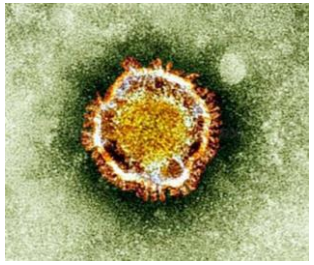
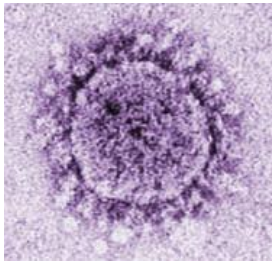
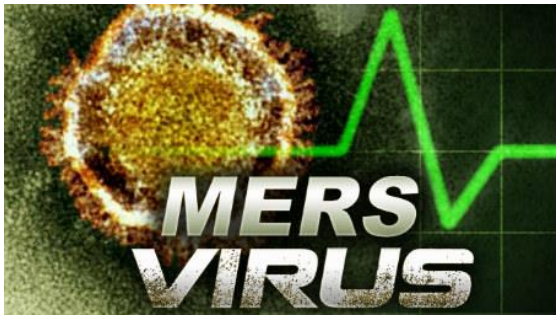
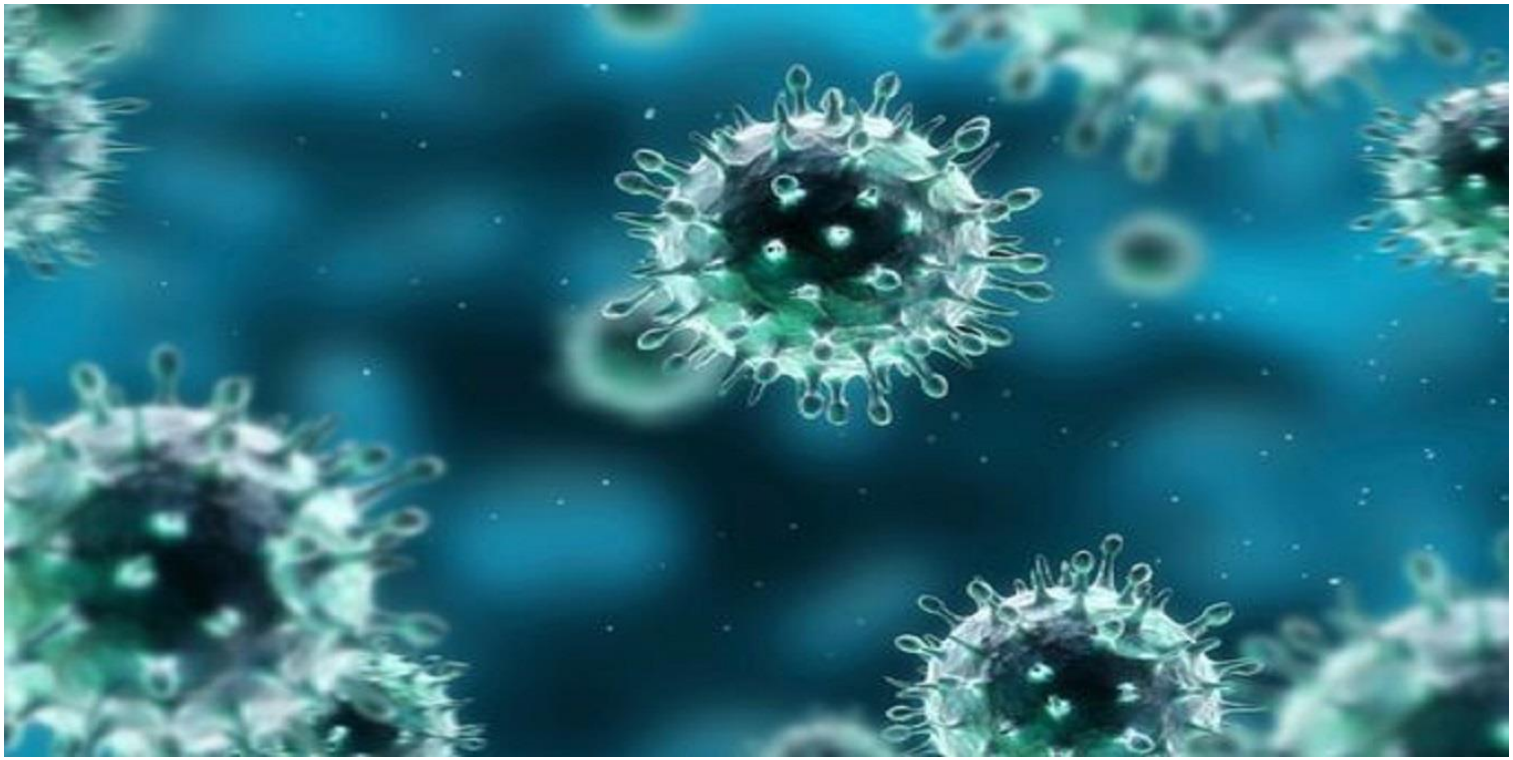




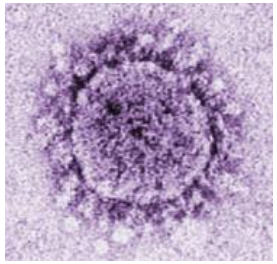
Nosocomial infections in SARS-CoV and MERS-CoV

B. Guery
Maladies Infectieuses
CHRU Lille



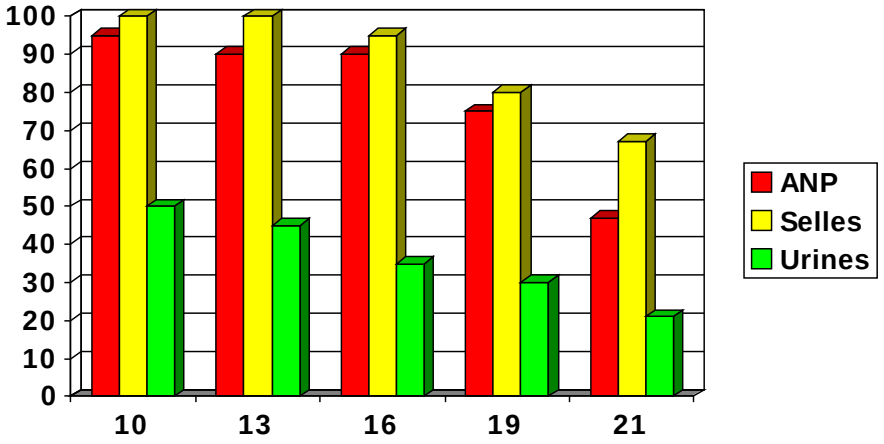


EXCRETION VIRALE

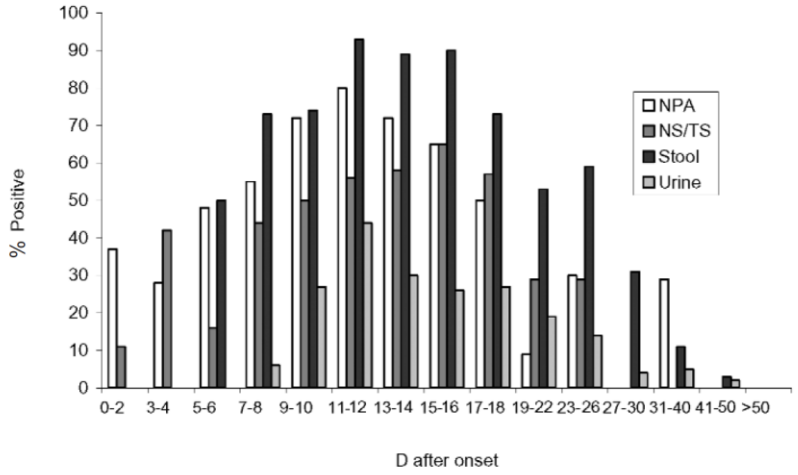


SARS

- ✓ Peiris, Lancet 2003 (n=75)
  - ARN coronavirus en RT-PCR: 32% à l'admission, et 68% à J14
    - Selles: 97%, 14,2 jours après le début des symptômes



- ✓ Chan, EID 2004 (n=332)



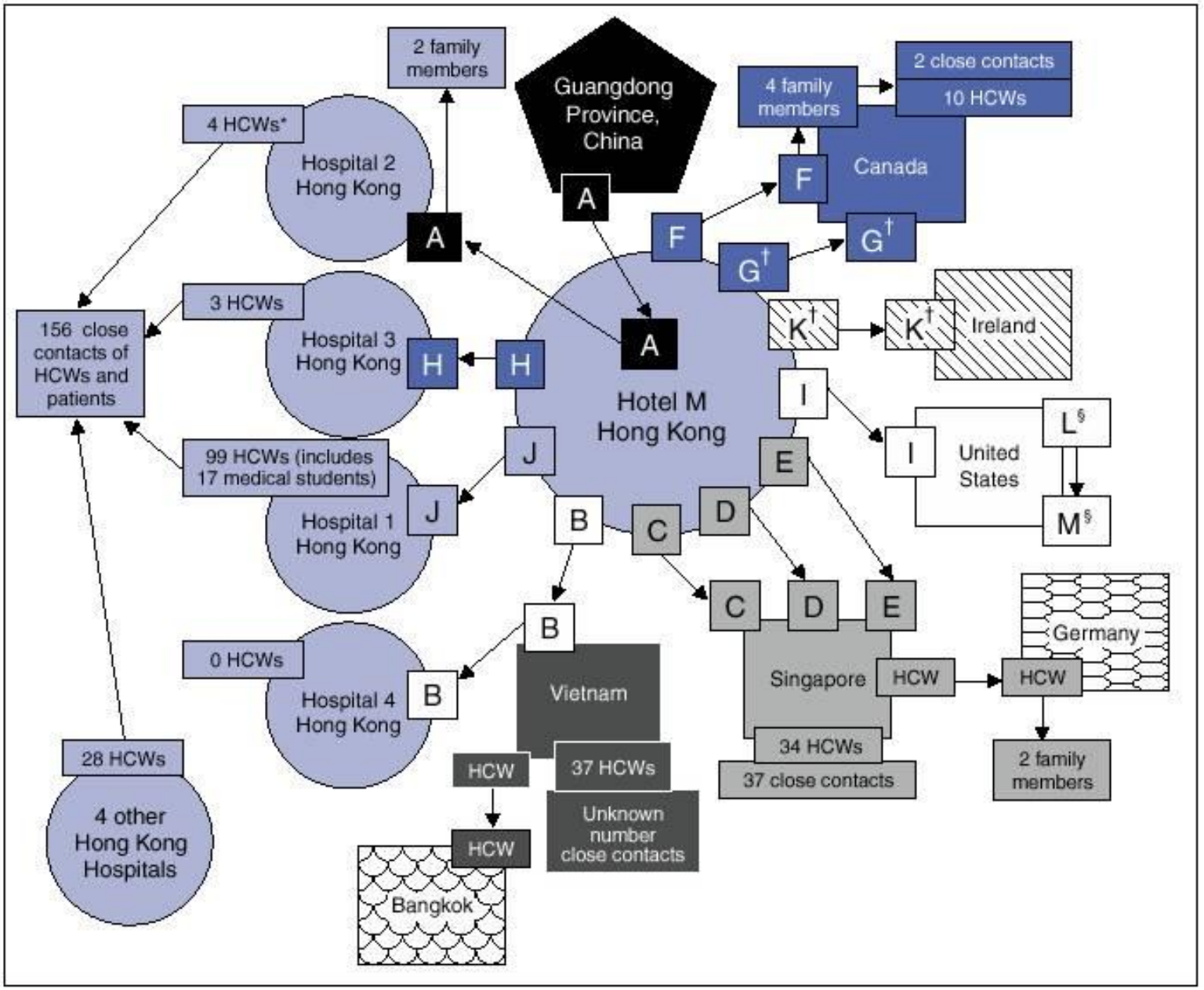
Virus detection in samples collected from patient 2.

Specimen	Date Day	May 14 6	May 17 9	May 20 12	May 23 15	May 24 16	May 31 23	June 3 26	June 5 28	June 7 30	June 10 33
Nasal swab	UpE (*Cp*)	38.9	37.6	neg	neg	neg	neg	neg	neg	neg	neg
	Orf1a (*Cp*)	neg	neg	neg	neg	neg	neg	neg	neg	neg	neg
Pharyngeal swab	UpE (*Cp*)	37.8	38.8	neg	neg	neg	neg	neg	neg	neg	neg
	Orf1a (*Cp*)	neg	neg	neg	neg	neg	neg	neg	neg	neg	neg
Tracheal swab	UpE (*Cp*)	26.3	23.3	24.7	34.9	28.6	28.7	36.2	36.2	32.8	36.9
	Orf1a (*Cp*)	28.8	25.8	26.8	34.5	30.5	29.8	36.4	35.5	34.3	36.5
Whole blood	UpE (*Cp*)	nd	neg	neg	neg	neg	neg	neg	neg	nd	nd
	Orf1a (*Cp*)	nd	neg	neg	neg	neg	neg	neg	neg	nd	nd
Urine	UpE (*Cp*)	neg	neg	neg	neg	neg	neg	neg	neg	neg	nd
	Orf1a (*Cp*)	neg	neg	neg	neg	neg	neg	neg	neg	neg	nd
Rectal swab	UpE (*Cp*)	37.5	38.8	neg	neg	neg	neg	neg	neg	nd	neg
	Orf1a (*Cp*)	neg	neg	neg	neg	neg	neg	neg	neg	nd	neg

Day: days after the onset of illness; *Cp*: cycle point; neg: negative; nd: not determined.

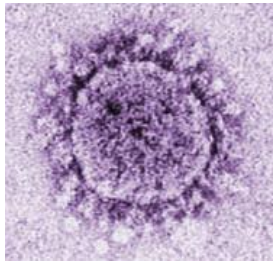
TRANSMISSION SARS

SCHEMA EPIDEMIE



Transmission nosocomiale

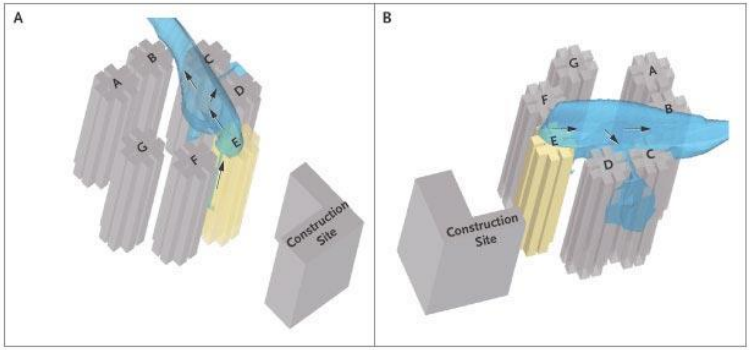
- Au décours de l'admission du patient index à Hong Kong
  - 716 cas secondaires et tertiaires
  - 52,3% étaient des soignants
- Trois éléments importants
  - Précautions complémentaire
    - Entre l'admission et PC: 4,5j (1-13j)
    - Variabilité entre les centres (physiopathologie inconnue)
  - Education
  - Superspreader



SARS

- ✓ Gouttelettes
  - Contact rapproché (soignants, famille,..)
  - Dynamique de l'épidémie : 2.7 infections secondaires par cas au début de l'épidémie (Riley et al, Science)
- ✓ Contact: Foyer Amoy Garden

  -321 résidents contaminés sur 15 blocs
- ✓ Air
  - Yu et al, N Engl J Med 2004
  - Booth et al, JID 2005
  - Li et al, Indoor Air 2004



Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS)

*W H Seto, D Tsang, R W H Yung, T Y Ching, T K Ng, M Ho, L M Ho, J S M Peiris, and Advisors of Expert SARS group of Hospital Authority**
**Members listed at end of report*

✓ Transmission au personnel soignant **en absence de gestes invasifs** : 21% des cas de SARS (n = 1707)

Mesure	Infectés	Non infectés	p	OR
Masque	2 (15%)	169 (70%)	0,0001	13
Gants	4 (31%)	117 (48%)	0,364	2
Blouses	0 (0%)	83 (34%)	0,006	NC
Lavage des mains	10 (77%)	227 (94%)	0,047	5
Toutes les mesures	0 (0%)	69 (29%)	0,022	NC

NC: non calculable

Seto et al. Lancet 2003

SARS Transmission among Hospital Workers in Hong Kong

Joseph T.F. Lau,* Kitty S. Fung,* Tze Wai Wong,* Jean H. Kim,* Eric Wong,* Sydney Chung,* Deborah Ho,* Louis Y. Chan,* S.F. Lui,† and Augustine Cheng*

- Etude cas contrôle
  - 72 soignants SARS+
  - 144 soignants SARS-
- Sur-risque si:
  - Non usage systématique des EPP (lunettes, blouses, gants, masques)
  - Moins de 2h de training en hygiène
  - Absence de compréhension des mesures de protection

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 10, No. 2, February 2004

SARS in Three Categories of Hospital Workers, Hong Kong

Joseph T.F. Lau,* Xilin Yang,* Ping-Chung Leung,* Louis Chan,* Eliza Wong,* Carmen Fong,* and Hi-Yi Tsui*

- Taux d'attaque dans 16 hopitaux
  - N: IDE
  - S: AS, techniques, ..
  - O: médecins, Rx, étudiants….

	Mean of attack rates (%)	SD
Group N	1.07	1.38
Group S	2.34	3.43
Group O	0.32	0.49
Overall[a]	1.06	1.31
p value	0.035[b]	

✓ Cleaning and clerical staff on hospital wards were at a much higher risk

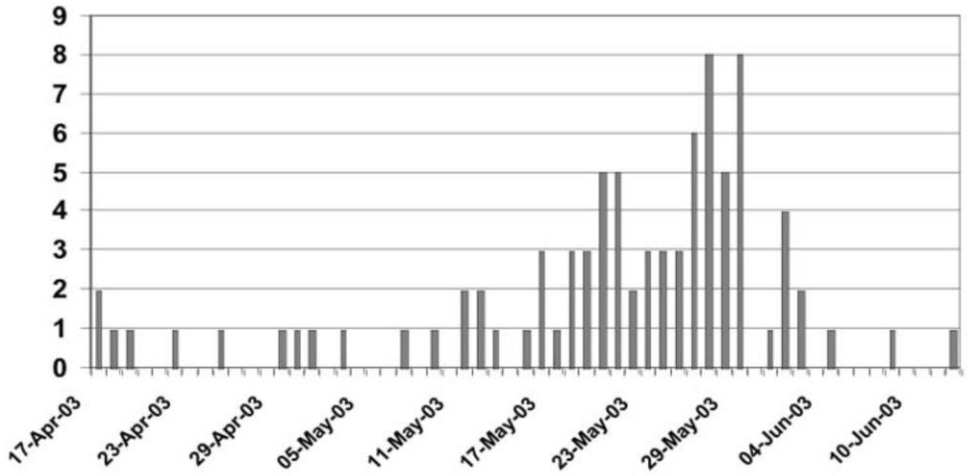
Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 10, No. 8, August 2004

Investigation of the second wave (Phase 2) of severe acute respiratory syndrome (SARS) in Toronto, Canada. What happened?

M. Ofner-Agostini, PhD(1), T. Wallington, MD(2), B. Henry, MD(2), D. Low, MD(3), L.C. McDonald, MD(4), L. Berger, MD(2), B. Mederski, MD(5), the SARS Investigative Team and T. Wong, MD(1)

- ✓ What was believed to be the end of the Toronto SARS outbreak led the Provincial Operations Centre to issue a directive allowing a more relaxed use of infection-control precautions during the beginning of Phase 2 of the outbreak.
- ✓ These relaxations of precautions were temporally associated with the nosocomial transmission of SARS to hospital staff, other patients and visitors at Hospital X.

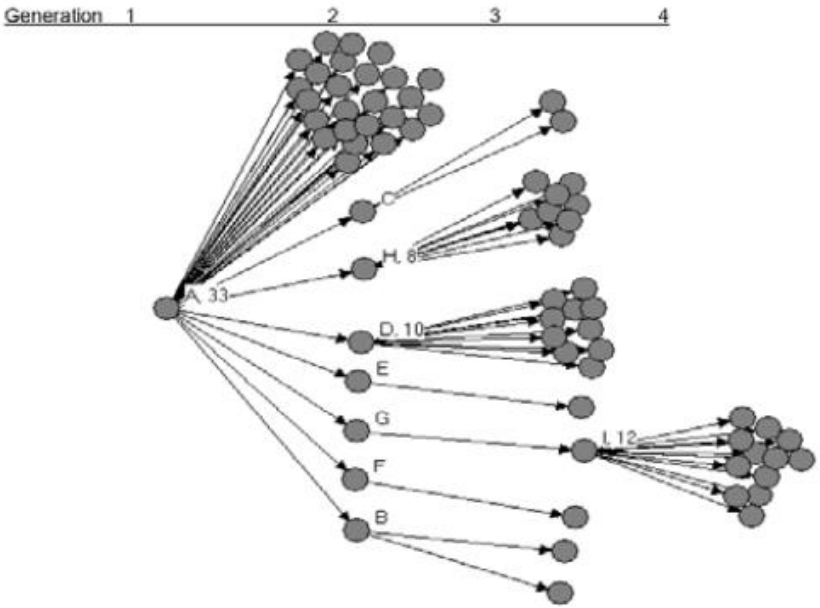
Figure 1: Number of probable and suspect SARS cases at Hospital X during Phase 2



Superspreading SARS Events, Beijing, 2003

Zhuang Shen,* Fang Ning,* Weigong Zhou,†‡ Xiong He,* Changying Lin,* Daniel P. Chin,†
Zonghan Zhu,§ Anne Schuchat†‡

- ✓ Définition: 1 pour 8
- ✓ 1 cas index responsable
  - 76 cas
  - 12 soignants
- ✓ Facteurs associés
  - Age
  - Mortalité
- ✓ Retard à l'identification



Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 10, No. 2, February 2004

Transmission

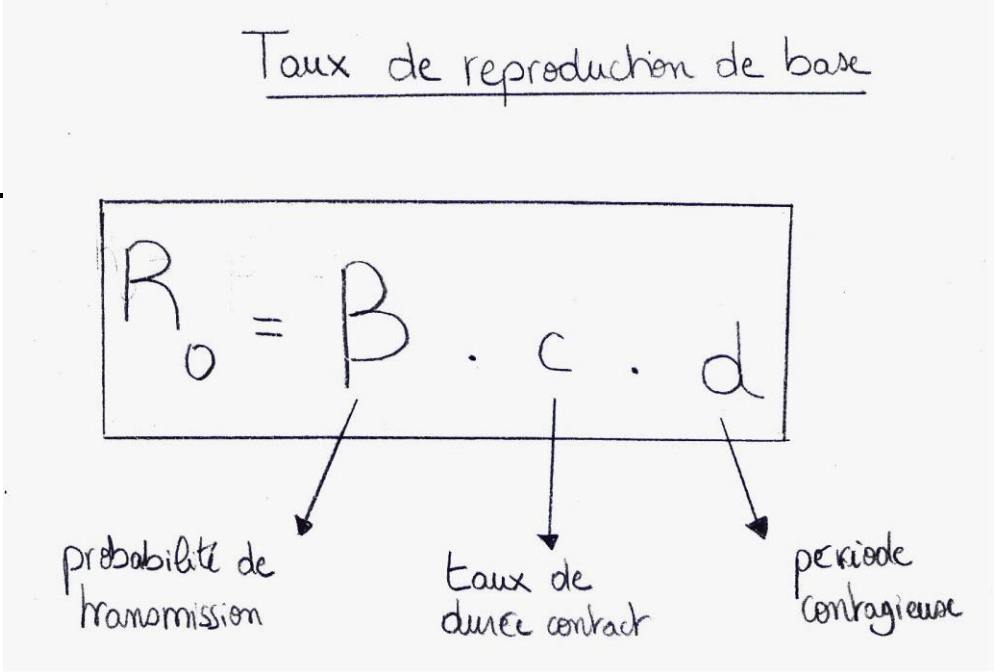
- Facteur influençant la transmission
  - La charge virale du patient
  - La distance au patient index
- Conditions idéales
  - Patient infectés excrétant de grandes quantités de virus
  - Co-morbidité masquant le tableau initial
  - Multiples contacts rapprochés avec procédures à risque (intubation, fibroscopie, nébulisation, …)
- Notion de « superspreader »
  - Infection très sévère
  - Co-morbidité

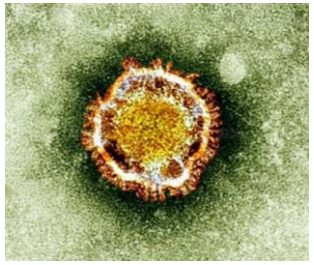
TRANSMISSION MERS

Interhuman transmissibility of Middle East respiratory syndrome coronavirus: estimation of pandemic risk

Romulus Breban, Julien Riou, Arnaud Fontanet

- ✓ SARS-CoV was 0.80 (0.54–1.13)
- ✓ Pessimistic scenario, MERS-CoV R0: 0.69 (95% CI 0.50–0.92)
- ✓ Optimistic scenario MERS-CoV R0 of 0.60 (0.42–0.80)
- ✓ MERS-CoV does not yet have pandemic potential

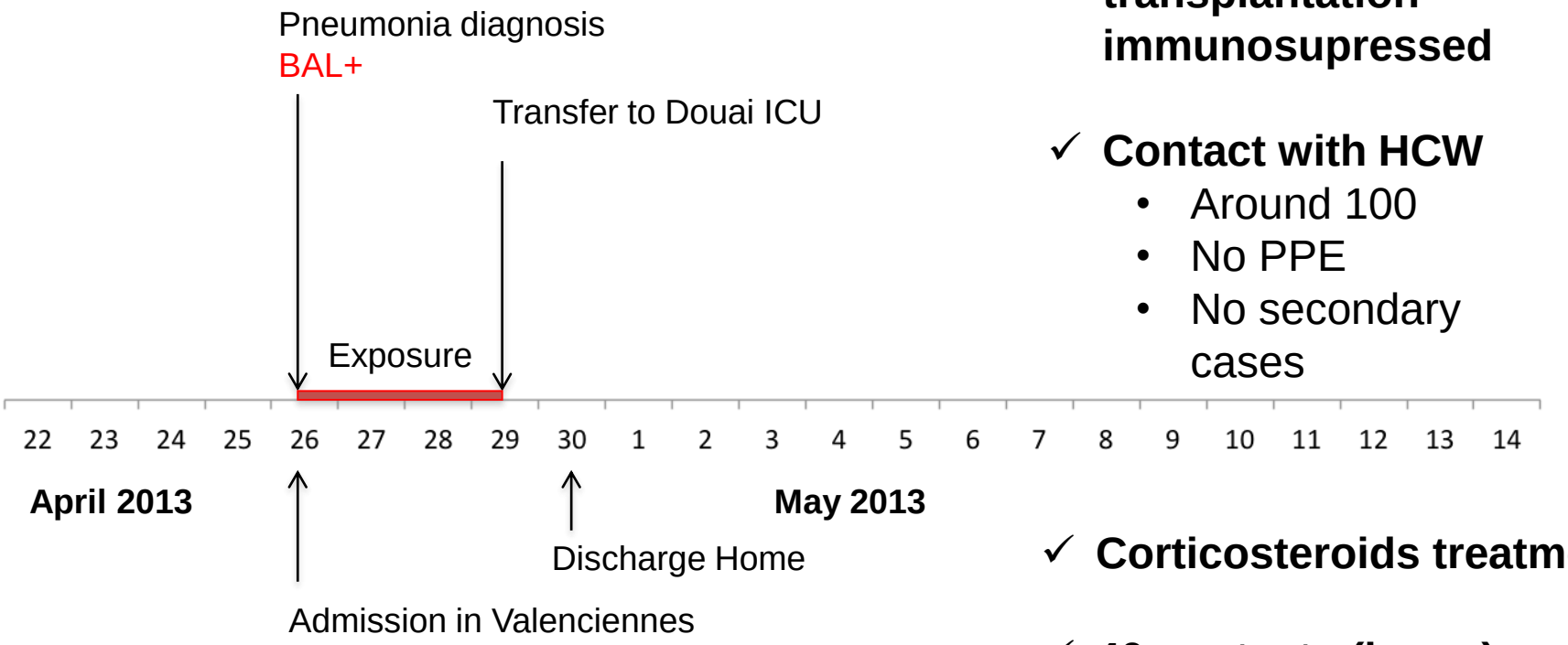




Clinical features and viral diagnosis of two cases of infection with Middle East Respiratory Syndrome coronavirus: a report of nosocomial transmission

Benoit Guery, Julien Poissy, Loubna el Mansouf, Caroline Séjourné, Nicolas Ettahar, Xavier Lemaire, Fanny Vuotto, Anne Goffard, Sylvie Behillil, Vincent Enouf, Valérie Caro, Alexandra Mailles, Didier Che, Jean-Claude Manuguerra, Daniel Mathieu, Arnaud Fontanet, Sylvie van der Werf, and the MERS-CoV study group*

Estimation R0: 0.7-0.8



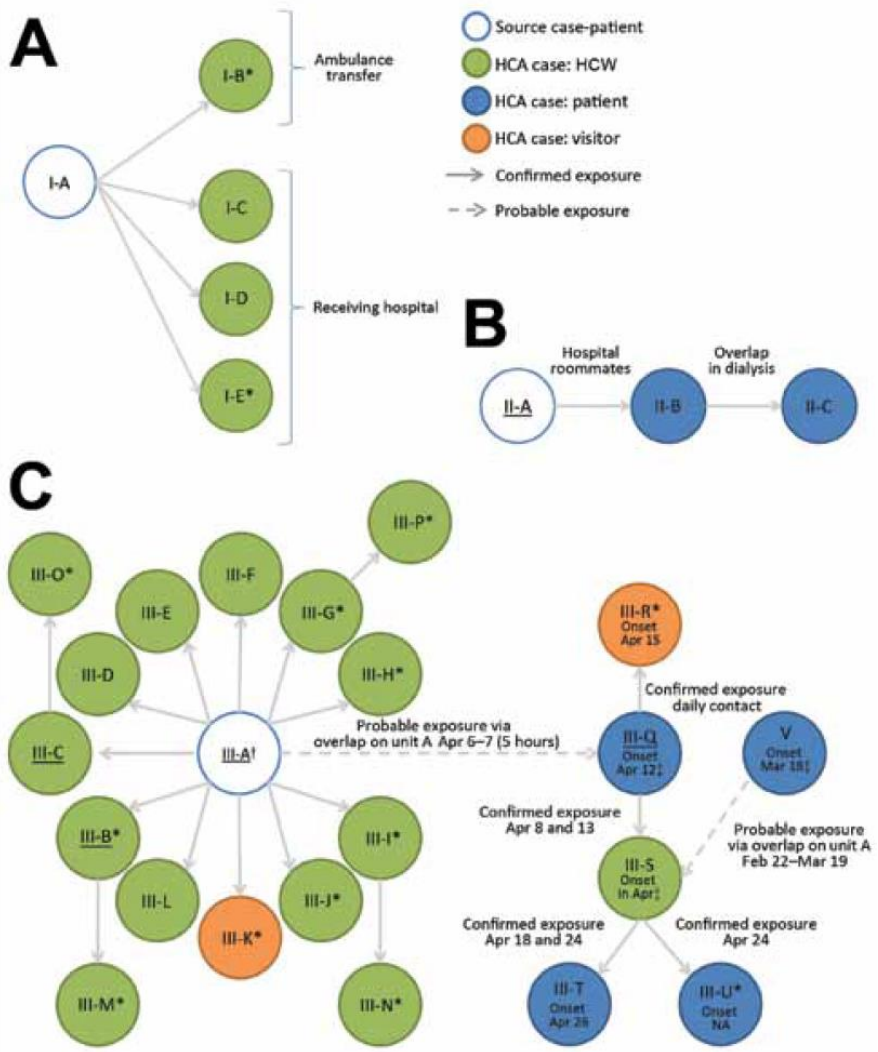
- ✓ **Renal transplantation immunosupressed**
- ✓ **Contact with HCW**
  - Around 100
  - No PPE
  - No secondary cases
- ✓ **Corticosteroids treatment**
- ✓ **40 contacts (home)**
  - No PPE
  - No secondary cases

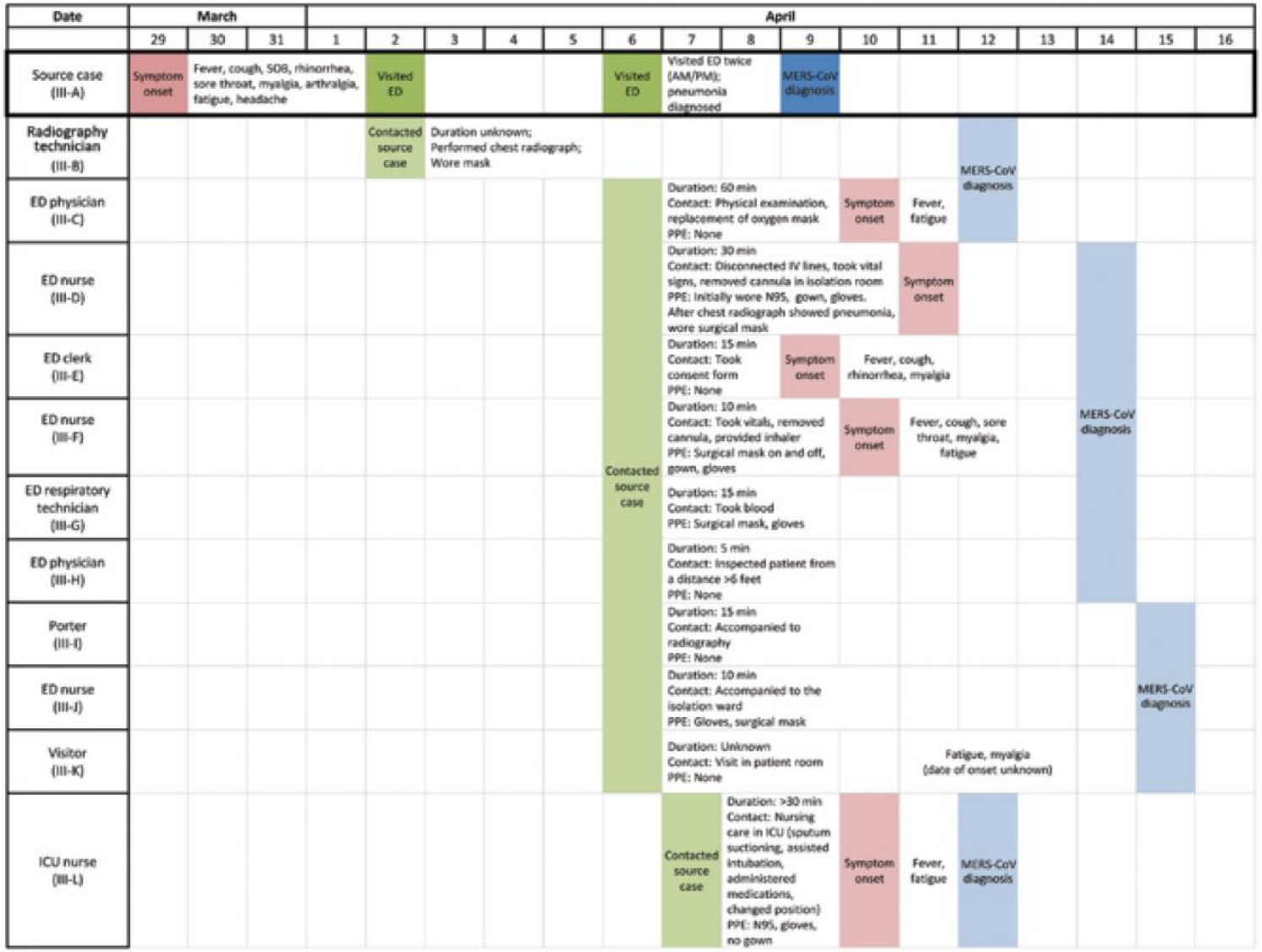
- ✓ The room was 20 m^2, and 1·5 m separated the two patients' beds.
- ✓ Both patients shared the same bathroom.

Transmission of Middle East Respiratory Syndrome Coronavirus Infections in Healthcare Settings, Abu Dhabi

Jennifer C. Hunter, Duc Nguyen, Bashir Aden, Zyad Al Bandar, Wafa Al Dhaheri, Kheir Abu Elkheir, Ahmed Khudair, Mariam Al Mulla, Feda El Saleh, Hala Imambaccus, Nawal Al Kaabi, Farrukh Amin Sheikh, Jurgen Sasse, Andrew Turner, Laila Abdel Wareth, Stefan Weber, Asma Al Ameri, Wesal Abu Amer, Negar N. Alami, Sudhir Bunga, Lia M. Haynes, Aron J. Hall, Alexander J. Kallen, David Kuhar, Huong Pham, Kimberly Pringle, Suxiang Tong, Brett L. Whitaker, Susan I. Gerber, Farida Ismail Al Hosani

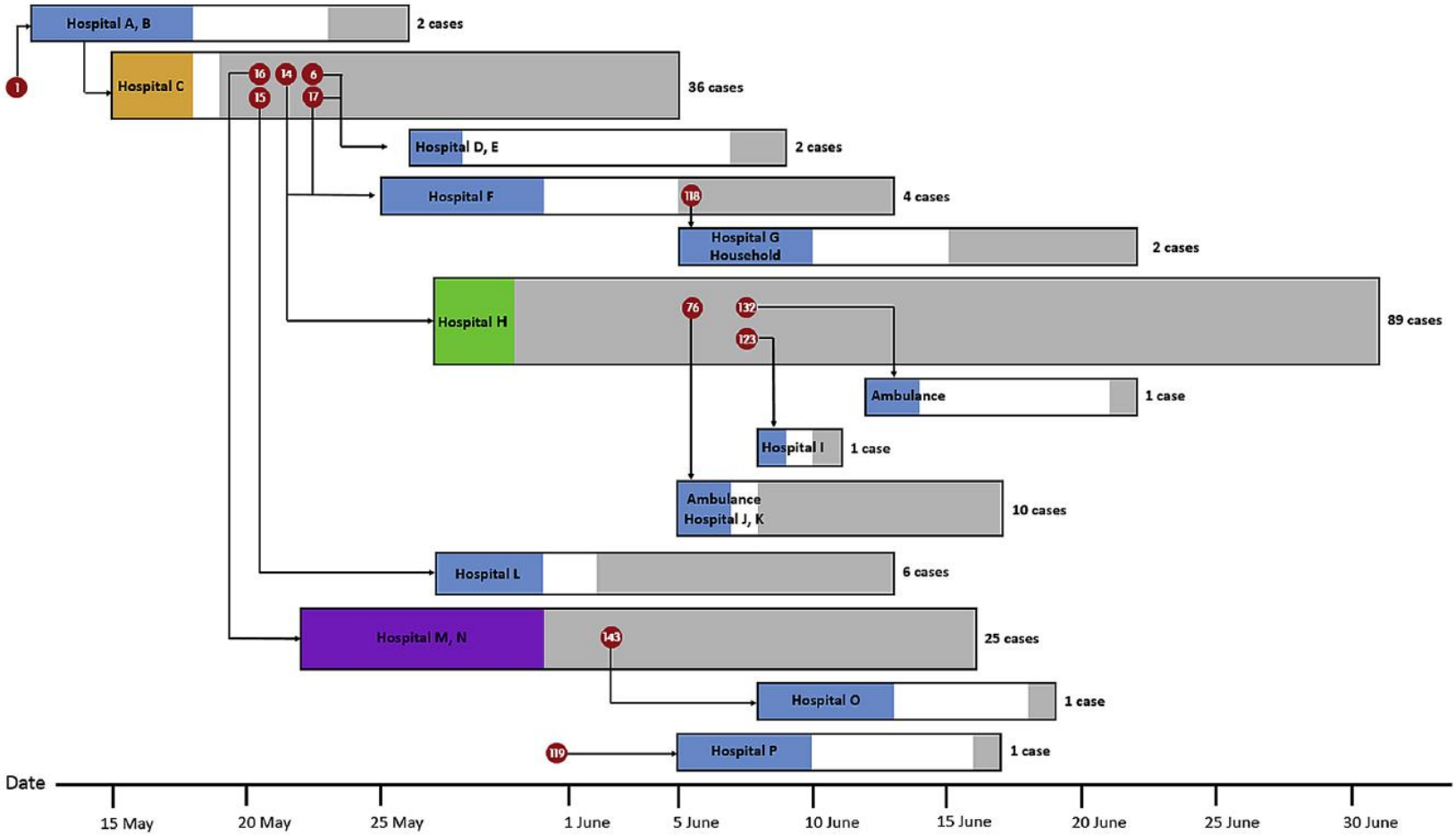
- ✓ Laboratory-confirmed MERS-CoV cases : January 1, 2013–May 9, 2014.
- ✓ 65 case-patients identified with MERS-CoV infection, 27 (42%) had healthcare-associated cases




Date
March
April
29
30
31
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Source case (III-A)
Symptom onset
Fever, cough, SOB, rhinorrhea, sore throat, myalgia, arthralgia, fatigue, headache
Visited ED
Visited ED
Visited ED twice (AM/PM): pneumonia diagnosed
MERS-CoV diagnosis
Radiography technician (III-B)
Contacted source case
Duration unknown; Performed chest radiograph; Wore mask
MERS-CoV diagnosis
ED physician (III-C)
Duration: 60 min
Contact: Physical examination, replacement of oxygen mask
PPE: None
Symptom onset
Fever, fatigue
ED nurse (III-D)
Duration: 30 min
Contact: Disconnected IV lines, took vital signs, removed cannula in isolation room
PPE: initially wore N95, gown, gloves.
After chest radiograph showed pneumonia, wore surgical mask
Symptom onset
ED clerk (III-E)
Duration: 15 min
Contact: Took consent form
PPE: None
Symptom onset
Fever, cough, rhinorrhea, myalgia
ED nurse (III-F)
Duration: 10 min
Contact: Took vitals, removed cannula, provided inhaler
PPE: Surgical mask on and off, gown, gloves
Symptom onset
Fever, cough, sore throat, myalgia, fatigue
MERS-CoV diagnosis
Contacted source case
ED respiratory technician (III-G)
Duration: 15 min
Contact: Took blood
PPE: Surgical mask, gloves
ED physician (III-H)
Duration: 5 min
Contact: Inspected patient from a distance >6 feet
PPE: None
Porter (III-I)
Duration: 15 min
Contact: Accompanied to radiography
PPE: None
ED nurse (III-J)
Duration: 10 min
Contact: Accompanied to the isolation ward
PPE: Gloves, surgical mask
MERS-CoV diagnosis
Visitor (III-K)
Duration: Unknown
Contact: Visit in patient room
PPE: None
Fatigue, myalgia (date of onset unknown)
ICU nurse (III-L)
Contacted source case
Duration: >30 min
Contact: Nursing care in ICU (sputum suctioning, assisted intubation, administered medications, changed position)
PPE: N95, gloves, no gown
Symptom onset
Fever, fatigue
MERS-CoV diagnosis

Middle East Respiratory Syndrome Coronavirus Outbreak in the Republic of Korea, 2015

Korea Centers for Disease Control and Prevention*



- ✓ Transmission map of 182 confirmed cases of Middle East respiratory syndrome coronavirus (MERS-CoV) infection in the Republic of Korea
- ✓ 83.2% of the transmission events were linked to **five superspreaders**

Osong Public Health Res Perspect 2015 6(4), 269–278

Environmental Contamination and Viral Shedding in MERS Patients During MERS-CoV Outbreak in South Korea

Seo Yu Bin,[1,a] Jung Yeon Heo,[2,a] Min-Suk Song,[3,a] Jacob Lee,[1,a] Eun-Ha Kim,[3] Su-Jin Park,[3,4] Hyeok-il Kwon,[3,4] Se mi Kim,[3,4] Young-il Kim,[3,4] Young-Jae Si,[3,4] In-Won Lee,[3,4] Yun Hee Baek,[3] Won-Suk Choi,[3] Jinsoo Min,[2] Hye Won Jeong,[2] and Young Ki Choi[3,4]

Swab Site	PCR Results (Positivity Percent, %)	Culture Results (Positivity Percent, %)
Bed sheet	3/15 (20.0)	1/15 (6.7)
Bedrails	4/15 (26.7)	1/15 (6.7)
Bed tables	2/5 (40.0)	0/5 (0.0)
Bed controllers	5/15 (33.3)	0/15 (0.0)
Shelves	0/14 (0.0)	0/14 (0.0)
Door buttons	1/10 (10.0)	0/10 (0.0)
Bathroom door knobs	1/10 (10.0)	0/10 (0.0)
Patient room floor	0/7 (0.0)	0/7 (0.0)
Patient monitor buttons	0/5 (0.0)	0/5 (0.0)
Thermometers	1/5 (20.0)	0/5 (0.0)
IV fluid hangers	5/14 (35.7)	2/14 (14.3)
Portable X-rays	1/5 (20.0)	0/5 (0.0)
Computed radiography cassette	1/1 (100.0)	1/1 (100.0)
Anteroom floors	2/14 (14.3)	0/14 (0.0)
Anteroom tables	3/7 (42.8)	1/7 (14.3)
Entrances of air-ventilating equipment	1/6 (16.7)	0/6 (0.0)

Conclusion

- ✓ Mise en place plus systématiques de précautions complémentaires
- ✓ Constance de l'application des mesures dans le temps
- ✓ Education prenant en compte l'ensemble des intervenants
- ✓ Superspreaders

Unité spécialisé?

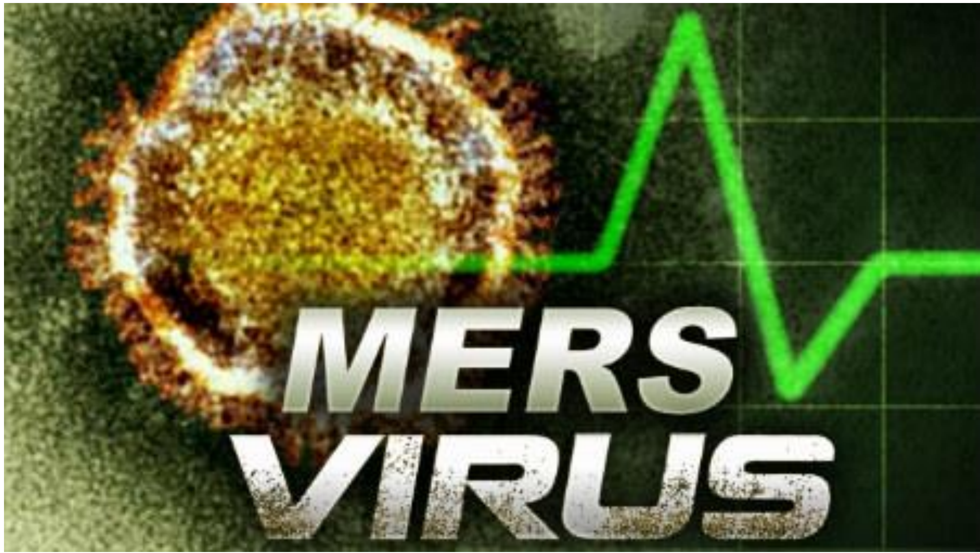
Hôpitaux de recours?

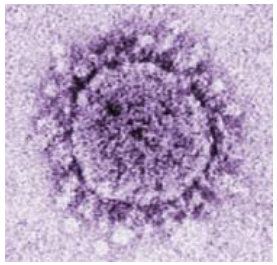
Plans et choix nationaux


الطوارئ
EMERGENCY

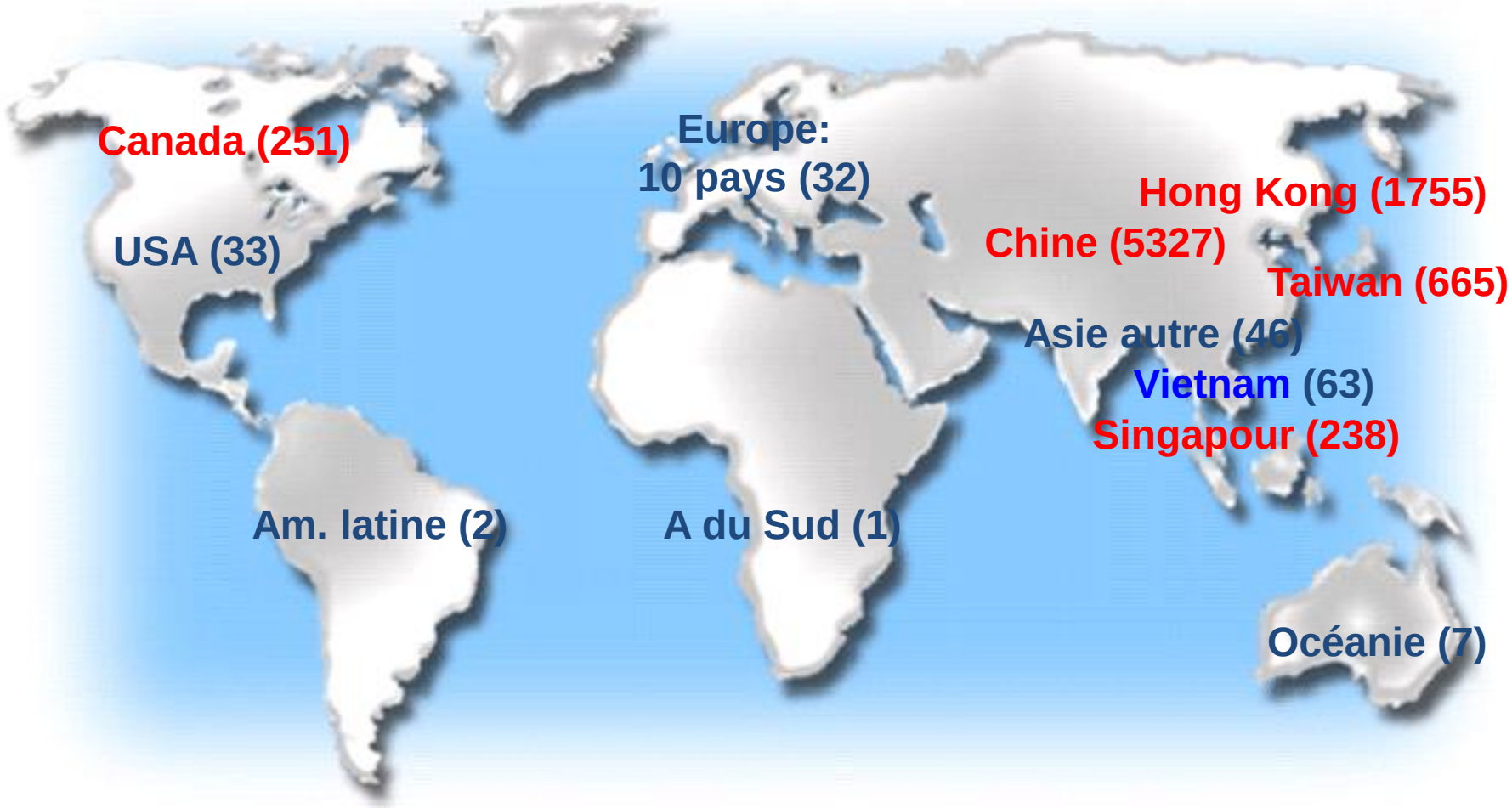

SARS
VACCINE
QUARANTINE
CHINATOWN
FOUND
GOVERNMENT
CITATION
ACCESSED
CONTROL
HOSPITAL
NEW
PUBLIC
CAUSED
SEVERE
PATIENTS
SINGAPORE
RESPIRATORY
CORONAVIRUS
INFECTION
PEOPLE
CANADA
NEEDED
SYSTEM
ONE
UNITED
MAY
SYNDROME
SPREAD
PATIENT
HUMANS
FIRST
CHINESE
JULY
VIRUS
ARTICLE
INFECTIONS
SUSPECTED
ORGANIZATION
PMID
OFFICIALS
WORLD
LOCAL
CASES
TAIWAN
TORONTO
ALSO
HONG
KONG
CHINA
TREATMENT
HEALTH
EDIT
DISEASE
OUTBREAK
INFORMATION
INTERNATIONAL
TRAVEL
GLOBAL
SEVERAL
TEST
CASE
ASIAN
RESEARCH
SARS-COV
MARCH
SYMPTOMS
PROBABLE
ACUTE
APRIL
VIRAL
INFECTIOUS
EPIDEMIC
RESEARCHERS
CORONAVIRUSES
CAUSE

HISTORIQUE

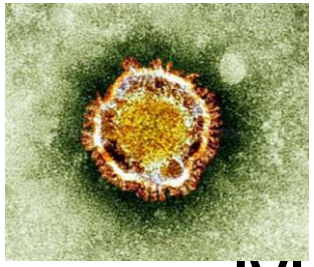

MERS
VIRUS



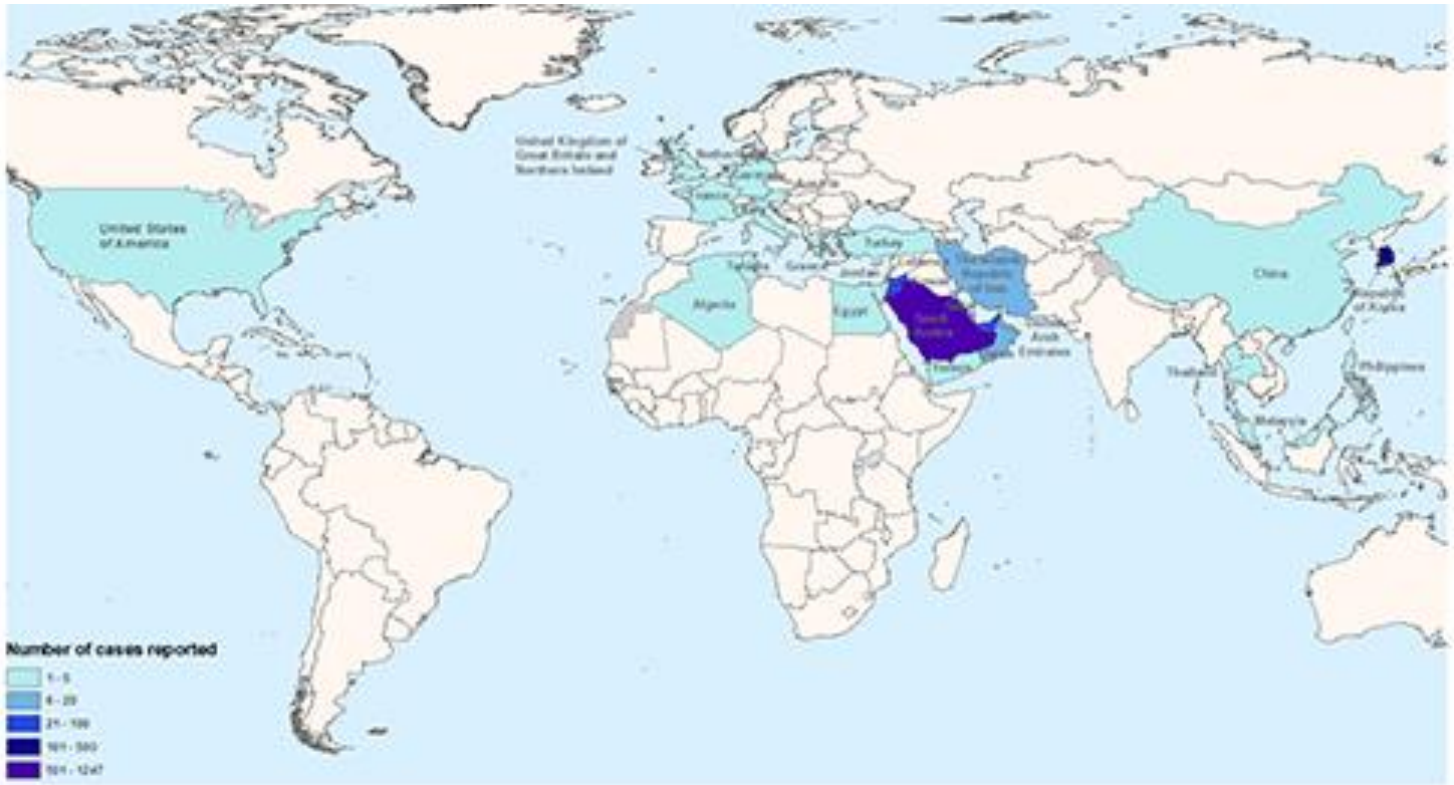
SARS-CoV



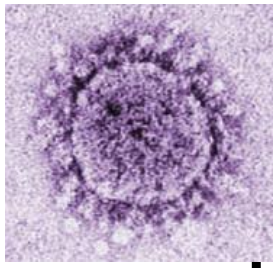
8422 cas, 916 décès (11%)

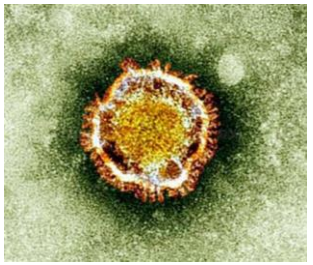


MERS-CoV



1684 cas confirmés / 600 décès





Historique

- 16 novembre 2002: 305 cas de pneumonie, Guangdong.
- 21 février: Cas index, hôtel Métropole
- 26 février: Début épidémie à l'hôpital Français de Hanoi
- 12 mars: Alerte mondiale déclenchée par OMS
- 16 avril: SARS-CoV « authentifié »
- 5 juillet: Fin officielle de l'épidémie

- Signalement Avril 2012 WHO
- 13 Juin 2012: 1 cas en Arabie Saoudite
- Séquençage du nouveau coronavirus réalisé en Octobre 2012
- Jordanie, Qatar, Arabie Saoudite, Emirats Arabes
- Angleterre, France, Allemagne, Italie, Tunisie
- 26 pays touchés
- …...