

# A large common point source nosocomial outbreak caused by ESBL-producing *Enterobacter cloacae* at one Belgian university hospital

Y. Glupczynski<sup>1</sup>, A. Noël,<sup>1</sup> I. Michaux,<sup>2</sup> S. Dupont<sup>1</sup>, S. Lessire<sup>3</sup>, A.-S. Dincq<sup>3</sup>, L. Melly,<sup>5</sup> T.-D. Huang,<sup>1</sup> N. Ausselet,<sup>4</sup> C. Dransart,<sup>3</sup> B. Delaere,<sup>4</sup> B. Rondelet<sup>5</sup>

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<sup>1</sup> Infection control unit and clinical microbiology laboratory, CHU UCL Namur, 5530 Yvoir, Belgium

<sup>2</sup> Intensive Care Unit Dept, CHU UCL Namur, 5530 Yvoir, Belgium

<sup>3</sup> Anesthesiology Dept., CHU UCL Namur, 5530 Yvoir, Belgium

<sup>4</sup> Infectious Diseases Unit, Dept. of Internal Medicine, CHU UCL Namur, 5530 Yvoir, Belgium

<sup>5</sup> Cardiothoracic surgery Dept., CHU UCL Namur, 5530 Yvoir, Belgium CHU Dinant-Godinne UCL Namur, 5530 Yvoir, Belgium



## Setting



- **University hospital**

- 3 hospitalization sites (St Elisabeth Namur, Mont-Godinne, Dinant)

- Bed Size: 946 beds (4300 Employees, 600 MDs)

Population of 450,000 inh. (Province of Namur)

- 42,000 patients adm.; 500,000 polyclinic visits, 120,000 day care visits/year

- **Full medical coverage + specialized poles of activity**

- onco-hematology, (autogenic/allogenic HSCT),

- 400-500 cardiac surgery interventions /year

- Cardiothoracic surgery: 30 lung transplant recipient/year)

# First episodes of clustered infections caused by ESBL-producing *E. cloacae* (I)

- **Alert triggered on Nov. 26<sup>th</sup> 2015: post-operative infections by ESBL- producing *E. cloacae* in 4 cardiac surgery patients hospitalized in ICU at the time of microbiological sampling/result**
- **Visit of ICUs** for observation of routine clinical practices
- **Reinforcement of hand hygiene and infection control measures**
- **Revision of care policies** (inhalation therapy, respiratory procedures, cleaning/disinfection practice of materials/equipment and environment)

# Occurrence of the first clustered cases of ESBL-positive *E. cloacae* infections in ICU patients (Nov. 2015)

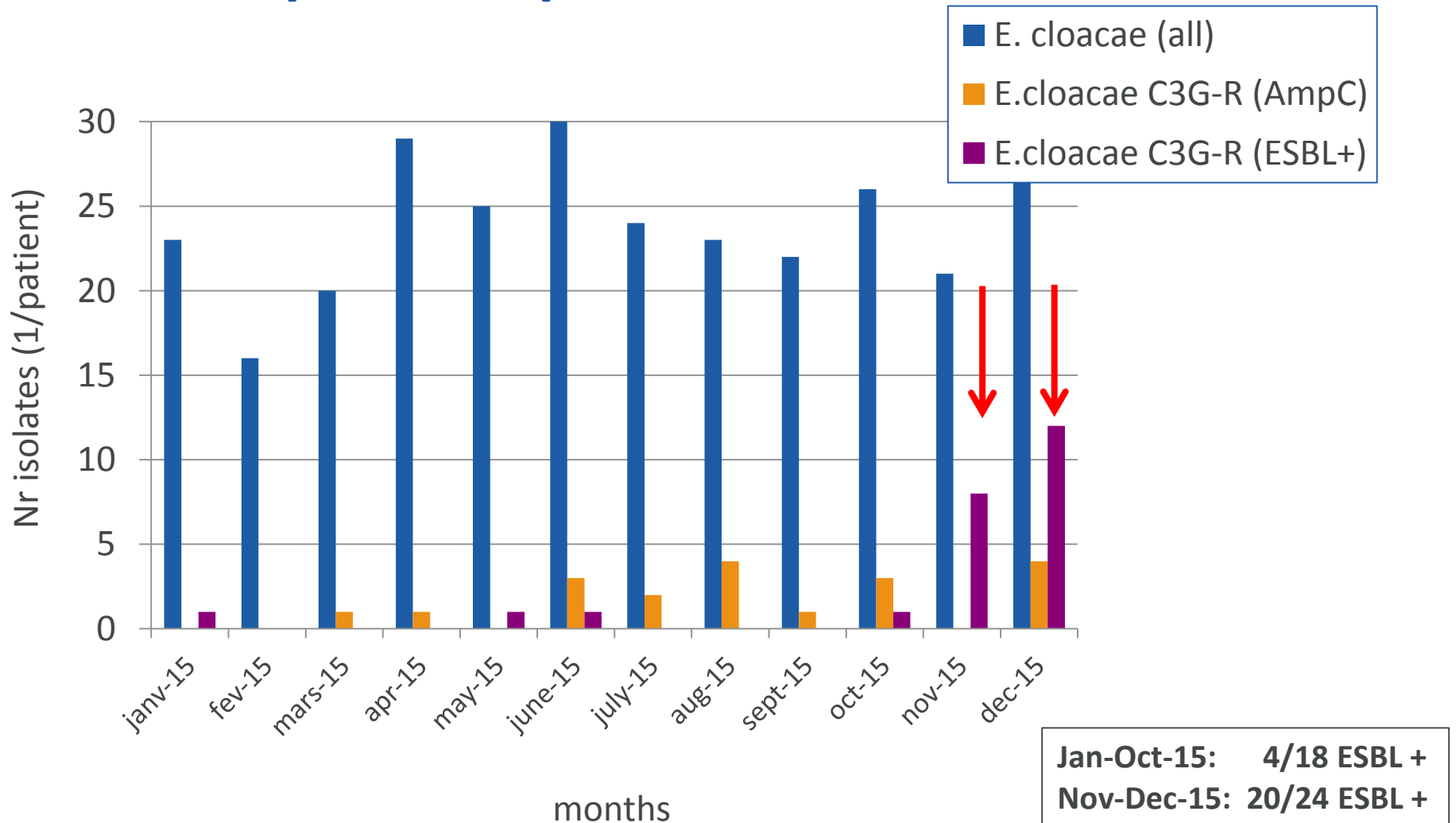
Patients 1 & 2 transferred from the same hospital; no screening specimens obtained upon admission

Patient number	Age (yrs)	Date of Admission	Date of Intervention	Date of first isolation	Anatomical site	Infection	Clinical outcome
P1	84	8/11/2015	9/11/2015	12/11/2015	Blood, ETA*	Sepsis, Pneumonia	Died (day 4)
P2	64	5/11/2015	10/11/2015	16/11/2015	Sternum, ETA	Sternititis, wound abscess	Chronic morbidity
P3	68	23/11/2015	23/11/2015	26/11/2015	ETA	Broncho-pneumonia	Cure
P4	68	20/11/2015	23/11/2015	27/11/2015	ETA	Broncho-pneumonia, superficial sternal infection	Chronic morbidity

\*ETA= Endotracheal aspirates

Four patients in two different ICU units (ICU A and ICU B)

# Monthly incidence of 3<sup>rd</sup> Gen ceph-resistant *Enterobacter cloacae* isolates detected in hospitalized patients (Mont-Godinne-2015)

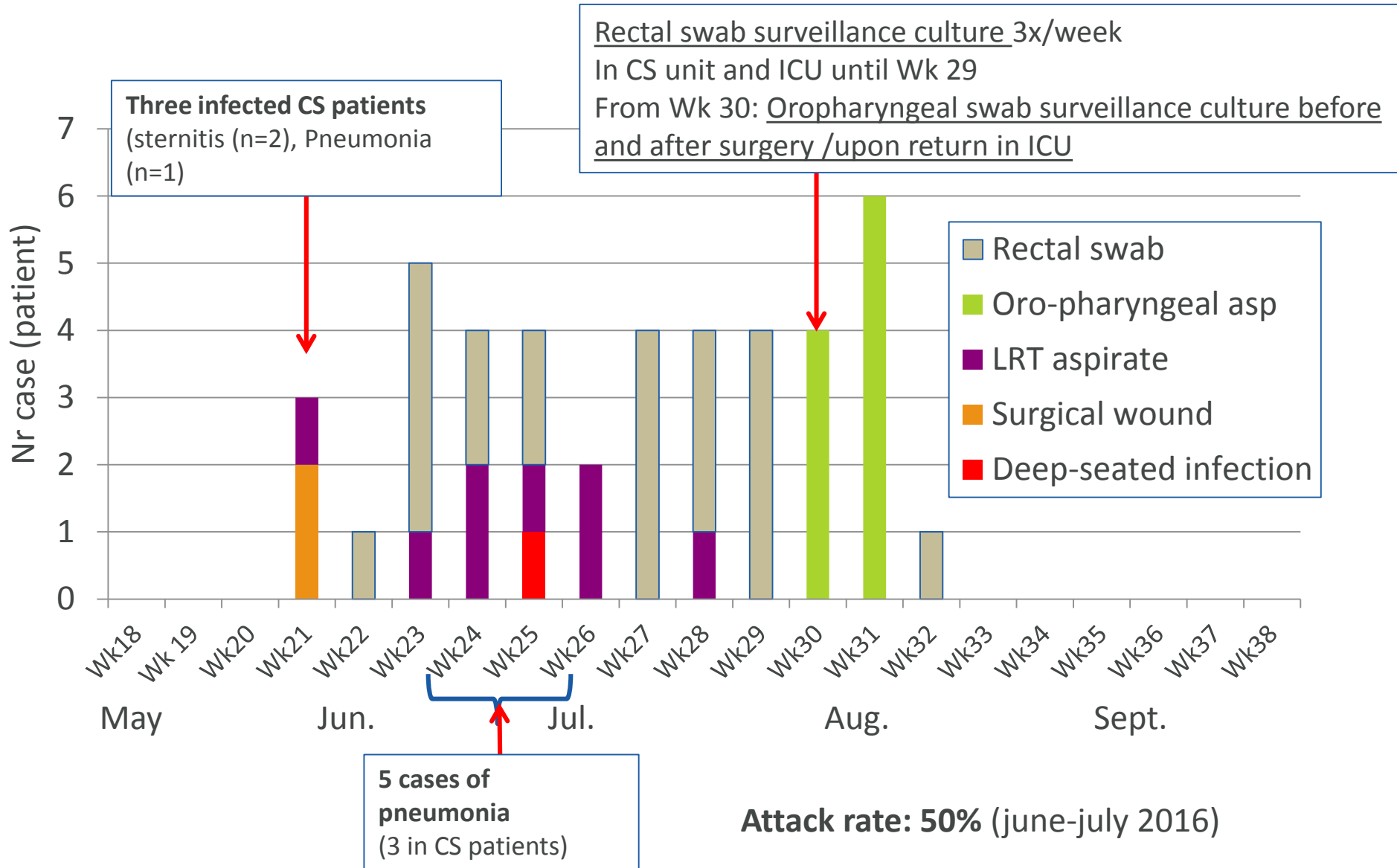


# First episode of clustered infections caused by ESBL-producing *E. cloacae* (II)

- **Progression of the outbreak** despite reinforced infection control measures (new carriers identified in several wards)
- **Intensification of surveillance cultures** (3x/week; collection of respiratory samples for all CS patients in ICU)
- **Cohorted nursing** with additional designed personnel
- **Repeated visits** to ICU and to OR (12/2015)
  - ✓ Observation of routine care practice
  - ✓ Microbiological sampling of the environment
  - ✓ Revision of selected procedures with altered standard practice (intubation/extubation, respiratory support care)
  - ✓ Reinforced cleaning disinfection of environment
- **Stop of lung transplantation programme** (10/12/2015)
- **Closure of CS hospitalization unit** to new admissions and **stop of all cardiac surgical activities** (during 2 weeks)

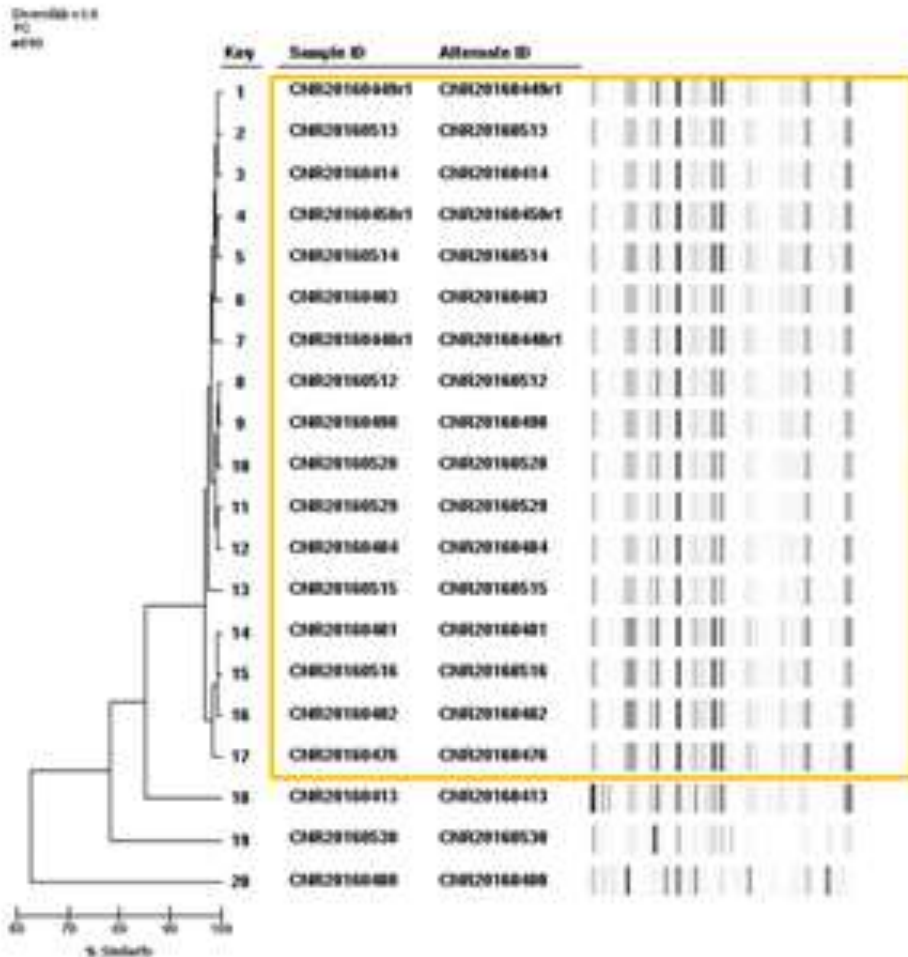
 *Situation considered under control by Jan. 15, 2016*

# Second epidemic wave of ESBL-producing *E. cloacae* (may-Sept. 2016)



# Microbiological investigations

## ➤ Typing of ESBL-producing *E. cloacae* isolates



Dendrogram of the isolates

**Single cluster** of *E. cloacae* (17/20 strains) associated with single Rep-PCR type (DL type 11)

**Similar antibioresistance type:**  
(C3-G: I/R, Genta- Tobra-R, Cipro-I, SXT-R)  
Carbapenem-S

### Genotyping of resistance:

*bla*<sub>CTX-M-15</sub> (+ *bla*<sub>TEM-1</sub>)  
Aminoglycoside: *aacC2*  
Fluoroquinolones: *aac-6'-Ib-cr*, *qnrB*)

-> **Clonal outbreak**

MLST type= **ST190** (not very prevalent/  
widespread clone)

Same isolate in both periods (phase I and II)



# Case definition

- **ESBL-producing *E. cloacae*** in a **respiratory sample** of patients hospitalization in the **ICU** (period Nov-Dec. 2015)
- **ESBL-producing *E. cloacae*** (C3rdG, Genta-R, Cipro-I) in **cardiac surgery patient** (whatever the hospitalization unit) **in any type of culture specimens** (clinical specimens or surveillance culture) (period Jan.-Sept. 2016)
- Patients categorized as **colonized or infected** according to **CDC definitions** on the basis of retrospective review of medical records

# Timing of colonisation by ESBL-producing *E. cloacae* from cardiac surgery intervention

- According to patient status:
  - **Infected:** mean: 1,4d; median: 2 d
  - **Colonized:** mean: 6,5d; median: 4 d
- According to sampling site:
  - **Rectal swab:** mean: 5,6 d; median 5 d (2 negative rectal swab results before becoming positive) (low inoculum, oral -> bowel, antimicrobial prophylaxis)
  - **Respiratory tract:** mean: 1,4 d; median 1 d  
(several patient with positive RT and negative rectal swab culture results)

- ➔ **implementation of screening in the OR immediately after intervention** (*at time of retransfer to ICU*)
- ➔ **New hypothesis in favor of early point source acquisition in the OR** (rather than cross-transmission in ICU or in CS ward)

# Case-control study assessing risk factors for carriage of ESBL-producing *E. cloacae*

Characteristics	Case patients (n=26)	Control (n=49)	OR	CI95%	p-value
Age, Mean years	63.8	64.4			.98
Male	20 (77)	38 (78)			.95
Previous history of stay to the ICU	25 (96)	44 (89)	2,8	0.3-23.6	.33
Duration of ICU stay > 7 days	4 (15)	13 (27)	0.5	0.1-1.7	.27
Inhalation therapy/kinesitherapy	21 (81)	41 (84)	0.8	0.2-2.8	.75
Exposure to intubation	22 (85)	42 (86)	1.1	0.3-4.0	.89
Exposure to any type of surgery	25 (96)	39 (80)	6.4	1.0-42.3	.054
<b>Exposure to cardiac surgery</b>	<b>24 (92)</b>	<b>7 (14)</b>	<b>72</b>	<b>19.9-259.9</b>	<b>&lt;.0001</b>
<b>Exposure to TOE during surgery</b>	<b>24 (92)</b>	<b>6 (12)</b>	<b>89</b>	<b>23.5-314.4</b>	<b>&lt;.0001</b>
<b>Rectal probe for temperature monitoring during surgery</b>	<b>22 (85)</b>	<b>14 (29)</b>	<b>14</b>	<b>4.5-41.8</b>	<b>&lt;.0001</b>

Cardiac surgery: case patients had more complex and longer interventions

- valvular prosthesis surgery (n=14);
- Thoracic surgery (n=3; 2 bi-pulmonary transplantation),
- Coronar artery by-pass grafting CABG (n=7)

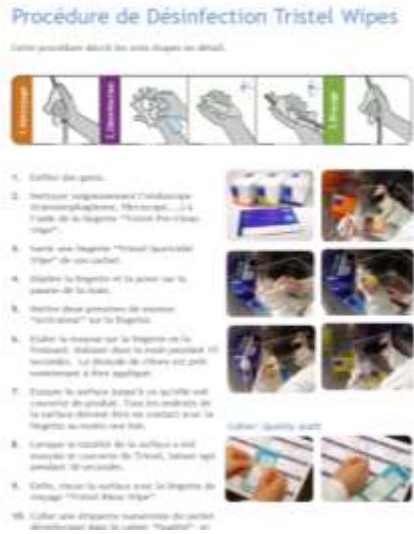
univariate conditional logistic regression analysis for the calculation of risk factors

2-tailed test of significance; P value <.05 considered statistically significant

# Numerous breaks in procedures related TEE in the OR during cardiac surgery



Lack of appropriate maintenance/cleaning  
Of the ultrasonographic instruments  
Dedicated for cardiac surgery (blood stains/spots,....)



Inappropriate procedure of cleaning/disinfection  
Of TEE probe ( ≠ high level disinfection)



suboptimal storage conditions



Sterile lubrication gel K-Y monodose (5g)  
not always traced as single use



No use of protective sheath of the TEE probe during intervention, proximity contact of the probe with heater-cooler reservoir



# Multiple sampling of environment and equipment/material in Cardiac surgery OR

7 days swab and enrichment culture on Lethen (lecithin/polysorbate) broth and on McConkey agar + ceftazidime (2 µg/ml)

**>50 samples obtained: None were culture-positive for *Enterobacter cloacae***  
**All swab samples from TTE equipment: culture-negative**

- ✓ *Computers, keyboards, pads,....*
- ✓ *Artificial respirator circuit and intubation equipment set, heat exchanger CEC equipment*
- ✓ *Water, Solution, Liquids (cardioplegia solutions, antiseptic solutions, local anesthetics, sterile gel for TEE probe, ....)*
- ✓ *Tip/connector of thermal probes (rectal, esophageal, vesical)*
- ✓ *Transesophageal echocardiographic (TOE) equipment ((transducer tip, shaft, handle, socket,....)*

# Report of cardiac surgery nosocomial outbreaks associated with transesophageal echocardiography

Author (year)	Country	Organism	Nr of affected patients	Duration of outbreak	Causal Link
Levy (2003)	France	<i>Legionella pneumophila</i>	3	NR	Probable; contamination of TEE rinsing water
Kanemitsu (2004)	Japan	<i>E. cloacae</i>	17	2 months	Proven; TEE probe contamination
Bancroft (2006)	USA	<i>E. coli</i>	8	1 month	Unproven; TEE probe contamination
CDC MMWR (2011)	USA	<i>P. aeruginosa</i>	16	2 months	Proven; multidose ultrasound gel contamination
Vetter (2012)	Switzerland	<i>S. marcescens</i>	91	12 months	Proven; TEE probe contamination
Suleyman (2015)	USA	<i>ESBL+ Salmonella enterica serov. Isangi</i>	19	2 months	Probable; TEE probe contamination

# « *Disconnect the socket* » strategy

- **Repeated negative microbiological culture** of TEE probe specimens (12 swab samples/obtained at different time intervals)
- **Lack of visual (macroscopic) defects** of the TEE probe tip (*Presence of microscopic surface scratches/defects of the probe tip possible/probable but not investigated...* )
- **Decision to remove the 3D TEE probe** taken on Aug 8th, 2016 led to rapid termination of the outbreak  
(1 single asymptomatic intestinal carriage, 64 days after intervention)  
*No single case since Sept 2<sup>nd</sup>, 2016*



....and the light bulb will go off

# Major consequences of the outbreak

## ➤ Period May-Sept. 2016 (94 days)

- ✓ **42 patients affected** (33 colonized, 9 infections)
- ✓ **Attack rate: 50%** (40 of 81 pts with cardiac surgery and per-operative TEE) colonized/infected (respiratory tract/rectal swab) in the week after surgery
- ✓ **9 infections** (pneumonia [n=7]; sternitis/mediastinitis [n=2])
- ✓ **30-days crude mortality rate: 9.5%** (4 possible/probable link)
- ✓ **Increase in the median LOS vs control patients)**
  - Colonization : +1 day in ICU ; + 5 days in LOS
  - Infection : + 10 days in ICU; + 17 days in LOS

**Decreased medical activity** (ward closure, stop of cardiac/lung transplantation surgery), major changes in organization at all levels



# Conclusion

- **Large point source outbreak caused by an ESBL-producing *E. cloacae*** traced to contamination of TEE probe used intra-operatively in cardiac surgery patients
- **Major medical and economical impact** with decrease of activity and modifications of care organization
- **Central role of the infection control team** in the coordination of the outbreak management and implementation of appropriate containment strategies