Control of MDROs and Invasive Fungal Infections Among Geriatrics COVID-19 Patients: Lessons Learnt

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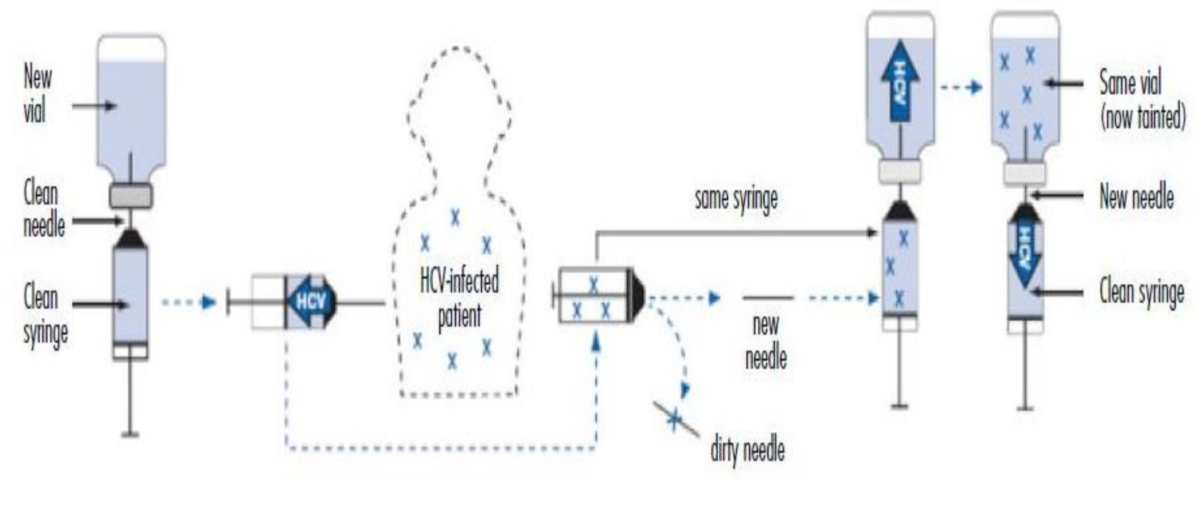
Objectives

- Suboptimal Practices during COVID-19
- Cases of COVID-19 in Geriatric patients
- Solutions to these suboptimal IC practices
- Lessons Learnt

Suboptimal IC Practices

- *Suboptimal = being below optimal level/standard (of care)*

- *Unnecessary = no being needed (in care)*



Journal of Hospital Infection (1998) **40**: 55–59

Unnecessary hospital infection control practices in Thailand: a survey

S. Kunaratanapruk and K. Silpapojakul*

*Office of the Permanent Secretary, Ministry of Public Health, Nonthaburi 11000, Thailand; and *Department of Medicine, Prince of Songkla University, Hat yai, Songkla, Thailand*

Table I *Results of the survey of unnecessary infection control practices*

Unnecessary procedures	References	Hospitals that routinely performed this procedure. Numbers/total (percentage)	Comparison between group having an infection control committee (ICC) versus group without an ICC*	*P*-value
(1) Routine floor disinfection.	Daschner, 1984[3] Danforth, 1987[6]	14/84 (16.7%)	6/57 vs 7/25	0.051
(2) Aerosol disinfection using disinfectant spray.	Bauer *et al*, 1990[9]	22/83† (26.5%)	14/57 vs 7/25	0.47
(3) Fogging isolation and operating rooms with formaldehyde.	Centers for Diseases Control, 1972[11]	57/84 (67.9%)	34/57 vs 21/25	0.02
(4) Installation of ultraviolet light in the operating rooms.	National Research Council, 1964[12]	41/84 (48.8%)	25/57 vs 14/25	0.22
(5) Routine environmental cultures.	Ayliffe. 1991[8]	48/84 (57.1%)	31/57 vs 17/25	0.22
(6) Culture of intravascular line tips.	Maki, 1982[14]	66/83† (79.5%)	46/57 vs 18/25	0.88
(7) Wearing a gown in Intensive Care Units	Donowitz, 1986[15]	48/84 (57.1%)	33/57 vs 14/25	0.66
(8) Setting temperatures >71 °C for washing hospital linen.	Smith *et al*, 1987[17] Blaser *et al*, 1984[18]	25/84 (29.8%)	16/57 vs 8/25	0.46
(9) Use of sterile gloves in non-surgical activities.	Crow, 1988[19]	21/84 (25.0%)	12/57 vs 8/25	0.21

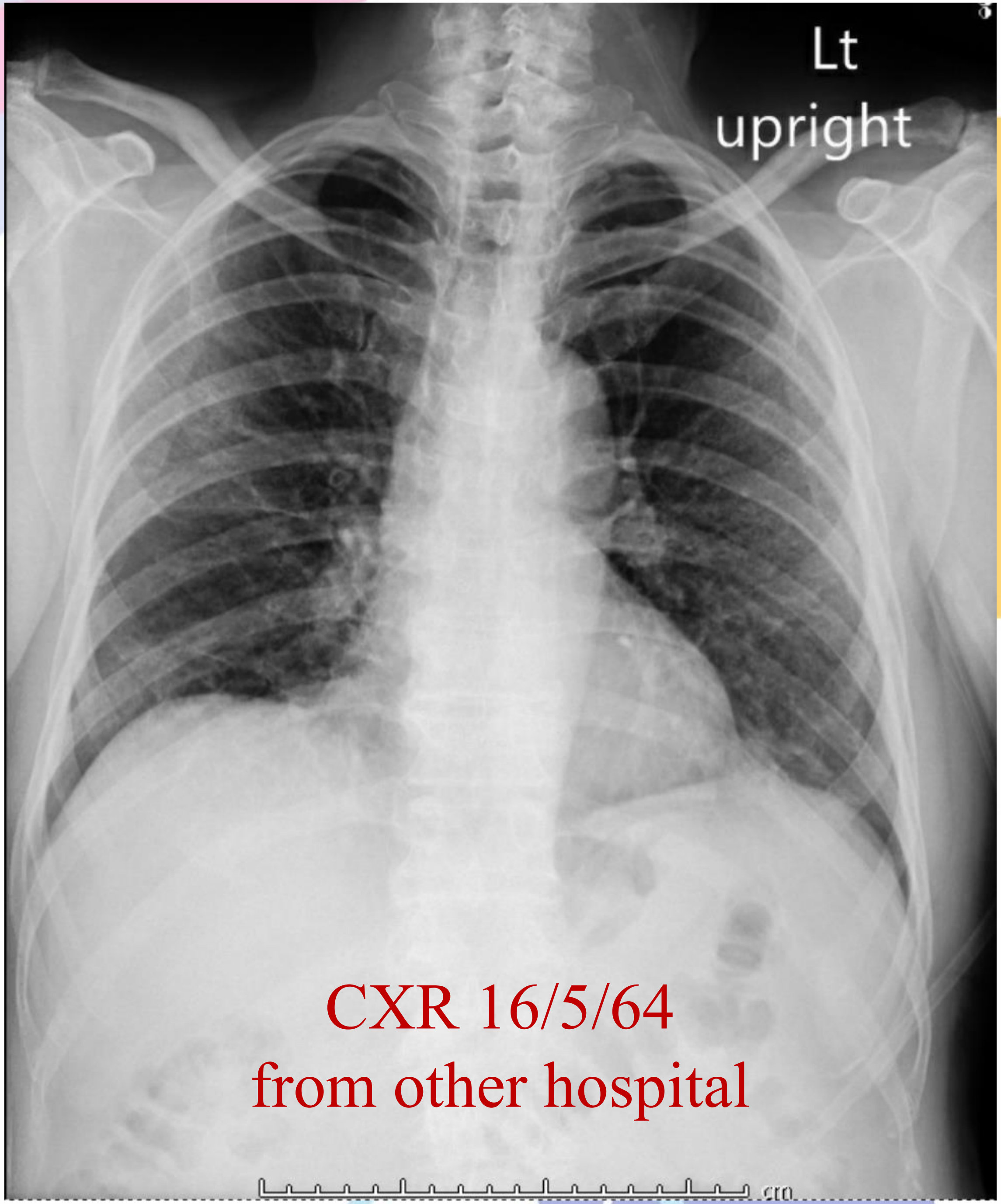
* The presence or absence of an ICC was not reported from two hospitals.
† Data from one hospital was incomplete.

Causes of Suboptimal IC Practices

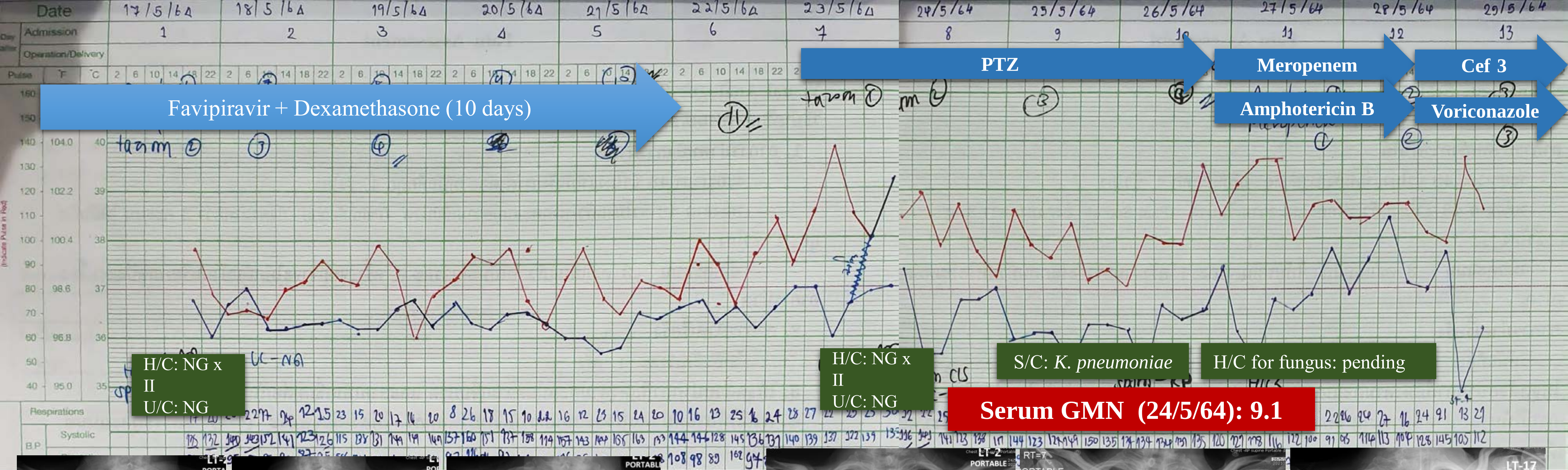
- Environmental
- Inappropriate design of COVID-19 units
- Limitations of laboratory detections for pathogens
- Others (emotions)

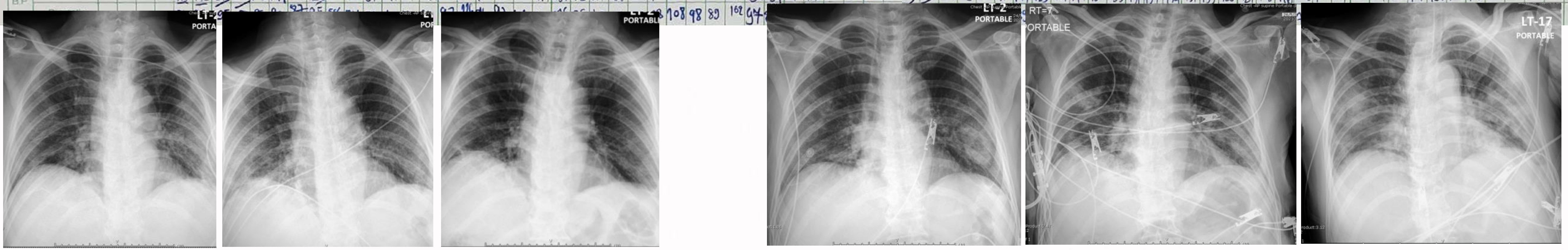
67-yr-old man

- U/D: T2DM, HTN, DLP, gout
- +ve Smoking
- NP Swab PCR for SARS-CoV2 11/5/64: Detected
- O2 Sat 95% RA → 95-97% (cannular 3 LPM)
- Dx: COVID-19 Pneumonia
- Mx: Favipiravir, LPV/r, Dexamethasone (started 12/5/64)
- Refer to TUH 17/5/64



CXR 16/5/64
from other hospital





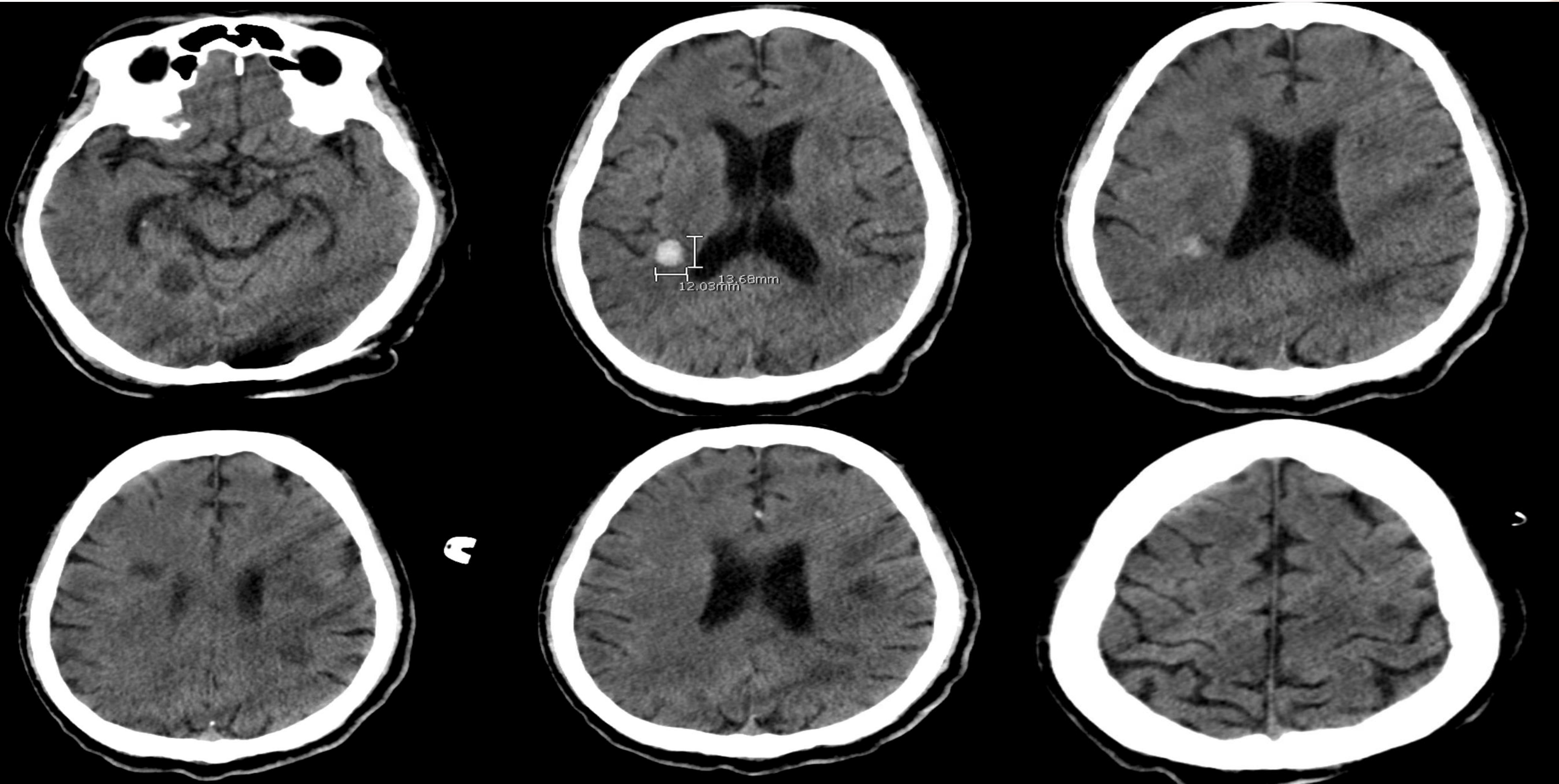
CXR **17/5/64** **18/5/64** **19/5/64** **24/5/64** **26/5/64** **28/5/64**

ETT

28/5/64: Seizure, AOC

CT brain (non-contrast)

CT brain without contrast 28/5/64



Three additional Aspergillosis cases was detected in this unit. What should be the cause?

- A) Contamination of air filtration
- B) Construction nearby
- C) Protocol for steroid use in COVID-19 pneumonia
- D) Do nothings as invasive fungal infections is commonly associated with COVID-19 pneumonia

After Inspections of the Sites

- 3 cases of mold infections occurred in patients with COVID-19
- Constructions with heavy dust was detected in front of the unit
- Unit inspection was performed



What additional steps should you do next?

- A) Air sampling
- B) Check the pressure in the COVID-19 unit
- C) Inspect the construction site to identify possible solutions
- D) All of the above

Review of Fungal Outbreaks and Infection Prevention in Healthcare Settings During Construction and Renovation

HEALTHCARE EPIDEMIOLOGY

Robert A. Weinstein, Section Editor

Hajime Kanamori,[1,2] William A. Rutala,[1,2] Emily E. Sickbert-Bennett,[1,2] and David J. Weber[1,2]

[1]Hospital Epidemiology, University of North Carolina Health Care, and [2]Division of Infectious Diseases, University of North Carolina School of Medicine, Chapel Hill

Table 2. Fungal Infections and Associated Mortality by Each Underlying Disease During Construction, Renovation, or Demolition

Underlying Diseases	No. of Articles Published	No. of Patients Infected	No. of Patients Died	Mortality, No.[a] (%)
Hematologic malignancies or bone marrow transplant	26	414	148	131/288 (45.5)
Other malignancies, transplant, and/or immunosuppressed patients	13	105	38	38/60 (63.3)
Patients in intensive care unit	3	8	2	2/4 (50)
Rheumatology patients	2	6	4	4/6 (66.7)
After surgery	2	8	1	1/8 (12.5)
Premature infant	2	3	2	2/3 (66.7)
Nephrology and dialysis patients	1	3	2	2/3 (66.7)
Total	49	547	197	180/372 (48.4)

CID 2015:61 (1 August) • HEALTHCARE EPIDEMIOLOGY

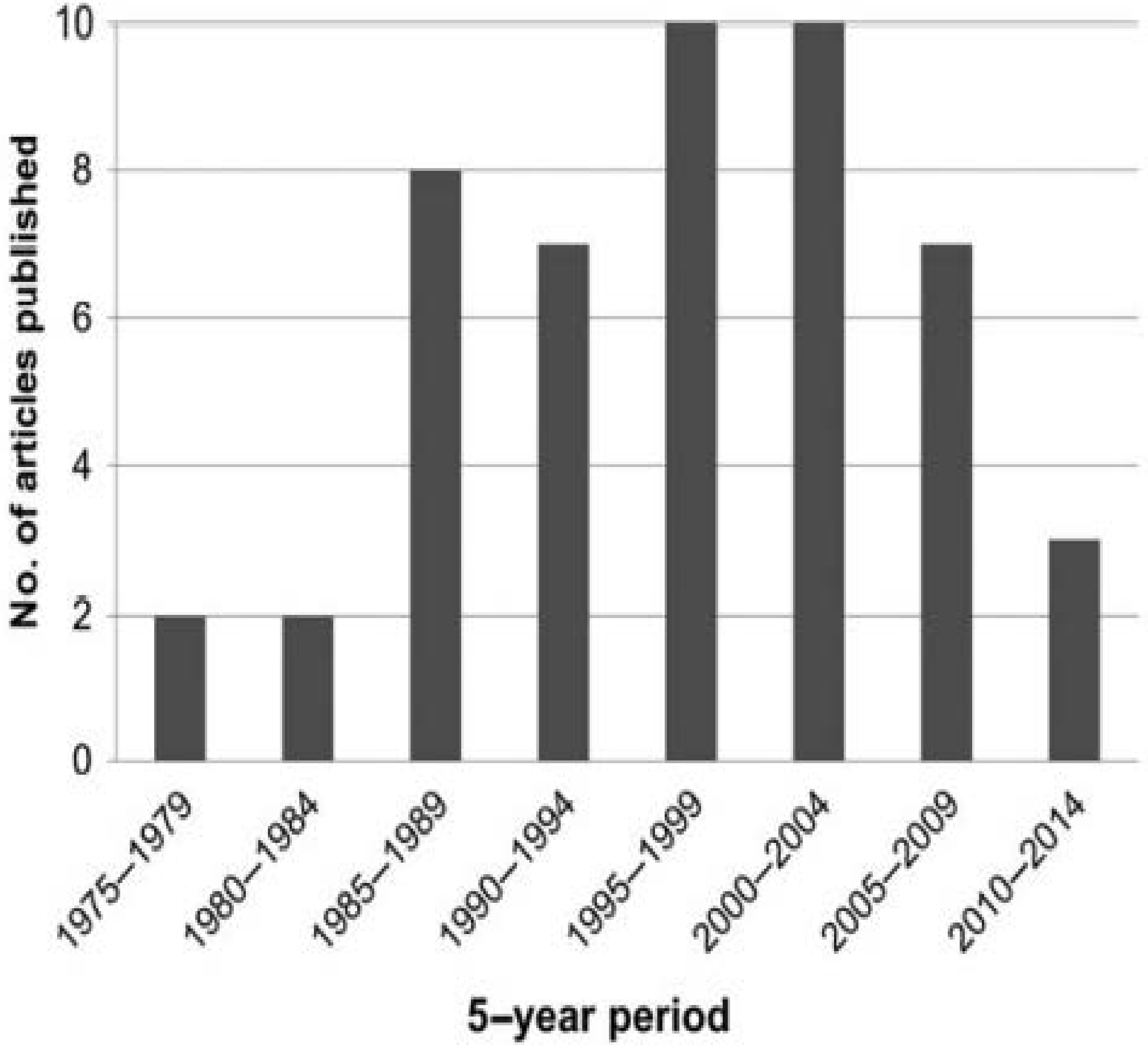


Figure 1. Trend of fungal outbreaks and infections associated with construction, renovation, and demolition.

Table 3. Bundle of Key Methods for Preventing Filamentous Fungal Infections Associated With Renovation/Construction Activities

1. Hospital epidemiology (infection control) should be notified by plant engineering prior to any renovation/construction activities in the healthcare facility.
2. Conduct an ICRA for all renovation/construction activities: implement recommended prevention strategies as guided by the ICRA.
3. Focus prevention efforts on control of airborne dissemination of fungal spores (eg, barriers, containment, air handling, portable HEPA filters).
4. Consider impact of renovation/construction on the involved hospital unit plus adjacent units on the same floor, and hospital units on floors above and below the renovation/construction activities.
5. Maintain surveillance for healthcare-associated filamentous fungal infections during renovation/construction. Investigate any cases to see if they are related to renovation/construction and determine if prevention efforts need to be revised.
6. Visit renovation/construction sites regularly to assure compliance with recommended prevention activities.

Source: Adapted from the Centers for Disease Control and Prevention. Guidelines for Environmental Infection Control in Health-Care Facilities. Available at: http://www.cdc.gov/hicpac/pdf/guidelines/eic_in_HCF_03.pdf. Accessed 2 January 2015.

Infection Control Risk Assessment

Step 1: Using the following table, identify the Type of construction Project Activity (A-D)

Type A	**Inspection and Non-Invasive Activities** Includes, but is not limited to: • Removal of ceiling tiles for visual inspection limited to 1 tile per 50 square feet • Painting (but not sanding) • Wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection
Type B	**Small scale, short duration activities which create minimal dust** Includes, but is not limited to: • Installation of telephone and computer cabling • Access to chase spaces • Cutting of walls or ceiling where dust migration can be controlled
Type C	**Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies** Includes, but is not limited to: • Sanding of walls for painting or wall covering • Removal of floorcoverings, ceiling tiles and casework • New wall construction • Minor duct work or electrical work above ceilings • Major cabling activities • Any activity which cannot be completed within a single work shift
Type D	**Major demolition and construction projects** Includes, but is not limited to: • Activities which require consecutive work shifts • Requires heavy demolition or removal of a complete cabling system • New construction

Step 2: Using the following table, identify the Patient Risk Groups that will be affected. If more than one risk group will be affected, select the higher risk group.

Low Risk	Medium Risk	High Risk	Highest Risk
• Office	• Cardiology • Echocardiography • Endoscopy • Nuclear Medicine • Physical Therapy • Radiology/MRI • Respiratory Therapy	• CCU • Emergency Room • Labor & Delivery • Laboratories (specimen) • Newborn Nursery • Outpatient Surgery • Pediatrics • Pharmacy • Post Anesthesia Care Unit • Surgical Units	• Any area caring for immunocompromised patients • Burn Unit • Cardiac Cath Lab • Central Sterile Supply • Intensive Care Units • Medical Unit • Negative pressure isolation rooms • Oncology • Operating rooms including C-section rooms

Step 3: Match the;

1. **Patient Risk Group** (low, medium, high, highest) with the planned…
2. **Construction Project Type** (A, B, C, D) on the following IC Matrix to find the…
3. **Class of Precautions** (I, II, III, IV) or level of infection control activities required.
   (Class I-IV Precautions are delineated on the following page)

IC Matrix: Class of Precautions for Construction Projects by Patient Risk

Patient Risk Group	Type A	Type B	Type C	Type D
Low Risk (Group 1)	I	II	II	III/IV
Medium Risk (Group 2)	I	II	III	IV
High Risk (Group 3)	I	II	III/IV	IV
Highest Risk (Group 4)	II	III/IV	III/IV	IV


ANTEROOM 1/2
MAGNEHELIC
ICU 1
MAGNEHELIC
安装时请勿用力按压液晶屏
Please do not press LCD hard during installing
Johnson Controls
WINDCHILL
Windchill Limited
Tel: +66(0)2885 2995
Email: sales@windchill.co.th

Measurement of air samplings

- Measurement at 3 sites (outside, nursing unit, patient room)
- Active versus passive measurements
- No real standard cut-point
- Need to compare with the same unit over a period of time

Air sampling (8 มิถุนายน 2564) วาง Plate

No.	หน่วยงาน	ตำแหน่ง	(วาง plate)			
			number of colony fungus (day5)	CFU/m[3]	number of colony bacteria (day5)	CFU/m[3]
1	งานการพยาบาลผู้ป่วยวิกฤตไฟไหม้น้ำร้อนลวก (Burn Unit)	หน้า Ward	3	290	42	1260
2		ใน Ward	2	263	7	210
3		เตียง 4	1	235	0	0

เกณฑ์มาตรฐาน		เกณฑ์มาตรฐานกรณี OR	
ค่า จำนวนเชื้อแบคทีเรีย	$\leq$ 500 CFU/m3	ค่า จำนวนเชื้อแบคทีเรีย	$\leq$ 140 CFU/m3
จำนวนเชื้อรา	$\leq$ 500 CFU/m3	จำนวนเชื้อรา	$\leq$ 0.1 CFU/m3

Air Quality of a Hospital after Closure for Black-Water Flood: An Occupational-Health Concern?

levels greater than 500 CFU/m³. Indoor air quality measurements were different for open- and closed-ventilation patient care areas (Table 1). Bacterial and fungal bioburden levels greater than 500 CFU/m³ were detected only on units with excess humidity (100% [23/23] vs 0% [0/45]; $P < .001$). All

TABLE 1. Air Quality Characteristics Assessed after Reopening 68 Patient Care Areas of 18 Hospital Units That Were Closed after Excess Black-Water Flooding in Central Thailand

Air quality characteristics	All rooms ($N = 68$)	Open-ventilation patient care areas[a] ($N = 39$)	Closed-ventilation patient care areas[b] ($N = 29$)	P value
Median relative humidity, % (range)	60.9 (56.9–72.4)	60.3 (57.3–72.4)	61.6 (56.9–71.9)	.24
Median temperature, °C (range)	26.6 (20.0–28.6)	27.6 (25.5–28.6)	25.9 (20.0–28.2)	**.001**
Median carbon dioxide, ppm (range)	537.5 (492.0–707.0)	524.0 (504.0–594.0)	554.0 (492.0–707.0)	.09
Median bacterial bioburden, CFU/m³ (range)[c]	654 (120–8,360)	880 (140–8,360)	475 (120–1,980)	**.04**
Median fungal bioburden, CFU/m³ (range)[c]	590 (160–4,400)	775 (200–4,400)	430 (160–2,680)	**.05**

Short report

Post-flood measurement of fungal bio-aerosol in a resource-limited hospital: can the settle plate method be used?

T. Khawcharoenporn [a], A. Apisarnthanarak [a,*], K. Thongphubeth [b], C. Yuekyen [b], S. Damnin [c], M.K. Hayden [d], R.A. Weinstein [d,e]

Table I
Characteristics of the 38 examined hospital units[a]

Characteristics	All units ($N = 38$)	Open-ventilation units ($N = 16$)	Closed-ventilation units ($N = 22$)	P [b]
Air quality				
Relative humidity (%, median, range)	60.9 (56.9–72.4)	60.3 (57.3–72.4)	61.6 (56.9–71.9)	0.25
Temperature (°C, median, range)	26.6 (20.0–28.6)	27.6 (25.5–28.6)	25.9 (20.0–28.2)	0.001
Unit activity				
Presence of a patient in room at time of air sampling (no., %)	25 (66)	12 (75)	13 (59)	0.49
Patient load (patient-days, median, range)	7.0 (0–376.0)	52.0 (0–376.0)	4.0 (0–239.0)	0.04
Nurse:patient ratio[c] (median, range)	0.7 (0.3–5.0)	0.5 (0.2–0.8)	0.8 (0.3–5.0)	0.005
Fungal bio-aerosol counts (cfu/m³, median, range), by:				
MAS, day 3	440 (0–2820)	475 (100–2820)	415 (0–1980)	0.20
MAS, day 5	455 (0–3030)	480 (140–3030)	430 (0–1980)	0.21
SPM, day 3	195 (0–2700)	270 (60–2700)	90 (0–840)	0.008
SPM, day 5	255 (0–2760)	420 (90–2760)	180 (0–900)	0.007

Lessons Learnt

- Always identify source of invasive fungal infections in COVID-19 patients.

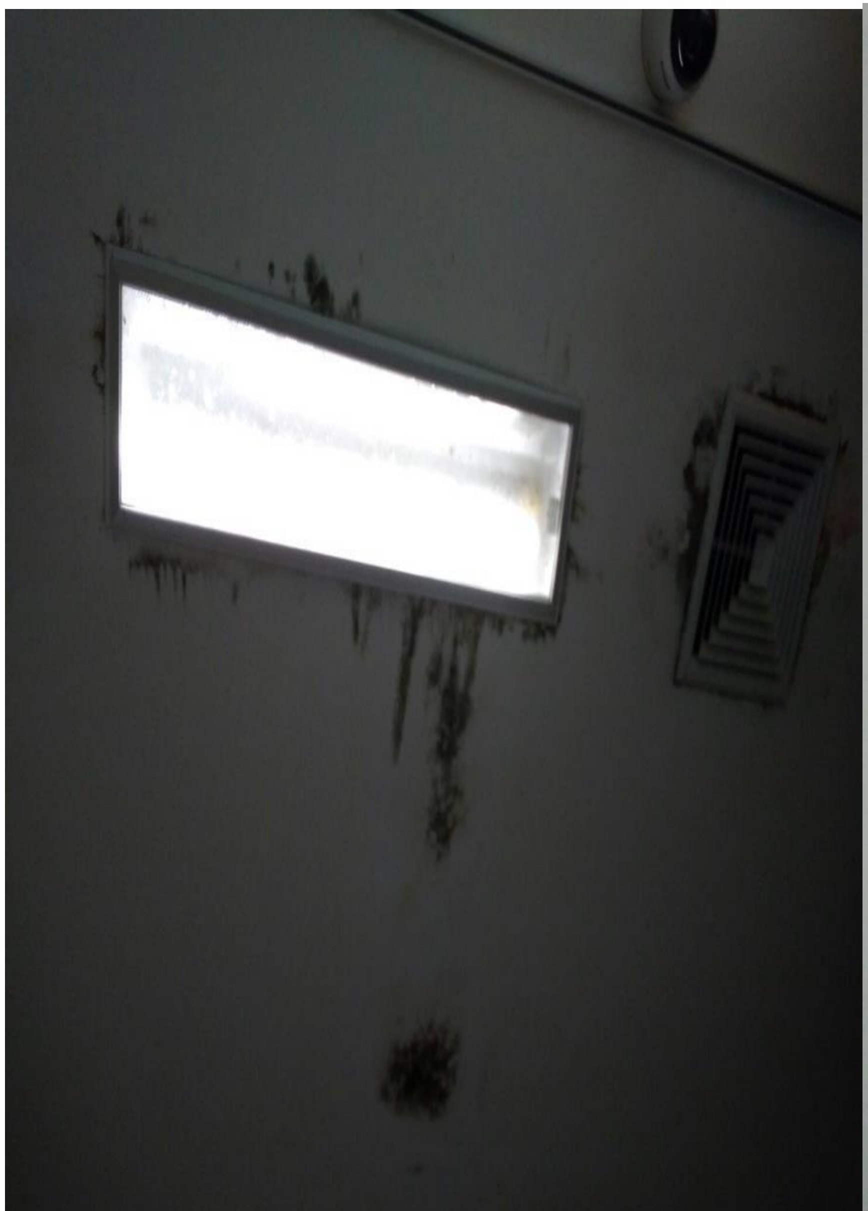
- Constructions was a clear link to some IFI incident and outbreak.

- Appropriate IC practices during construction is often ignored, but is the most important fundamental to prevent patient from IFI.

**Invasive fungal infection reduced from this unit, but 10 cases of IFIs occurred in another COVID-19 units over 3-months period.
No construction exist in that units. What should be next investigation step?**

- A) Inspection of the air ventilation system
- B) Air sampling for fungal in that unit
- C) Perform environmental sampling for possible fungal contamination in that unit and laboratory unit
- D) Reduce steroid doses in COVID-19 pneumonia
- E) A & B

Inspections of the index unit



Inspections at the Sites

What should be appropriate interventions?

- A) Stop using the units and re-engineer the whole unit
- B) Do fumigation and environmental cleaning and re-open
- C) Changing the air ventilation system and re-open for COVID-19 pneumonia
- D) B & C

Units closed, extensive environmental cleaning, fumigation with Hydrogen peroxide, changing in air ventilation system and plan not to use for patient care, if patients need to stay more than 3 days.

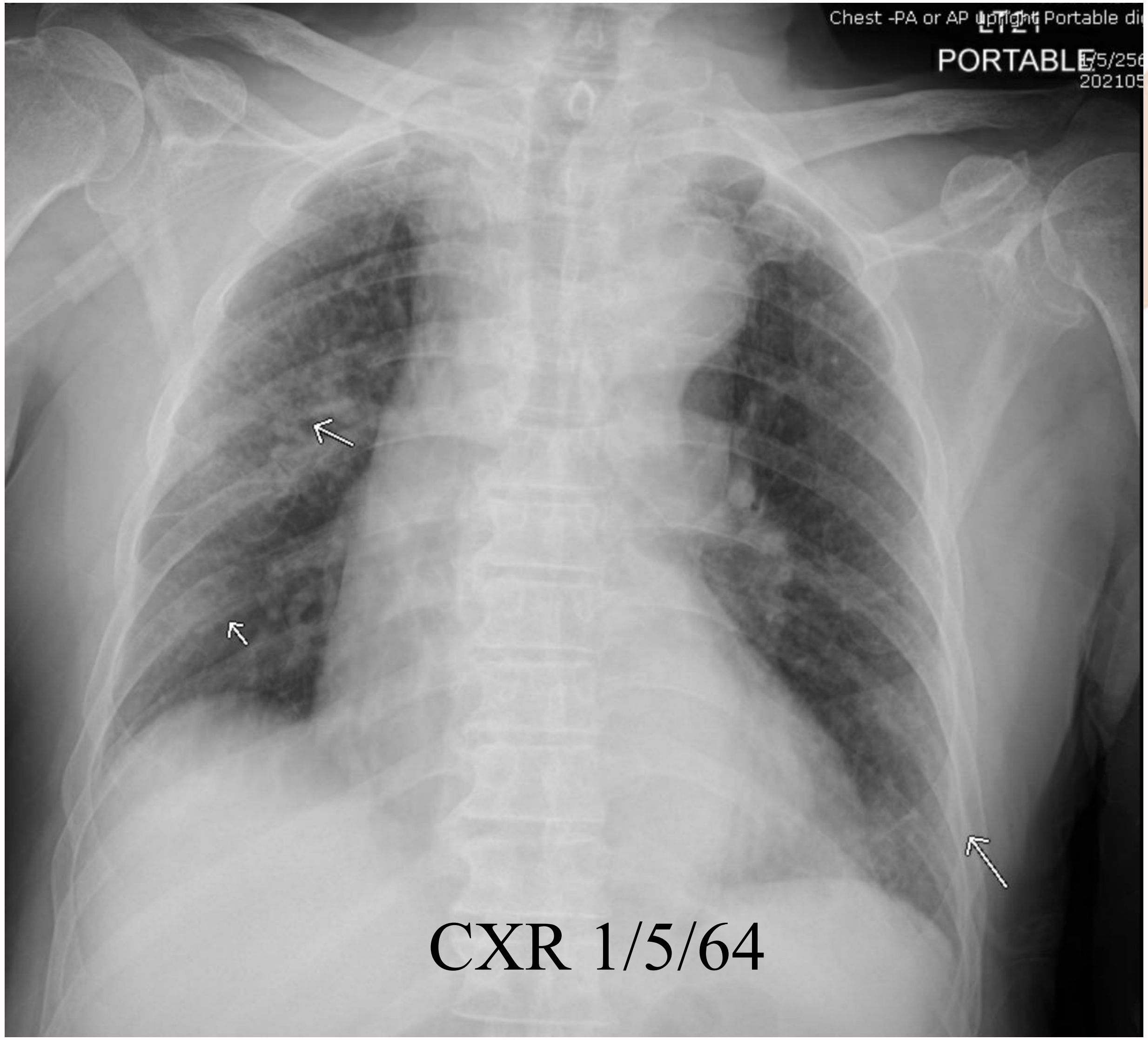


Lessons Learnt

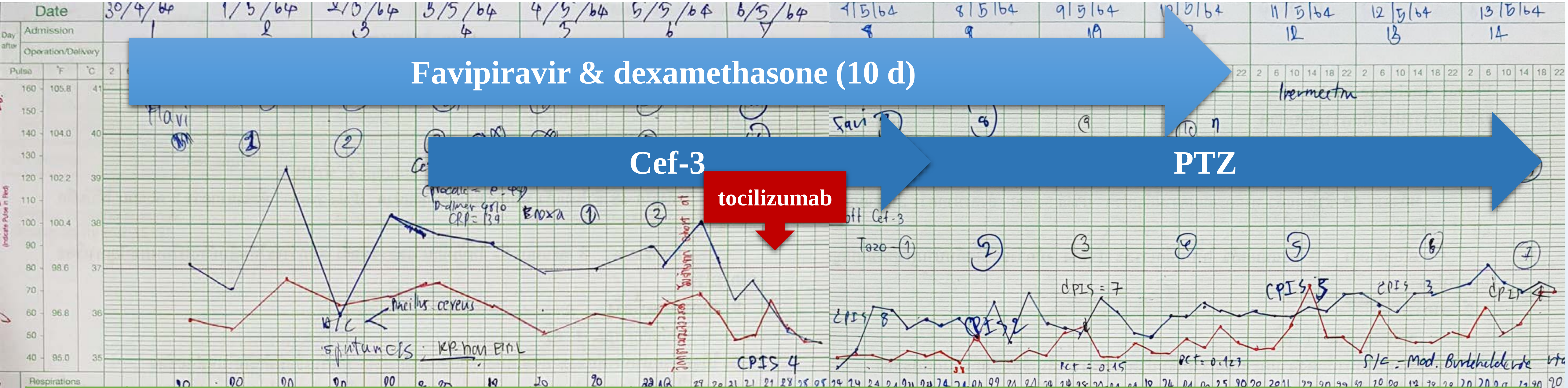
- COVID-19 unit is often designed sub optimally due to the emergency of outbreak and the need to care for large amounts of patients.
- Appropriate unit design is very important during COVID-19 outbreak.
- Decision to not use suboptimally designed unit will prevent patients from unsafe situations

89-yr-old man

- U/D: HTN, CKD, BPH
- NP Swab PCR For SARS-CoV2 (28/4/64): Detected
- Admit to TUH cohort ICUs
- Dx: COVID-19 Pneumonia
- Start on favipiravir, dexamethasone
- HFNC → ETT 6/5/64



CXR 1/5/64



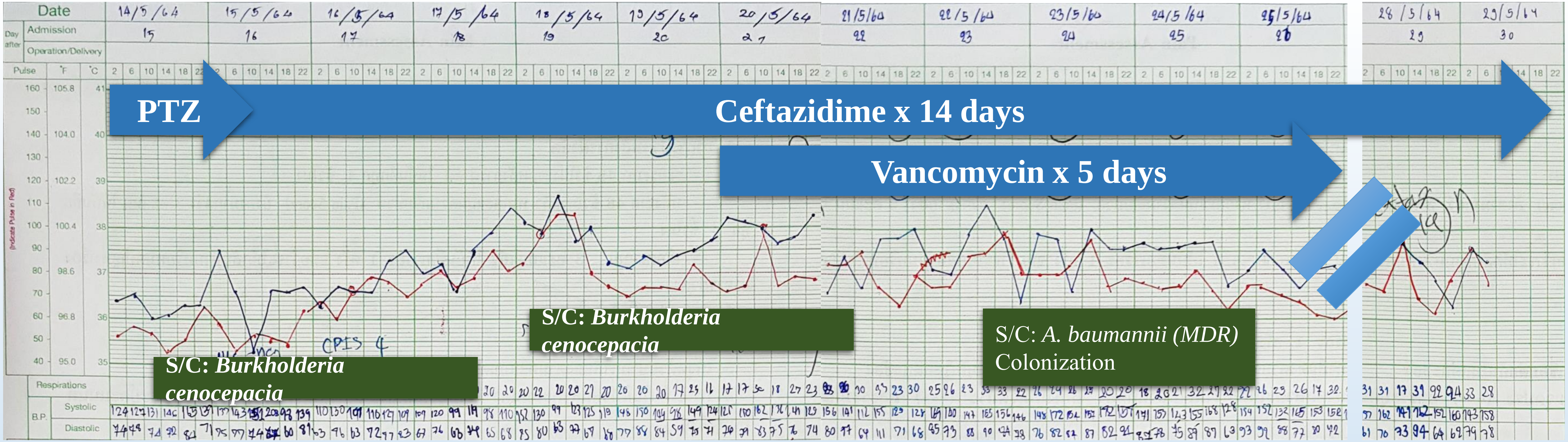
CRP														
CRP					139		121.39		32.02	13.94	7.08			1.53

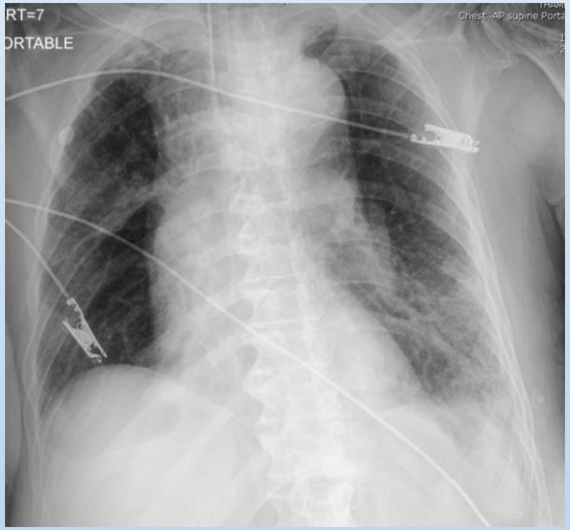
Enoxaparin (prophylaxis)

Enoxaparin (treatment)

Suspected acute PE

Desaturation (O2 sat 88%) despite Improvement of infiltration on CXR





Off ETT

Cellulitis of Rt forearm

***B. cenocepacia* VAP**

7 additional cases of MDR-Acinetobacter (16.9 cases/1000 patient-days) were detected in the same unit. What should be the cause?

- A) Cohort ICUs
- B) Unable to change PPE when seeing COVID-19 cases
- C) Environmental contaminations
- D) Inappropriate antibiotic use
- E) All of the above

What interventions should you implement?

- A) Assign specific nurse to care for MDR-A. baumannii cases
- B) Put extra sheet cover and change between care, changing glove between cases
- C) Daily environmental cleaning in the cohort section with quaternary ammonium compound
- D) Feedback compliance to HCP dialy
- E) All of the above

Initial interventions

- Assign specific nurse to care for MDR-A. baumannii cases. 100% mortality was detected (35 cases).
- Put extra sheet cover and change between care, changing glove between cases
- Daily environmental cleaning in the cohort section with quaternary ammonium compound
- Feedback compliance to HCP daily

Despite intervention, MDR-A. baumannii rate did not decline. 5 additional cases of MDR-A baumannii cases were detected in cohort unit. What should be done next?

A) Close the unit

B) Do fumigation with hydrogen peroxide, then open to accept COVID-19 patients

C) Come up with policy to discharge isolation from COVID-19 cohort ICUs

D) B and C

Additional interventions: Lessons Learnt

- Nosocomial Infections from *Acinetobacter baumannii* can be difficult to prevent
- It need special approach, since PPE cannot be changed between cases
- These strategies include: *Separate at-risk patients who developed MDR-pathogens in separate isolation room (if cohort unit is designed), Assign specific nurse to care for these patients, Change PPE prior to entry the room, Do environmental cleaning using hydrogen peroxide vapour, and come up with Discontinuation of isolation policy to move to standard ICUs (usually patient get better, quicker care). Incidence drop to 3/1000 patient-days.*

Apisarnthanarak A, et al. Strategy to limit MDR-A baumannii transmission in cohort COVID-19 ICUs. ICHE 2021

Cases increased again couple with increase in IFI cases. Unit was then closed and changed to new unit that leads to significant reduction in *MDR-A baumannii* cases. Mortality is also significant reduced from 35 cases (100%) to 2 cases (4%) after changing unit.

Lessons learnt: suboptimal unit design do compromise patient safety

Things to consider when you design new cohort unit

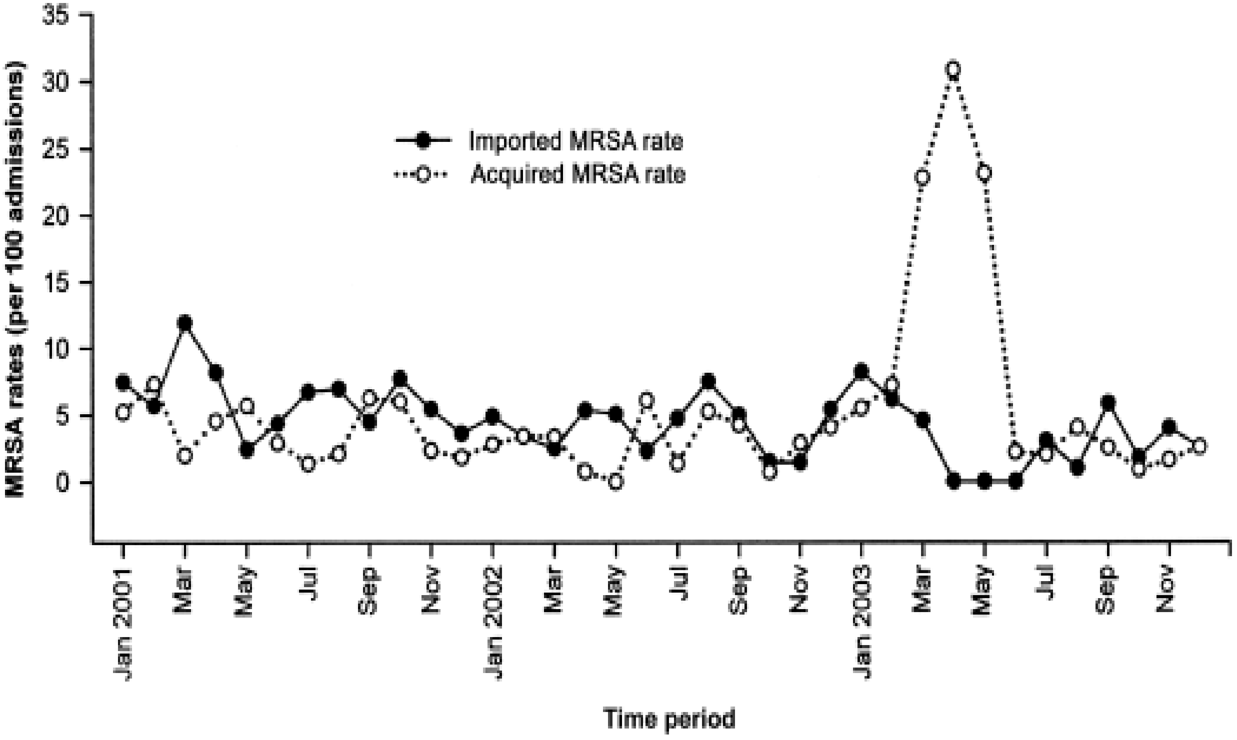
- Need to identify appropriate patient movement pathway (location, elevator for patients, PPE policy when transfer patient to general unit, mechanisms to send the specimen between zones and space for anti-room and nursing station). Policy to change PPE between cases will be important to reduce MDROs cross transmission.

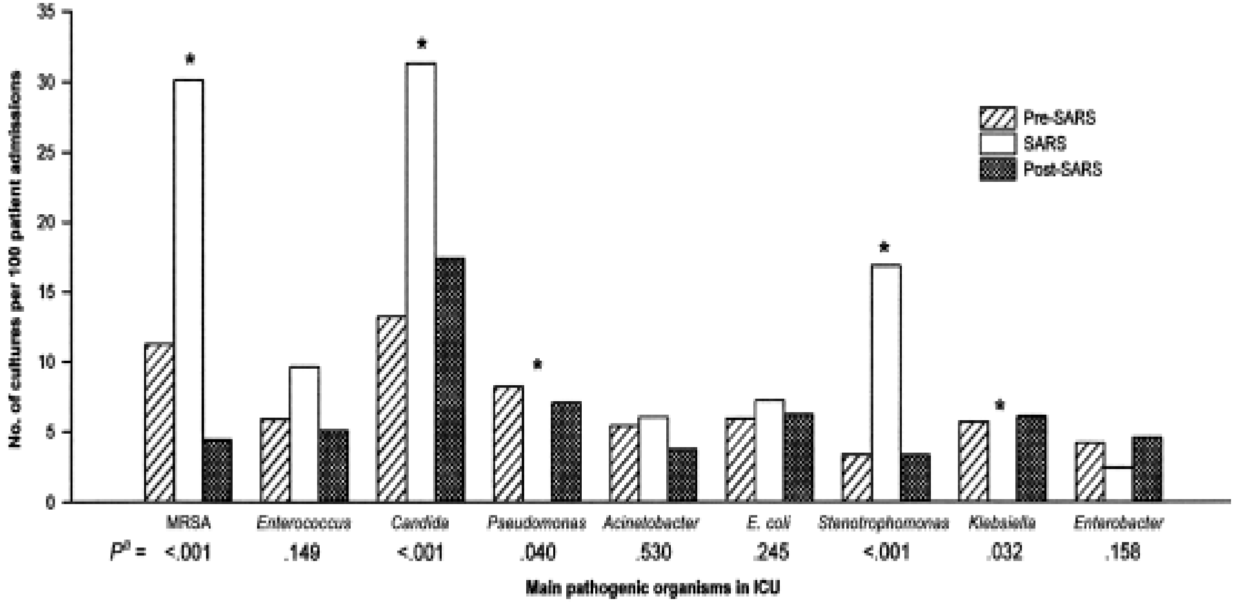
Increase in Methicillin-Resistant *Staphylococcus aureus* Acquisition Rate and Change in Pathogen Pattern Associated with an Outbreak of Severe Acute Respiratory Syndrome

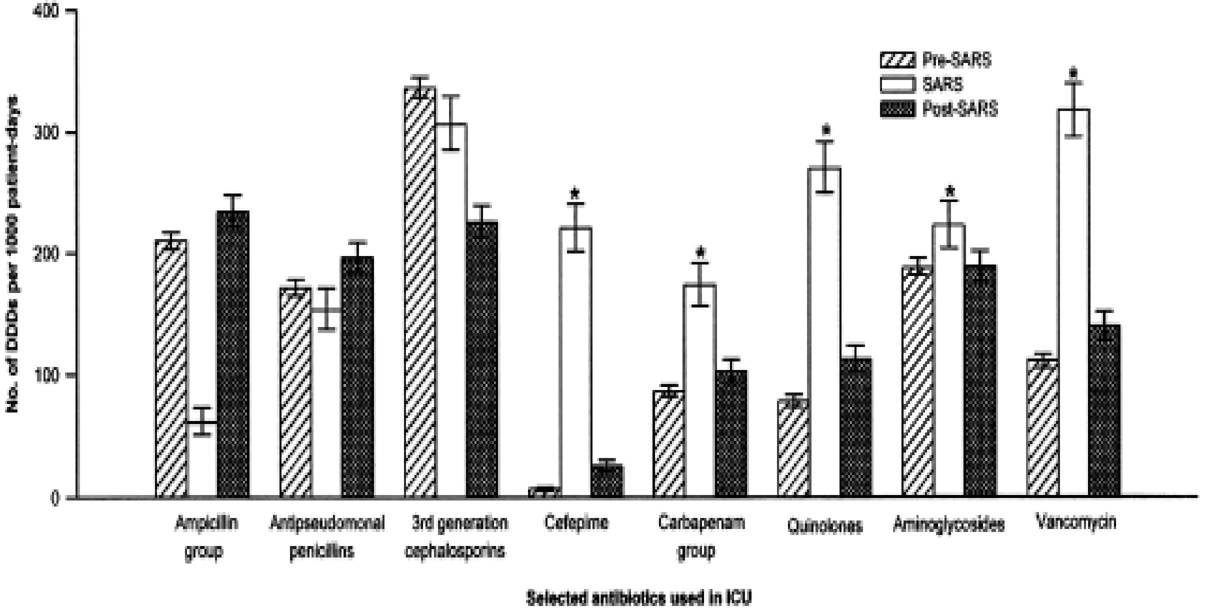
Florence H. Y. Yap,[1] Charles D. Gomersall,[1] Kitty S. C. Fung,[2] Pak-Leung Ho,[3] Oi-Man Ho,[1] Phillip K. N. Lam,[1] Doris T. C. Lam,[1] Donald J. Lyon,[2] and Gavin M. Joynt[1]

Results. During the SARS period in the ICU, there was an increase in the rate of isolation of MRSA and *Stenotrophomonas* and *Candida* species but a disappearance of *Pseudomonas* and *Klebsiella* species. The MRSA acquisition rate was also increased: it was 3.53% (3.53 cases per 100 admissions) during the pre-SARS period, 25.30% during the SARS period, and 2.21% during the post-SARS period ($P < .001$). The VAP rate was high, at 36.5 episodes per 1000 ventilator-days, and 47% of episodes were caused by MRSA.

Conclusions. A SARS outbreak in the ICU led to changes in the pathogen pattern and the MRSA acquisition rate. The data suggest that MRSA cross-transmission may be increased if gloves and gowns are worn all the time.





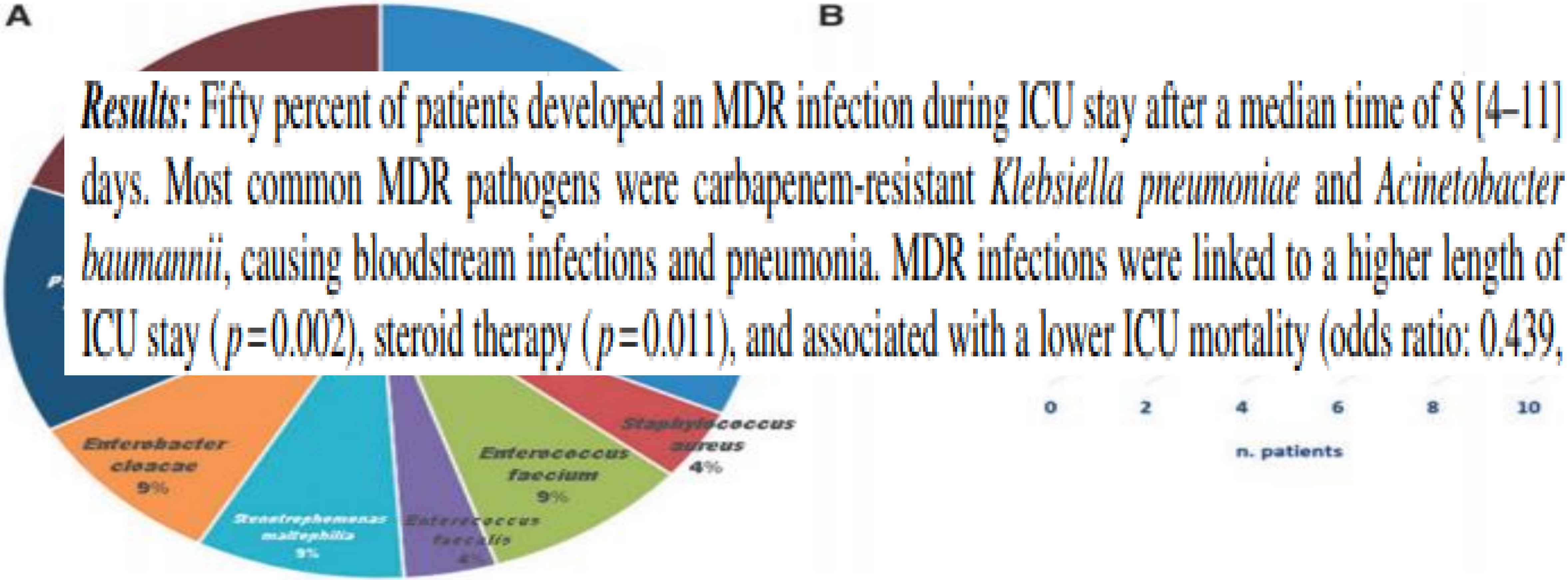


MICROBIAL DRUG RESISTANCE
Volume 00, Number 00, 2021

DOI: 10.1089/mdr.2020.0489

Multidrug-Resistant Infections and Outcome of Critically Ill Patients with Coronavirus Disease 2019: A Single Center Experience

Arta Karruli,[1] Filomena Boccia,[1] Massimo Gagliardi,[1] Fabian Patauner,[1] Maria Paola Ursi,[1] Pino Sommese,[1] Rosanna De Rosa,[2] Patrizia Murino,[2] Giuseppe Ruocco,[3] Antonio Corcione,[2] Roberto Andini,[4] Rosa Zampino,[4,5] and Emanuele Durante-Mangoni[1,4]



Results: Fifty percent of patients developed an MDR infection during ICU stay after a median time of 8 [4–11] days. Most common MDR pathogens were carbapenem-resistant *Klebsiella pneumoniae* and *Acinetobacter baumannii*, causing bloodstream infections and pneumonia. MDR infections were linked to a higher length of ICU stay (p = 0.002), steroid therapy (p = 0.011), and associated with a lower ICU mortality (odds ratio: 0.439,

Major Article

Unintended consequences of infection prevention and control measures during COVID-19 pandemic

Liang En Ian Wee MPH [a,b,*], Edwin Philip Conceicao BSc [c], Jing Yuan Tan MBBS [d], Kamini Devi Magesparan BSc [c], Ismawati Binte Mohamad Amin BSc [c], Bushra Binte Shaik Ismail BSc [c], Hui Xian Toh BSc [c], Pinhong Jin BSc [c], Jing Zhang BSc [e], Elaine Geok Ling Wee MSc [c], Sheena Jin Min Ong BSc [c], Gillian Li Xin Lee BSc [c], Amanda En-min Wang BSc [e], Molly Kue Bien How MPH [c], Kwee Yuen Tan MSc [c], Lai Chee Lee MPH [c], Poh Choo Phoon BSc [e], Yong Yang PhD [c], May Kyawt Aung MPH [c], Xiang Ying Jean Sim MRCP [b,c], Indumathi Venkatachalam FRACP [b,c], Moi Lin Ling FRCPA [c,**]

Results: Enhanced IPC measures introduced to contain COVID-19 had the unintended positive consequence of containing HA-RVI. The cumulative incidence of HA-RVI decreased from 9.69 cases per 10,000 patient-days to 0.83 cases per 10,000 patient-days (incidence-rate-ratio = 0.08; 95% confidence interval [CI] = 0.05-0.13, $P < .05$). Hospital-wide MRSA acquisition rates declined significantly during the pandemic (incidence-rate-ratio = 0.54, 95% CI = 0.46-0.64, $P < .05$), together with central-line-associated-bloodstream infection rates (incidence-rate-ratio = 0.24, 95% CI = 0.07-0.57, $P < .05$); likely due to increased compliance with Standard Precautions. Despite the disruption caused by the pandemic, there was no increase in CP-CRE acquisition, and rates of other HAIs remained stable.

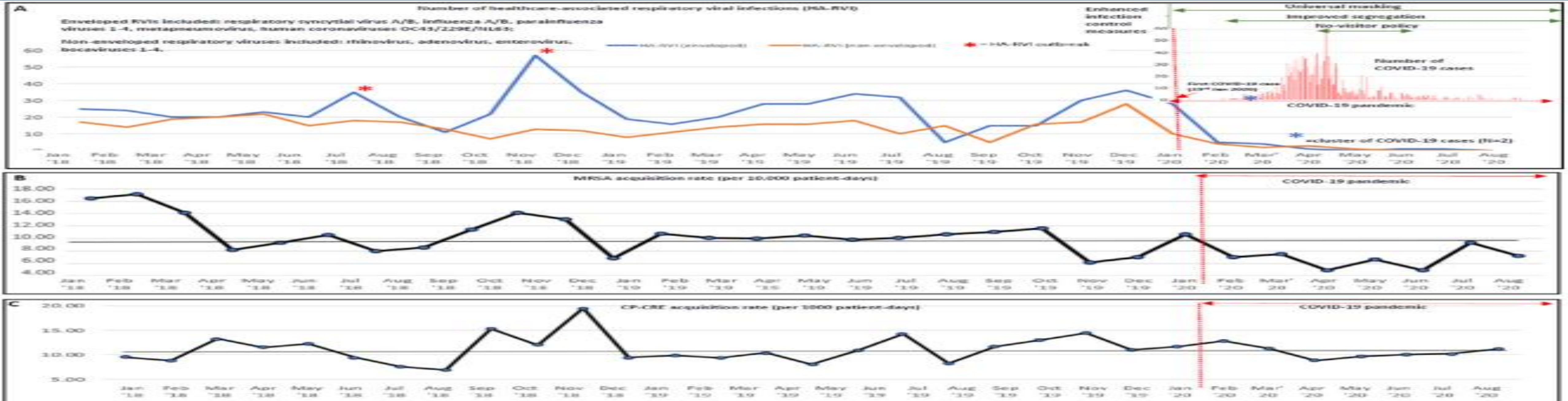
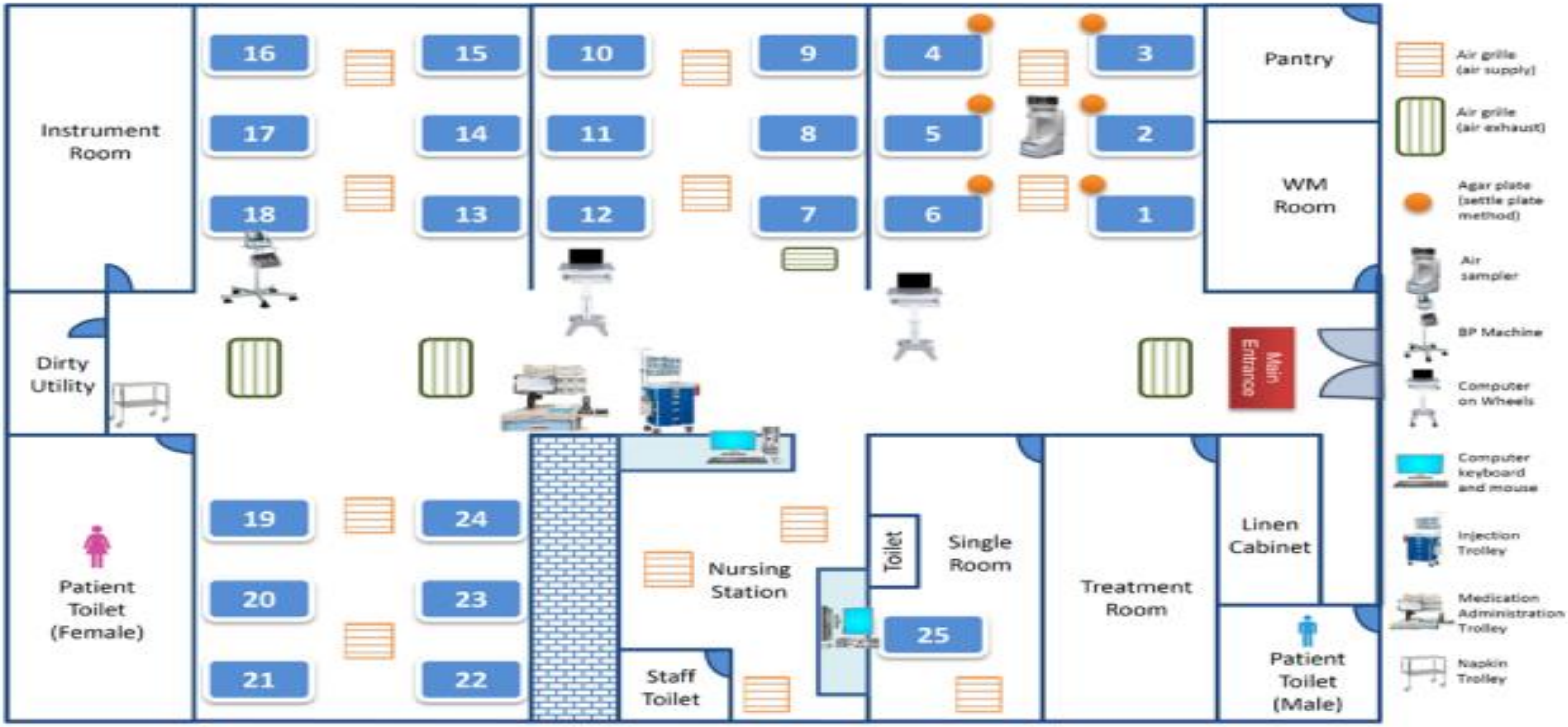


Figure 1

The proportion of MRAB-contaminated commonly shared items was significantly lower in cohort than in non-cohort patient care (0/10,0% vs 12/18,66.7%;p<0.001). Air dispersal of MRAB was consistently detected during but not before diaper change in the cohort cubicle by 25-minute air sampling (4/4,100% vs 0/4,0%;p=0.029). Settle plate



Air dispersal of multidrug-resistant *Acinetobacter baumannii*: implication in nosocomial transmission during COVID-19 pandemic

J Hosp Infect (in press)

Shuk-Ching Wong,[1] Germaine Kit-Ming Lam,[1] Jonathan Hon-Kwan Chen,[2] Xin Li,[2] Fanny Tung-Fun Ip,[3] Lithia Lai-Ha Yuen,[1] Veronica Wing-Man Chan,[1] Christine Ho-Yan AuYeung,[1] Simon Yung-Chun So,[2] Pak-Leung Ho,[4] Kwok-Yung Yuen,[4] Vincent Chi-Chung Cheng[1,2]

(5/9,55.6% vs 0/18,0%;p=0.002). The proportion of MRAB-contaminated non-reachable high-level surfaces was also significantly higher when there were ≥3 MRAB patients in the cohort cubicle (8/31,25.8% vs 0/24,0%;p=0.016). WGS revealed clonality of air, environment, and patients' isolates, suggestive of air dispersal of MRAB. Our findings support the view that that patient cohorting in enclosed cubicles with partition and closed door is preferred if single room is not available.

Clinical Infectious Diseases

REVIEW ARTICLE

Infectious Diseases Society of America · hiv medicine association · OXFORD

Duration of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infectivity: When Is It Safe to Discontinue Isolation?

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Defining the duration of infectivity of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has major implications for public health and infection control practice in healthcare facilities. Early in the pandemic, most hospitals required 2 negative RT-PCR tests before discontinuing isolation in patients with Covid-19. Many patients, however, have persistently positive RT-PCR tests for weeks to months following clinical recovery, and multiple studies now indicate that these generally do not reflect replication-competent virus. SARS-CoV-2 appears to be most contagious around the time of symptom onset, and infectivity rapidly decreases thereafter to near-zero after about 10 days in mild-moderately ill patients and 15 days in severely-critically ill and immunocompromised patients. The longest interval associated with replication-competent virus thus far is 20 days from symptom onset. This review summarizes evidence-to-date on the duration of infectivity of SARS-CoV-2, and how this has informed evolving public health recommendations on when it is safe to discontinue isolation precautions.

Keywords. SARS-CoV-2; COVID-19; transmission-based precautions; isolation.

Background

- Data on viral recovery from cell culture is the proxy of transmission rate.
- In majority of patients, PCR can be recovered for several weeks, while cultures could not be identified >8 days of those cases.
- US CDC reported that they had not been able to isolate competent virus from viral culture >9 days on onset of symptoms.
- In the first COVID-19 wave, sample with Ct value> 34 was associated with undetectable viral cultures and had been used to guide for D/C isolation

Limitations of using Ct Value to help guide for D/C Isolation

Ct values must be interpreted with caution as they do not reflect a true viral load, which requires standardization using reference curves. As such, they are not directly comparable across assays [37]. Furthermore, differences in specimen collection quality and reaction conditions can introduce further variation [38, 39]. This imprecision in PCR testing is most apparent when the amount of viral nucleic acid at the sampling site approaches the limit of detection for the assay and is the most common reason for why some patients alternate between testing negative and testing positive. Lastly, only traditional real-time PCR assays produce a Ct value; assays that use isothermal amplification do not product a Ct value and nested PCR assays are not designed for quantitative interpretation [40].

SIGNIFICANCE OF PATIENTS WHO TEST PCR-POSITIVE AFTER TESTING NEGATIVE

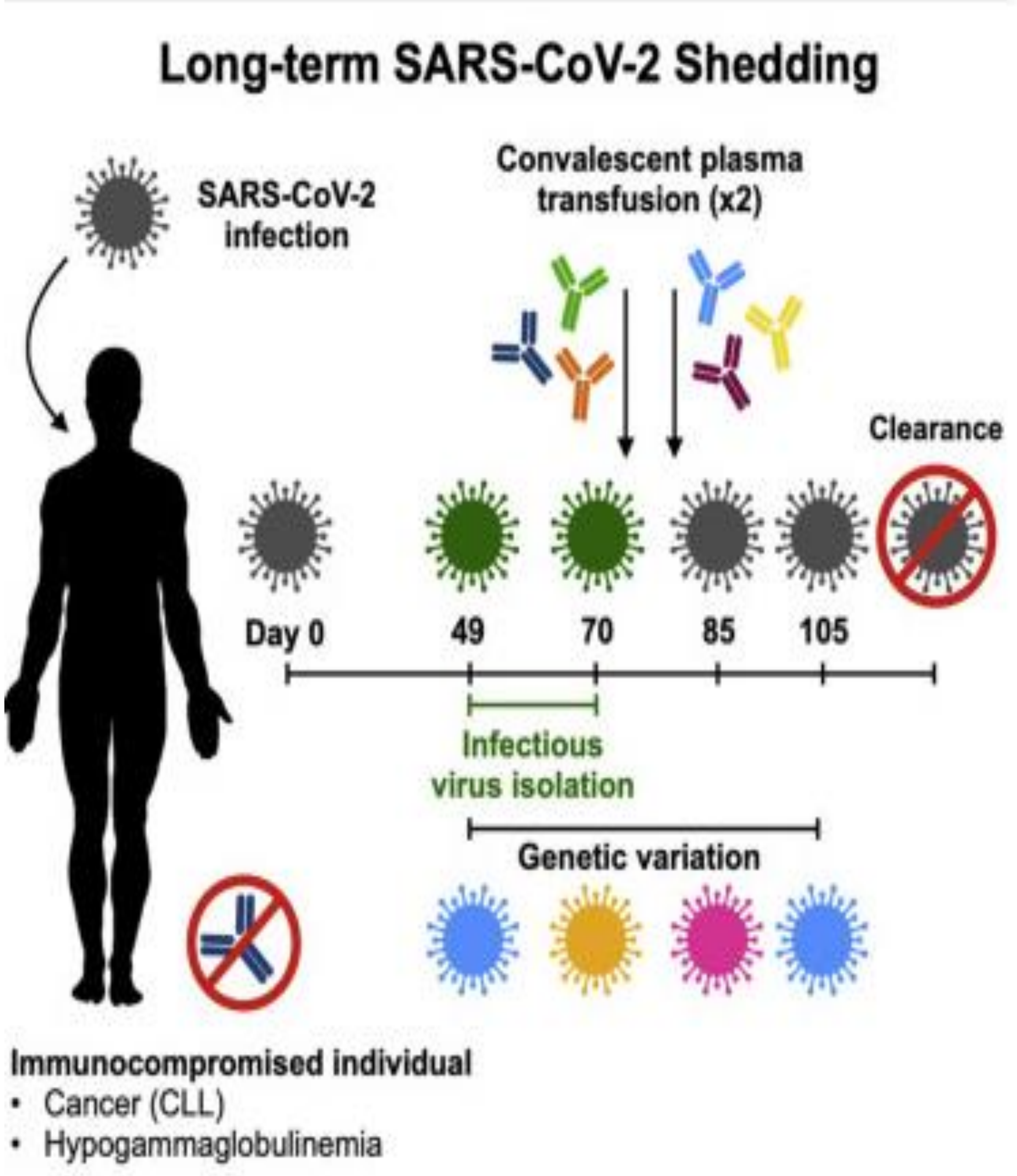
Investigators from Guangdong Province, China, analyzed 619 hospitalized patients with Covid-19 who were discharged after resolution of fever, improvement in respiratory symptoms, and 2 consecutive negative PCR samples >24 h apart on both respiratory tract and gastrointestinal tract samples [50]. All discharged cases were isolated in designated hotels, kept in observation, and retested on days 7 and 14 after recovery. 87 patients (14.1%) tested positive, of whom 77 were asymptomatic and 10 had mild cough. Viral cell culture was unsuccessful in all cases; furthermore, full-length genomes could not be sequenced in any cases, suggesting genome degradation.

Similarly, the Korean CDC reported on epidemiologic and contact tracing for 285 patients who recovered from Covid-19, tested negative, and then tested positive again by PCR [51]. On average, the re-positive test occurred 45 days after initial symptom onset (range 8–82 days). Retesting was done in 37.5% of patients because of new symptoms such as cough or sore throat. Viral cell culture testing was done in 108 re-positive cases, and all were negative. PCR Ct values were >30 in 89.5% of cases, suggesting that the negative-to-positive phenomenon represents sampling variability near the assay limit of detection. None of 790 contacts of the 285 re-positive cases (including 351 family members) developed Covid-19.

SUMMARY AND IMPLICATIONS FOR PUBLIC HEALTH RECOMMENDATIONS

In summary, based on a rapidly expanding evidence base, we currently draw the following conclusions regarding the timing and duration of SARS-CoV-2 transmissibility (Figure 1):

1. SARS-CoV-2 is most contagious right before and immediately following symptom onset.
2. Contagiousness rapidly decreases to near-zero after about 10 days from symptom onset in mild-moderately ill patients and 15 days in critically ill and immunocompromised patients. The longest duration of viral viability that has been reported thus far is 20 days from symptom onset.
3. Persistently positive SARS-CoV-2 RNA PCRs in recovered patients are common but are generally associated with high Ct values, reflecting low viral loads. These do not indicate replication-competent virus and are not associated with contagiousness.
4. PCR assays that alternate between positive and negative results in patients who have recovered from Covid-19 most likely reflect sampling variability and low levels of viral debris at the borderline of detection. These patients are unlikely to be contagious.
5. Infection confers at least short-term immunity in most cases; however, the duration of immunity is unclear and several cases of re-infection have now been confirmed.



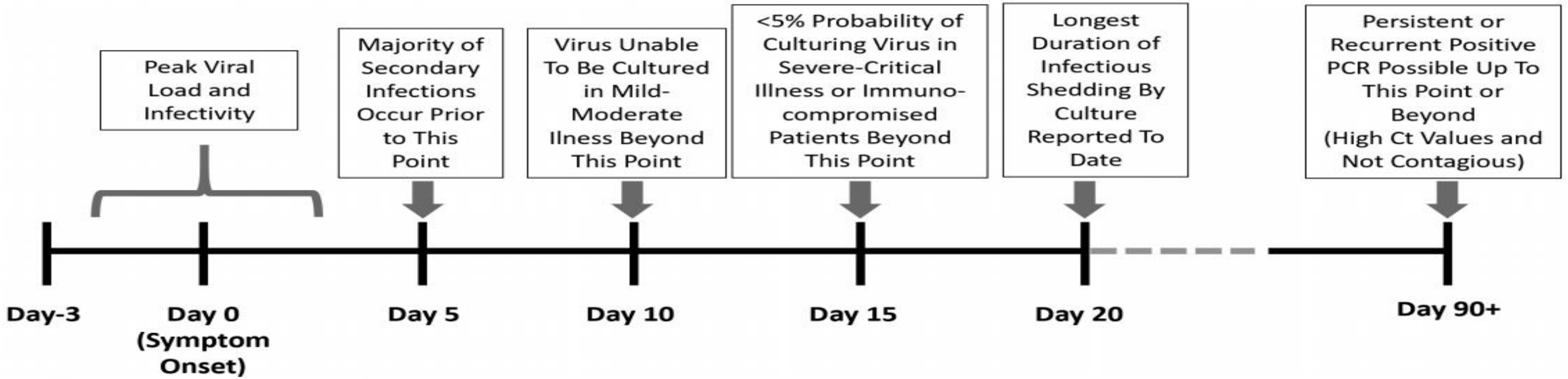


Table 2. WHO and CDC Guidance for Discontinuing Isolation in Patients with Confirmed Covid-19 Infection and Approach to Persistent or Recurrent Positive PCR Tests

Category	WHO	CDC
Symptomatic, initial infection	• 10 days after symptom onset, **plus** • At least 3 additional days without symptoms (fever or respiratory symptoms)	• *Mild-moderate Illness, Not Severely Immunocompromised*: 10 days since symptom onset + 24 h since last fever + improvement in symptoms • *Severe-critical Illness OR Severely Immunocompromised:* At least 10 days and up to 20 days since symptom onset + 24 h since last fever + improvement in symptoms
Asymptomatic, initial infection	• 10 days after positive test	• *Not Severely Immunocompromised*: 10 days since first positive test • *Severely Immunocompromised:* At least 20 days and up to 20 days since first positive test
Recovered from Covid-19 but persistent or pecurrent PCR positive	• No specific recommendation	• *Asymptomatic*: Retesting not recommended within 3 months after date of symptom onset, even if the patient has close contact with an infected person. • *Symptomatic*: If new symptoms develop within 3 months of initial symptom onset, and alternative etiology cannot be identified, consider retesting. Isolation may be considered in consultation with infectious disease or infection control experts, especially if symptoms developed within 14 days after close contact with an infected person.

In July and August, CDC modified their guidance to a more nuanced approach based on severity-of-illness and immunocompetence [64]. Specifically, while CDC still recommends 10 days of isolation from symptom onset (including >24 h since resolution of fever and improvement in symptoms) for mild-moderately ill patients without severely immunocompromising conditions, they now recommend at least 10 days and up to 20 days for patients with severe-critical illness or severely immunocompromising conditions. For asymptomatic patients, 10 days is recommended from the first positive PCR test (and up to 20 days for severely immunocompromised patients). Moreover, CDC recommends avoiding test-based clearance given the evidence that people with persistently positive PCR tests are not contagious. Test-based clearance should be reserved for rare cases when there is a need to discontinue isolation early, or potentially to inform a decision to prolong isolation for severely immunocompromised patients.

Infection Control & Hospital Epidemiology (2021), 1–2
doi:10.1017/ice.2021.335

SHEA

Letter to the Editor

Feasibility and safety of discontinuation of isolation precaution policy for coronavirus disease 2019 (COVID-19) patients from COVID-19 units to general medical units in Thailand

Anucha Apisarnthanarak MD[1], David K. Warren MD, MPH[2] and David J. Weber MD, MPH[3]

Table 1. Healthcare Personal and Patients' Demographics and Characteristics

Variable	No. (%)[a]
Healthcare personal (n = 69)	
Age, median y (range)	32 (22–49)
Sex, female	59 (85)
Underlying diseases	
None	59 (85.6)
Hypertension	2 (2.8)
Diabetes	6 (8.6)
Other[b]	3 (4.3)
BMI, median kg/m^2 (range)	24 (20–28)
Duration of care for COVID-19 patients, median d (range)	6 (2–12)
Development of COVID-19 symptoms	0 (0)
Patients (n = 25)	
Age, median y (range)	59 (24–79)
Sex, female	15 (60)
Underlying diseases	
Diabetes	15 (60)
Hypertension	10 (40)
Pulmonary diseases	9 (24)
Gastrointestinal diseases	6 (25)
Others[c]	5 (20.8)
Immunocompromised status[d]	2 (8)
BMI (median, range; kg/m^2)	28 (2–32)
Severity strata	
Mild COVID-19	0 (0)
Moderate COVID-19	10 (40)
Severe COVID-19	15 (60)
Test-based clearance for discontinuation of isolation precaution	0 (0)
Place of referral	
Intensive care unit	15 (60)
General medical units	10 (40)
Died	2 (8)

Note. BMI, body mass index.
[a]No. (%) unless indicated otherwise.
[b]Systemic lupus erythromatosus, rheumatic diseases, migraine.
[c]Stroke, cancers, human immunodeficiency syndromes.

In this study, a time-based policy for discontinuation of COVID-19 isolation precautions for infected patients in COVID-19 ICUs and general medical units was feasible and safe for HCP who cared for these patients. Such policies have become important because increasing COVID-19 cases that require acute care may exceed the maximum hospital capacity to care for these patients in COVID-19 units. In addition, once the policy was established, no significant barriers arose and no resistance to this policy by HCP

What you need to do, if DC Isolation?

- No need to wear PPE
- Practice Standard Precaution
- Clean environment well
- No need for RT-PCR to help guide for DC, but can be used to guide very early DC Isolation with Ct value
- Educate nurses in the unit (learn from ICU) and educate patients' relatives

- **แนวทางการยกเลิก isolation ผู้ป่วย COVID-19 เพื่อย้ายผู้ป่วยออกจากหอผู้ป่วยโควิด19 เพื่อมาทาการรักษาต่อในหอผู้ป่วยทั่วไป ของรพ.ธรรมศาสตร์เฉลิมพระเกียรติ**

  1. ในผู้ป่วยที่ไม่ได้มีภูมิคุ้มกันบกพร่องรุนแรง หรือ severe critically ill (ดูข้อ 2 และ 3) และปัจจุบันไม่ได้รับ high flow oxygen แล้ว สามารถย้ายได้ หลังจากมีอาการ 14 วัน หรือ หลังจากตรวจพบเชื้อ 14 วัน โดยไม่ต้อง swab ซ้า โดยผู้ป่วยทุกรายต้องได้รับการอนุมัติจากแพทย์ผู้เชี่ยวชาญโรคติดเชื้อก่อนย้ายเสมอ

  2. ในผู้ป่วยที่มีภูมิคุ้มกันบกพร่องรุนแรง เช่น เป็นมะเร็ง รับประทานยากดภูมิเป็นระยะเวลานาน หรืออื่น ๆ ตามวิจารณญาณของแพทย์ผู้เชี่ยวชาญโรคติดเชื้อ สามารถย้ายได้ หลังจากมีอาการ 21 วัน หรือ หลังจากตรวจพบเชื้อ 21 วัน โดยต้องให้ แพทย์ผู้เชี่ยวชาญโรคติดเชื้อพิจารณาว่าควรทา RT-PCR ประกอบ ก่อนย้ายผู้ป่วยเหล่านั้น หรือไม่

  3. ในผู้ป่วยที่มีอาการ severe critically ill สามารถย้ายได้ หลังจากมีอาการ 21 วัน หรือ หลังจากตรวจพบเชื้อ 21 วัน โดยต้องให้แพทย์ผู้เชี่ยวชาญโรคติดเชื้อพิจารณาว่าควรทำ RT-PCR ประกอบ ก่อนย้ายผู้ป่วยเหล่านั้น หรือไม่

Use of Procalcitonin and CPIS to limit Unnecessary Antibiotic Use Among COVID-19 ICU Patients

Abstract

Using procalcitonin and CPIS score (PCT-CPIS) successfully reduced inappropriate antibiotics use among severe-critically ill COVID-19 pneumonia patients. Compared to "non PCT-CPIS" group, "PCT-CPIS" group was associated with a reduction in the incidence of multidrug-resistant organisms and invasive fungal infections (p=0.025), shorter antibiotic duration (p<0.001) and length-of-hospital stay (p<0.001).

Sathitakorn O, et al. Feasibility of CPIS and procalcitonin to reduce inappropriate use among severely ill COVID-19 patients (under review)

Figure 1 Protocol of procalcitonin and CPIS score

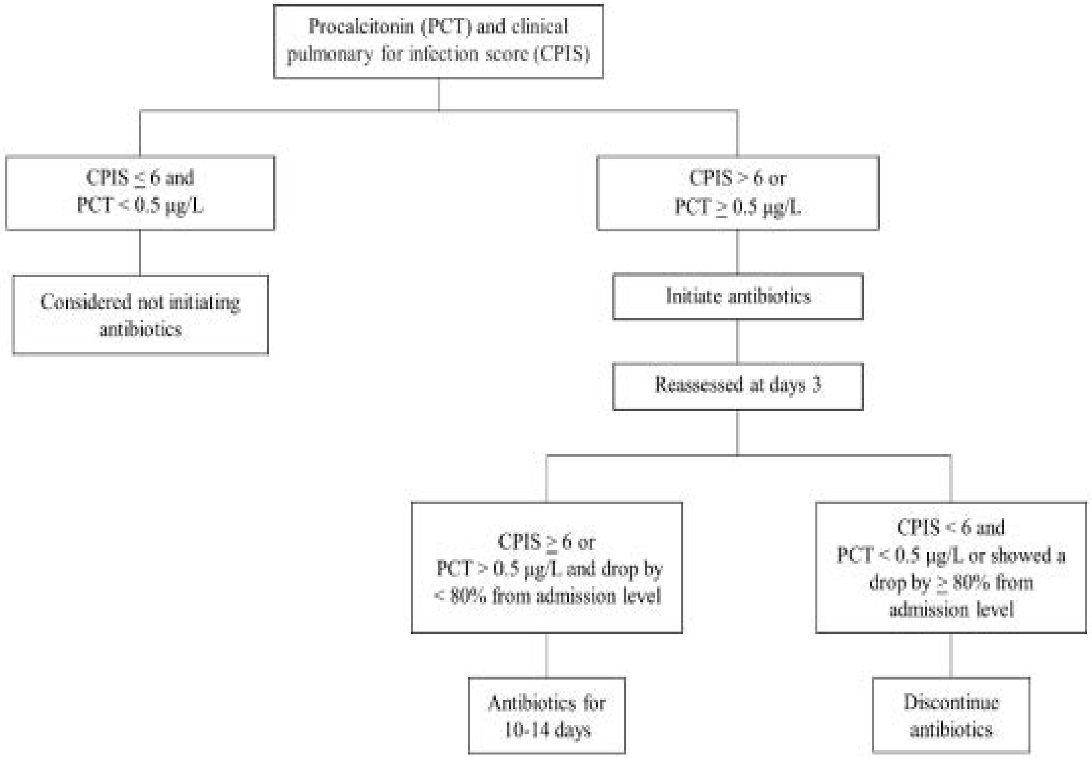


Table 1 Demographics and baseline characteristics of study populations compared "PCT-CPIS" group versus "non PCT-CPIS" group

Variable	Total (%) (N=120)	PCT-CPIS group (%) (N=60)	Non PCT-CPIS group (%) (N=60)	P-Value
Age, median year (range)	61 (26-87)	61 (28-81)	61 (26-87)	0.980
Sex, male	66 (55.00)	35 (58.33)	31 (51.67)	0.463
BMI (kg/m^2), median (range)	26.3 (18.7-60.6)	26.3 (19.0-60.6)	26.4 (18.7-53.3)	0.763
Underlying diseases				
None	40 (33.33)	18 (30.00)	22 (36.67)	0.439
Diabetes mellitus	31 (25.83)	16 (26.67)	15 (25.00)	0.835
Hypertension	52 (43.33)	25 (41.67)	27 (45.00)	0.713
Dyslipidemia	30 (25.00)	14 (23.33)	16 (26.67)	0.673
Chronic kidney disease	10 (8.33)	7 (11.67)	3 (5.00)	0.186
Coronary artery disease	6 (5.00)	2 (3.33)	4 (6.67)	0.402
Atrial fibrillation	2 (1.67)	1 (1.67)	1 (1.67)	1.000
Asthma	4 (3.33)	4 (6.67)	0 (0)	0.042
ICUs				
ICU-1	30 (25.00)	14 (23.33)	16 (26.67)	0.598
ICU-2	90 (75.00)	47 (78.33)	43 (71.67)	0.598
COVID-19 severity				
Critically	48 (40.00)	22 (36.67)	26 (43.33)	0.371
Severe	72 (60.00)	39 (65.00)	33 (55.00)	0.371
Site of infection				
No site of bacterial co-infection	25 (20.83)	25 (41.67)	0 (0)	<0.001
Bacterial pneumonia	91 (75.83)	35 (29.17)	56 (93.33)	<0.001
Urinary tract infection	2 (1.67)	0 (0)	2 (3.33)	0.154
Intra-abdominal infection	1 (0.08)	0 (0)	1 (1.67)	0.315
Septicemia	1 (0.08)	0 (0)	1 (1.67)	0.315
Outcome				
Primary outcome				
No ATB initiation	25 (20.83)	25 (41.67)	0 (0)	<0.001
Discontinuation of ATB in 48 hours	8 (6.67)	8 (13.33)	0 (0)	0.004
Decreasing ATB use at ≥7 days	35 (29.17)	6 (10.00)	29 (48.33)	<0.001
Secondary outcome				
ATB duration, median (range)	7 (0-24)	2 (0-17)	7 (4-24)	<0.001
Length of hospital stay, median (range)	12 (3-50)	10 (3-50)	16 (3-47)	<0.001
MDRO and IFI	33 (27.50)	11 (18.33)	22 (36.67)	0.025
MDR-*Acinetobactor baumannii*	21 (17.50)	7 (11.67)	14 (23.33)	0.093
MDR-*Pseudomonas aeruginosa*	2 (1.67)	2 (3.33)	0 (0)	0.154
ESBL-*Klebsiella pneumoniae*	3 (2.50)	1 (1.67)	2 (3.33)	0.559
ESBL-*Escherichia coli*	2 (1.67)	0 (0)	2 (3.33)	0.154
Invasive fungal infection	5 (4.17)	1 (1.67)	4 (6.67)	0.171
30-day mortality	41 (31.17)	20 (33.33)	21 (35.00)	0.847
Infection disease related mortality	30 (25.00)	12 (20.00)	18 (30)	0.206
Severe ARDS	8 (6.67)	6 (10.00)	2 (3.33)	0.143
Others[a]	3 (2.50)	2 (3.33)	1 (1.67)	0.559

Mechanisms to deal with HCWs emotions are also important for patient Safety

anxiety → panic → fear

Infection Control & Hospital Epidemiology (2020), 1–2
doi:10.1017/ice.2020.280

Research Brief

Impact of anxiety and fear for COVID-19 toward infection control practices among Thai healthcare workers

Anucha Apisarnthanarak MD[1], Piyaporn Apisarnthanarak MD[2], Chanida Siripraparat MD, PhD[3], Pavarat Saengaram MD[4], Narakorn Leeprechanon MD[5] and David J. Weber MD[6]

Table 1. Healthcare Personnel Characteristics, Emotions, and Infection Prevention Practices

Variable	No. (%) (N = 160)
Age, median y (range)	32 (23–62)
Sex, female	95 (59)
Occupation	
Physicians	52 (32)
Nurse	45 (28)
Nurse assistant	16 (1)
Others[a]	47 (29)
Direct contact with COVID-19 patients	82 (51.6)
Perceived high risk of contracting COVID-19 patients	144 (90)
Perceived high risk of being quarantine	136 (85.5)
Confidence in hospital preparedness policy for COVID-19	125 (78)
Confidence in hospital stockpile policy for PPE	119 (74.4)
Confidence in knowledge of COVID-19 diseases transmission	118 (73.8)
Confidence in knowledge of COVID-19 infection preventions	121 (75.6)
GAD-7 Score	
Minimal anxiety	51 (31.8)
Mild anxiety	37 (23.1)
Moderate anxiety	23 (14.4)
Severe anxiety	8 (5)
Infection prevention practices	
Hand washing	152 (95.6)
Wearing mask and PPE	148 (93.1)
Willing to see admitted patients during epidemics	78 (48.7)
Willing to accept new patients during epidemics	73 (45.1)
Social distancing in hospital	128 (82)
Social distancing in community	125 (78)
Suggestions to improve HCP emotions	
Hospital policy on adequate PPE stockpile	114 (71)
Ongoing education on diseases transmission and preventions	125 (77)
Mindfulness practices	89 (55)
Workshop to share knowledge and experience	75 (28)
Increase incentive for being at risk	35 (21.8)

Pro: Intensified Infection Control Practices (e.g,, double mask technique, face shield)

- Wearing a mask at all times while in the medical facility, hand hygiene, and physical distancing does not eliminate the risk of COVID-19 acquisition by HCP because patients may not always be able to wear a mask and HCP may not be fully compliant with IP recommendations.
- Wearing a cloth mask over a medical procedure mask (i.e.,double masking technique), to achieve improve mask filtration and more effectively prevent the spread/acquisition of COVID-19.
- Wearing eye protection (e.g., goggles, face shields) in addition to a medical mask for direct patient care is also recommended, especially when an aerosol generating procedure (AGP) is being performed.
- These intensified infection prevention (IIP) together with HCP vaccinations (e.g., COVID-19, influenza) would enhance HCP safety during the COVID-19 epidemic.


มหาวิทยาลัยธรรมศาสตร์
คณะแพทยศาสตร์
ร่วมฝ่าวิกฤติ covid-19
ร่วมใจใส่ หน้ากาก 2 ชั้น
ศ.นพ. อนุชา อภิสารธนรักษ์
หัวหน้าหน่วยโรคติดเชื้อ
คณะแพทยศาสตร์ มหาวิทยาลัยธรรมศาสตร์
หน้ากากอนามัยด้านใน
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โรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ
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คณบดี คณะแพทยศาสตร์ มหาวิทยาลัยธรรมศาสตร์


Available in 9 colours

Letter to the Editor

High mortality in coronavirus disease 2019 (COVID-19)–suspect unit: Lessons learned for patient safety

Anucha Apisarnthanarak MD[1], Surachai Chaononghin MD[1], Panipak Katawethiwong MD[1] and David K. Warren MD[2]

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Table 1. Comparison of 78 Patients Admitted to COVID-19 Suspect Unit, by In-Hospital Mortality

Variable	Total (n = 78)	Died (n = 10)	Survived (n = 68)	*P* Value
Age, median y (range)	40.5 (15–70.5)	55 (15–70.5)	37 (27–59)	0
Sex, female	36 (46)	6 (60)	32 (47.1)	0.74
Underlying comorbidities				
Hypertension	12 (15.4)	3 (25)	9 (13.2)	0.17
Diabetes	10 (12.8)	2 (20)	8 (11.8)	0.60
Lung disease	8 (10.3)	1 (10)	7 (10.3)	1
Heart disease	5 (6.4)	3 (30)	2 (2.9)	0.02
Kidney disease	3 (3.8)	0 (0)	3 (4.4)	1
Initial evaluation site				
Emergency department	40 (51.3)	10 (100)	30 (44)	0.001
Emerging infectious diseases unit	29 (37.2)	0 (0)	29 (42.6)	0.01
Outpatient department	9 (11.5)	0 (0)	9 (13.2)	0.59
Delay processes of care				
Laboratory procurement[a]	28 (29.5)	6 (60)	22 (32)	0.09
Time to admission[b]	49 (39.7)	5 (50)	44 (65)	0.36
Critical clinical management[c]	4 (5.1)	4 (40)	0 (0)	<.001
Final diagnosis				
Infectious diseases				
Viral infection[d]	34 (43.6)	0 (0)	34 (50)	0.004
Bacterial infections	29 (37.2)	9 (90)	20 (29.4)	<.001
Fungal infections	4 (5.1)	0 (0)	4 (5.9)	0.57
Noninfectious diseases[e]	12 (15.4)	2 (20)	10 (14.7)	0.19

Conclusions

- Suboptimal IC practices for COVID-19 occurred very common and related with multiple factors.
- Solutions to these suboptimal practices are important to improve patient safety during the COVID-19 pandemic.
- Understanding of the causes and solutions are important for ID clinicians who likely responsible for not only for treatment but also infection control

Thank you

Letter to the Editor

Patients' anxiety, fear, and panic related to coronavirus disease 2019 (COVID-19) and confidence in hospital infection control policy in outpatient departments: A survey from four Thai hospitals

Anucha Apisarnthanarak MD[1], Chanida Siripraparat MD, MPH[2], Piyaporn Apisarnthanarak MD[3], Michael Ullman PhD[4], Pavarat Saengaram MD[5], Narakorn Leeprechanon MD[6] and David J. Weber MD[7]

Table 1. Patients Characteristics, Emotions, Confidence in Hospital Infection Prevention Practices at Outpatient Departments During the COVID-19 Pandemic

Variables	Total (N = 200), No. (%)
Age, median y (range)	45 (15–92)
Sex, female	138 (69)
Occupation	
Employee	41 (20.7)
Business man	35 (17.3)
Government worker	22 (11)
Others[a]	102 (51)
Type of mask	
Cloth mask	113 (57)
Surgical mask	71 (36)
N95 mask	11 (5.6)
Others[b]	5 (2.5)
Contact with COVID-19 patients or patient under investigation	19 (19.6)
Fear for contracting COVID-19	89 (45)
Panic for being contracting COVID-19	82 (41.4)
Confidence in hospital preparedness policy	175 (88)
Confidence in hospital hand hygiene policy	196 (99)
Confidence in wearing mask policy at outpatient department	187 (94)
Confidence in social distancing policy at outpatient department	163 (82)
Confidence in COVID-19 knowledge	150 (76)
Source of COVID-19 information	
Social media	
Line app	164 (83.5)
Facebook	135 (67)
Instragram	154 (77)
Government news	171 (86)
Television news	174 (87)
Feeling of discrimination	113 (57)
Feeling of stigmatization	107 (54)
GAD-7 Score	
Mild anxiety	155 (78)
Moderate anxiety	15 (7.6)
Severe anxiety	11 (5.6)
Changing in infection control behavior	
Hand washing	140 (70)
Wearing mask	124 (62)
Social distancing at workplace and outpatient department	159 (79)

Table 3 Recommendations to deal with healthcare system and psychological support in team leaders, infection prevention and control (IPC) team, and healthcare personnel (HCP) in COVID-19 outbreaks.

Role	Healthcare system	Psychological support
Team leader	National guidelines for clinical care and IPC, revised for COVID-19	Recognition of staff efforts
	Clear communication with staff and accept coping difference	Minimizing time in quarantine
	Administrative team for HCP prevention	Access to psychological interventions, address grief
	Appropriate work shifts and regular breaks	Incentive or reward
	Availability of hospital security to help deal with uncooperative patients	Training to deal with identification of and responses to psychological problems
IPC team	Enforcement of IPC measures and regular training focus on how disease transmitting and prevention for HCP	Avoidance of compulsory assignment to caring or mindfulness practices for patients
	Nationally standardized trainings for disease understanding and donning and doffing of personal protective equipment for HCP	Rearranging hospital infrastructure, such as redeployment of wards and human resources
	Clear direction and enforcement of IPC procedures	Supporting staff in quarantine
	Screening stations to direct patients to relevant infection treatment clinics	
	Sufficient personal protective equipment and medication stockpiles	
	Redesigning nursing care procedures that pose high risks for spread of infections, reducing the density of patients on wards	
	Improving safety such as a better ventilation system or constructing or negative pressure rooms to isolate patients	
HCP, colleagues and community	Video facilities for staff to keep in contact with families and alleviate their concerns	Increased support and stay connected from family and friends (avoid isolation)
	Alternative accommodation for staff who are concerned about infecting their families	Encouragement among peers
	Guaranteed food and daily living supplies	Staff "buddy" system
	Attention to media portrayal of HCP and rely on trusted sources	Self-care and sufficient rest and time off
	Minimization of stigma and discrimination, and community engagement	Opportunities for reflection on the effects of stress and ask for help

New Technology Will Need More Understanding Before Use