enterococcus faecium* ST414 in Hong Kong

CHENG Vincent Chi-chung, TAI Josepha Wai-ming, NG Modissa Lai-ming, CHAN Jasper Fuk-woo, WONG Sally Cheuk-ying, LI Iris Wai-sum, CHUNG Hon-ping, LO Wai-kei, YUEN Kwok-yung and HO Pak-leung



Chin Med J (Engl). 2012 Oct;125(19):3450-7.

Summary of active surveillance culture for VRE in QMH (1 July 2011 to 13 November 2013)



Cheng VC, et al. J Formos Med Assoc. 2014 Oct;113(10):734-41.

Effectiveness of multifaceted hand hygiene interventions in long-term care facilities in Hong Kong: a cluster-randomized controlled trial (Nov 2009 – July 2010)



TABLE 2. Hand Hygiene (HH) Compliance Rates in 18 Homes Before and After the Intervention

	Control arm (6 homes)		omes)	Intervention arm 1 (6 homes)			Intervention arm 2 (6 homes)		
Phase	Complia	ance ^a	Р	Compli	anceª	Р	Compli	ance ^a	Р
Baseline	326/1,671	(19.5)		325/1,204	(27.0)	.080	313/1,410	(22.2)	.980
1 month after intervention	299/1,508	(19.8)		699/1,181	(59.2)	<.001	763/1,274	(59.9)	<.001
4 months after intervention	301/1,393	(21.6)		662/1,093	(60.6)	<.001	454/935	(48.6)	<.001
Change in % within arm ^b		2.1	.851		33.6	<.001		26.4	<.001

^a Proportion of HH opportunities resulting in compliant action (%).

^b Change in HH compliance rates between baseline and 4 months after intervention within each arm.

Ho ML, Seto WH, Wong LC, Wong TY. Infect Control Hosp Epidemiol. 2012 Aug;33(8):761-7.

Emergence of carbapenem-resistant *Acinetobacter baumannii* in RCHEs with high background rates of MRSA colonization



Cheng VC et al. Submitted & under review

Molecular characteristics of CRAB and MRSA isolated from residents in residential care homes of elderly

	Molecular type (number of strain type)
CRAB isolates ^b	
RCHE number 13	ST1000 (3), ST195 (1), ST575 (1)
RCHE number 22	ST575 (4), ST345 (2), New ST 1 (46-12-110-2-16-103-50) ^d , New ST 2 (1-43-3-1-2-141-3) ^d , New ST 3 (46-12-110-2-2-96-50) ^d , New ST 4 (1-43-3-1-16-141-3) ^d
RCHE number 24	ST575 (3), ST 345 (2), ST456 (1), ST543 (1), New ST 5 (46-12-110-2- 16-2-50) ^d , New ST 6 (46-12-110-2-2-103-50) ^d , New ST 7 (1-43-3-1- 67-141-3) ^d
Predominant strain type of CRAB	ST575 (7)
MRSA isolates ^c	
RCHE number 1	t1081 (6), t4677 (2), t032 (1), t037 (1)
RCHE number 5	t1081 (5), t032 (5)
RCHE number 9	t1081 (8), t032 (1), t824 (1)
Predominant strain type of MRSA ^d	t1081 (19)

Introduction of an electronic monitoring system for monitoring compliance with Moments 1 and 4 of the WHO "My 5 Moments for Hand Hygiene" methodology HH compliance: 88.9% with ICN observation 31.5% without ICN observation !

Vincent CC Cheng^{1,2}, Josepha WM Tai², Sara KY Ho², Jasper FW Chan^{1,2}, Kwan Ngai Hung³, Pak Leung Ho¹ and Kwok Yung Yuen^{1*}

MedSense devices including badges in beacon (left), pump bottle sensor (center), charger (right)



Cheng VC, et al. BMC Infect Dis. 2011 May 26;11:151.

Low education level of nursing home staff in Chinese nursing homes (Cross-sectional study conducted in December 2012 – 58 nursing homes at HKWC)

	Staff of Nonprofit Nursing Homes, n = 554	Staff of For-Profit Nursing Homes, n = 746	P Value
Age, y, mean \pm SD	43.8 ± 10.6	49.8 ± 11.5	<.001
Gender, male, n (%)	11.4 (85)	13.0 (72)	.38
Level of education, n (%)			<.001
Tertiary level*	15.7 (87)	6.4 (48)	
Secondary level*	62.5 (345)	45.0 (345)	
Primary level*	18.1 (100)	40.3 (301)	
No formal education	2.3 (13)	6.0 (45)	
No opinion	1.6 (9)	2.3 (17)	
Staffing ratio, mean \pm SD			
No. of staff per 100 residents	40.3 ± 13.5	21.8 ± 8.8	<.001
Converted to HPRD	2.8 ± 0.9	1.5 ± 0.6	
Tertiary staff ratio, mean \pm SD			
No. of staff with tertiary level	1.3 ± 1.1	1.3 ± 1.1	<.001
per 100 residents			
Converted to HPRD	0.4 ± 0.2 HPRD	$0.09\pm0.07\text{ HPRD}$	

Characteristics of 1300 Respondents

HPRD, hour per resident day.

*Tertiary level: >grade 12; secondary level: grade 7–12; primary level: grade 1–6.

Chant TC, Luk JK, Chu LW, and Chan FH. J Am Med Dir Assoc. 2013 Nov;14(11):849-50.

Prevalence of CRAB and MRSA colonization among residents in residential care homes of elderly by sampling of different body sites

Potential impact of Gastrointestinal colonization of MRSA

Different body sites	Prevalence of CRAB colonization	Prevalence of MRSA colonization
Nasal swab	14/1408 (1.0%) ^a	265/1408 (18.8%) ^b
Axillary swab	34/1408 (2.4%) ^a	129/1408 (9.2%) ^b
Rectal swab	64/1408 (4.5%) ^a	259/1408 (18.4%) ^b
Any combination of 2 sites		
Nasal and/or axillary swabs	46/1408 (3.3%) ^c	336/1408 (23.9%) ^e
Rectal and/or axillary swabs	83/1408 (5.9%) ^{c, d}	315/1408 (22.4%) ^e
Rectal and/or nasal swabs	73/1408 (5.2%) ^{c, d}	418/1408 (29.7%) ^e
All 3 sites	92/1408 (6.5%)	454/1408 (32.2%)

Frequency of environmental contamination with MRSA in isolation room



Boyce JM et al, Infect Control Hosp Epidemiol. 2007 Oct;28(10):1142-7.

Site sampled

Enhanced environmental cleansing





92% of curtain showed contamination

MRSA (21%)

within 1 week:

Am J Infect Control. 2012 Dec;40(10):904-6.



High Touch Areas - BEDSIDE



Drinking bottles



High-touch and mutual-touch surfaces or items in acute wards, Queen Mary Hospital Contact-episodes per hour per a 6-bedded cubicle



14 contact-episodes / h

12 contact-episodes / h

9 contact-episodes / h

1107 person-episodes involving in 6144 contact-episodes in 33 working days



6 contact-episodes / h



4 contact-episodes / h

1 contact-episodes / h

B6

Cheng VC, et al. J Hosp Infect. 2015 Jul;90(3):220-5.

Promotion of hand hygiene from healthcare workers to patients & residents

い清潔雙手做 起

SAVE LIVES Clean Your Hands 



入院七件事,確保你安全 Seven Important Things To Protect Yourself While In Hospital







Cheng VC, et al. Emerging Microbes & Infections (2015) 4, e8.

Compliance of self-initiated patient hand hygiene with respect to different age group (overall compliance ~ 38%)

	Observed	Observed	Observed	Overall P
	Moment 1	Moment 2	Moment 3	value
	(before snacks,	(after use of	(after	
	drinks, prn drugs	bedpan/urinal	attending	
	at the bedside)	at the bedside)	toilet facilities)	
Patient aged				
≤ 34 years	12.2% (6/49)	66.7% (4/6)	90.9% (20/22)	<0.001
35 to 49 years	21.0% (17/81)	33.3% (2/6)	86.4% (19/22)	<0.001
50 to 64 years	34.7% (33/95)	28.6% (4/14)	81.0% (17/21)	<0.001
65 to 79 years	32.7% (36/110)	30.8% (8/26)	95.7% (22/23)	<0.001
≥ 80 years	24.7% (20/81)	5.9% (1/17)	100% (9/9)	<0.001
Overall	26.9% (112 /416)	27.5% (19/69)	89.7% (87/97)	<0.001

Between 14 January and 30 June 2015, a total of 582 conscious patients were observed for 114 working days, with an average of 5 patients per day.

Cheng VC et al. Am J Infect Control. 2016 Jan 14. pii: S0196-6553(15)01217-1.



Nurse gives tablet of 1 gm Augmentin to patient; Patient - no hand hygiene !



Importance of Patients' Hand Hygiene "出入口管制" mouth and 😡 salivary glands 1 VRE 48 – 72 liver hours gallbladderduodenum ascending colon 1 million ileum-**VRE** per cecum gram of appendixstool anus

Patient's fingers & environment full of VRE

Directly observed hand hygiene (DOHH) before taking meals & drugs 進餐吃藥前潔手 超級惡菌難入口



Before drugs

(入口管制)

Before meals

Personal hygiene in toilet 如厠衛生要遵守 預防惡菌莫留手

BEFORE TOILET

Wipe the toilet seat lid with tissue sprayed with disinfectant

AFTER TOILET

Wash hands with soap and water, then rub hands with alcohol handrub

Exit control



283 toilet seat disinfectors:46 ward's toilets





Benchmark of hospital outbreaks in 7 hospital networks in HK (2010-2014)



Total number of outbreak per 1,000,000 patient discharges

→ Total number of outbreak per 1,000,000 patient days

Cheng VC et al. Am J Infect Control. 2015 Jun 6. pii: S0196-6553(15)00469-1.

Control of hospital endemicity of multiple-drug-resistant Acinetobacter baumannii ST457 with directly observed hand hygiene



Prevalence of multiple-drug resistant A. baumannii in HKWC

Cheng VC, et al. Eur J Clin Microbiol Infect Dis. 2015 Apr;34(4):713-8.

The observed incidence and the predicted incidence of VRE based on the segmented Poisson regression before and after the territory-wide implementation of the directly observed hand hygiene-based infection control measures



Cheng VC et al. Submitted & under review

Empower Healthcare Assistants: Hand Hygiene Ambassador to perform DOHH for patients before meal & medications Visit 197 staff in 70 wards in our healthcare network

Queen Mary Hospital

Grantham Hospital

Tung Wah Hospital





Tung Wah Group of Hospitals Fung Yiu King Hospital The Duchess of Kent Children's Hospital

MacLehose Medical Rehabilitation Centre Original Research Article

Implementation of directly observed patient hand hygiene for hospitalized patients by hand hygiene ambassadors in Hong Kong



Compliance of ambassador-initiated directly observed hand hygiene was 97.3% (428/440 episodes), which was significantly higher than patients' self-initiated hand hygiene via a patient education program (37.5%, 218/582 episodes, P < .001)

Cheng VC et al. Am J Infect Control. 2016 Jan 14. pii: S0196-6553(15)01217-1

Patients with gastrointestinal colonization of multiple-drug-resistant Acinetobacter baumannii in Hong Kong West (June - December 2014)



Use of fluoroquinolones: risk factor for the high bacterial load in patients with nasal and gastrointestinal colonization by MRAB

Cheng VC, et al. Eur J Clin Microbiol Infect Dis. 2015 Dec;34(12):2359-66.

While taking antibiotic which is necessary to cure your infection, the antibiotic also kills the normal bacteria in your body and predisposes you to acquire more resistant bacteria.

Therefore, you should enhance personal hygiene by:

- 1. Practise frequent hand hygiene
- 2. Eat or drink only thoroughly cooked or boiled items
- 3. Disinfect and cover all wounds
- 4. Wear mask if you have respiratory infection symptoms
- 5. Young children with symptoms of infection should minimize contact with other children



ANTIBIOTI

Prevalence of fecal samples carrying ESBL-producing *E. coli* in food animals in Hong Kong (2008-2013)



Cheng VC, et al. Emerging Microbes & Infections (2015) 4, e8.

Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study

Yi-Yun Liu*, Yang Wang*, Timothy R Walsh, Ling-Xian Yi, Rong Zhang, James Spencer, Yohei Doi, Guobao Tian, Baolei Dong, Xianhui Huang, Lin-Feng Yu, Danxia Gu, Hongwei Ren, Xiaojie Chen, Luchao Lv, Dandan He, Hongwei Zhou, Zisen Liang, Jian-Hua Liu, Jianzhong Shen



mcr-1 carriage in *E. coli* during 2011-2014:

Raw meat: 78 (15%) of 523 samples

Food animals: 166 (21%) of 804

Infected in-patients: 16 (1%) of 1322 samples

Liu YY, et al. Lancet Infect Dis. 2015 Nov 18. pii: S1473-3099(15)00424-7.

Evolution of antimicrobial resistance

ESBL (1990s)

VRE

(1990s)

Class A: KPC Class D: Oxa

Carbapenemase:

Class B (metallo-b-lactamase): IMP, VIM, NDM

(2000s)

Plasmid-mediated mcr-1 (2015)

Infection control – business of everyone of us !



Collaboration between hospitals, residential care homes of elderly, and community !

Thank you & welcome to Queen Mary Hospital, Hong Kong

