Screening for carriage of carbapenem-resistant Enterobacteriaceae

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Aims of screening for MDR GNR

- Patients screening:
  - Data for policy making
  - Evaluating the success of interventions
  - Limiting the spread of resistance, i.e., direct enhanced infection control measures
  - Discontinuation of infection control measures
- Lab based organism screening:
  - Screening of clinical isolates for early detection of new MDR pathogens

Screening for policy making

- During activity in acute-care hospitals to prevent the spread of CRE (2007) it become clear to us that influx from LCTF is a major problem
- No data on CRE in LTCF and variable measures were taken with unclear success
- To intervene we needed data

CRE in LTCF 2008

- We collaborated with the 12/14 PAC facilities ~3000 beds
- Conducted point prevalence screening by rectal swabs
  - 1004 not previously recognized patients were screened
  - 12% were carriers
- We Identified risk factors and targeted interventions accordingly

Ben-David D. ICHE 2011

Screening for evaluating an intervention
Cross-sectional prevalence survey
comparison between the 2 surveys

Type of ward	2008 (n=1004)	2010 (n=1027)	P
Skilled nursing care	**25.9%** (75/215)	**15.6 %** (49/266)	**0.001**
Chronic mechanical ventilation	11.9% (16/131)	10.9 % (15/126)	0.8
Sub-acute	9.6% (22/229)	7.7% (16/193)	0.5
Rehabilitation	2.5% (9/359)	1.1 % (4/350)	0.26
TOTAL	**12.0%** (121/1004)	**8.3%** (85/1027)	**0.005**

Screening to reduce transmission

- Assumptions
  - There is an unidentified pool of colonized patients
  - This pool is a significant source for transmission
  - These patients can be identified
  - Once identified, effective methods to prevent transmission can be taken

The value of screening

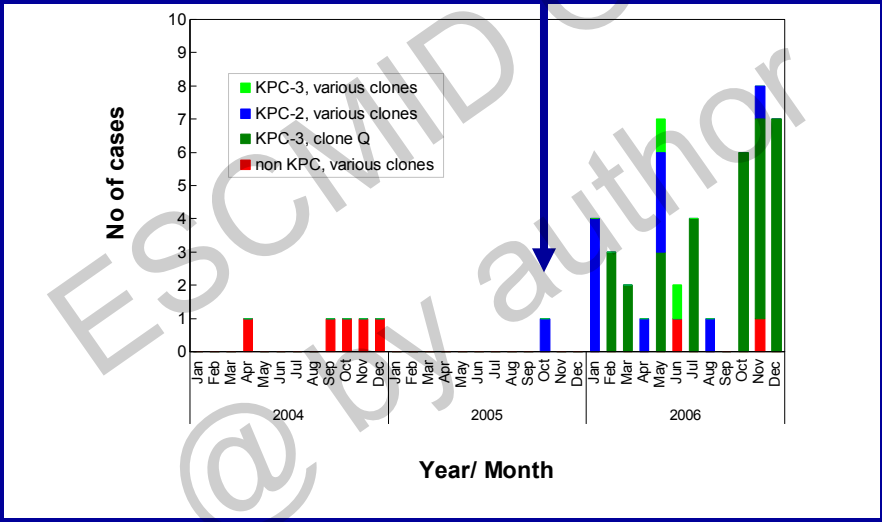
- Provides results with various accuracy, rapidity, and cost
- Triggers various actions
- Data for Action
  - Screening
    - Accuracy
    - Rapidity
    - Cost
  - Action
    - Effectiveness
    - Compliance
    - Cost
  - Screening and action are a bundle
    - Cost and effort required and medical and economic values should be considered for the bundle

Considerations

- Am I at a level of risk that I should screen?
- Universal vs. targeted screening
- Method of screening

When to screen

- Large scale intervention immediately when the first case occur is most effective
- Often missed opportunity
  - First case (or cases) not identified
  - Hard to justify costs and effort before "damage" has occurred.



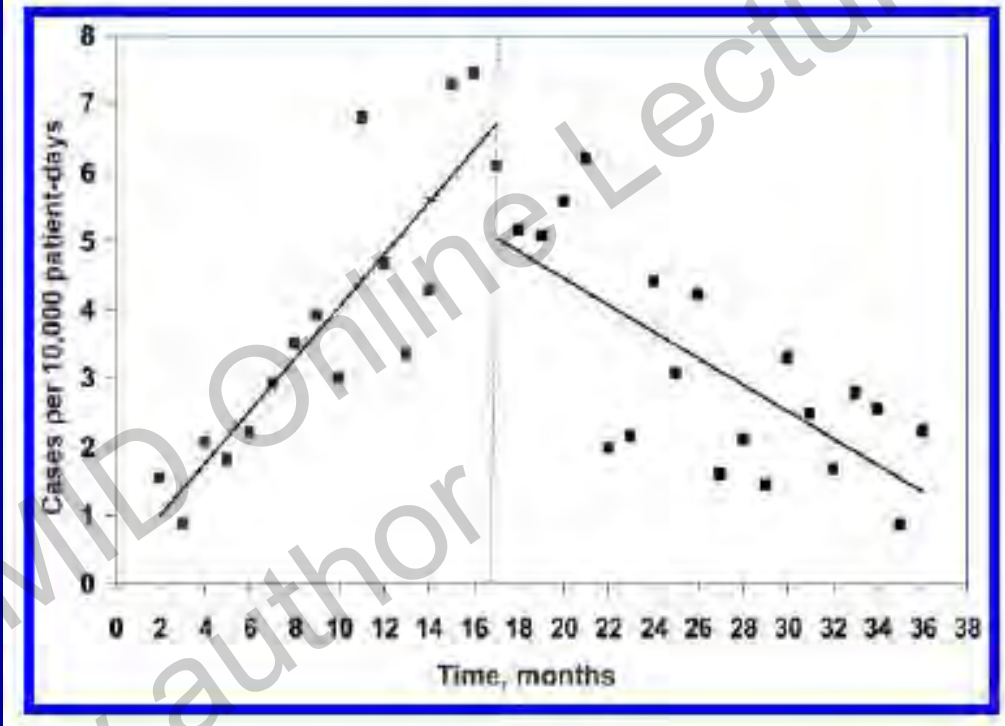
Intensive ntervention at this stage would have aborted the outbreak

Leavitt A., AAC, 2007

Strategy of screening

- Population at risk on admission
  - Early detection
  - Stoping the event at the gate
- Periodic screening at sites at risk
  - ICU
  - Hem/onc

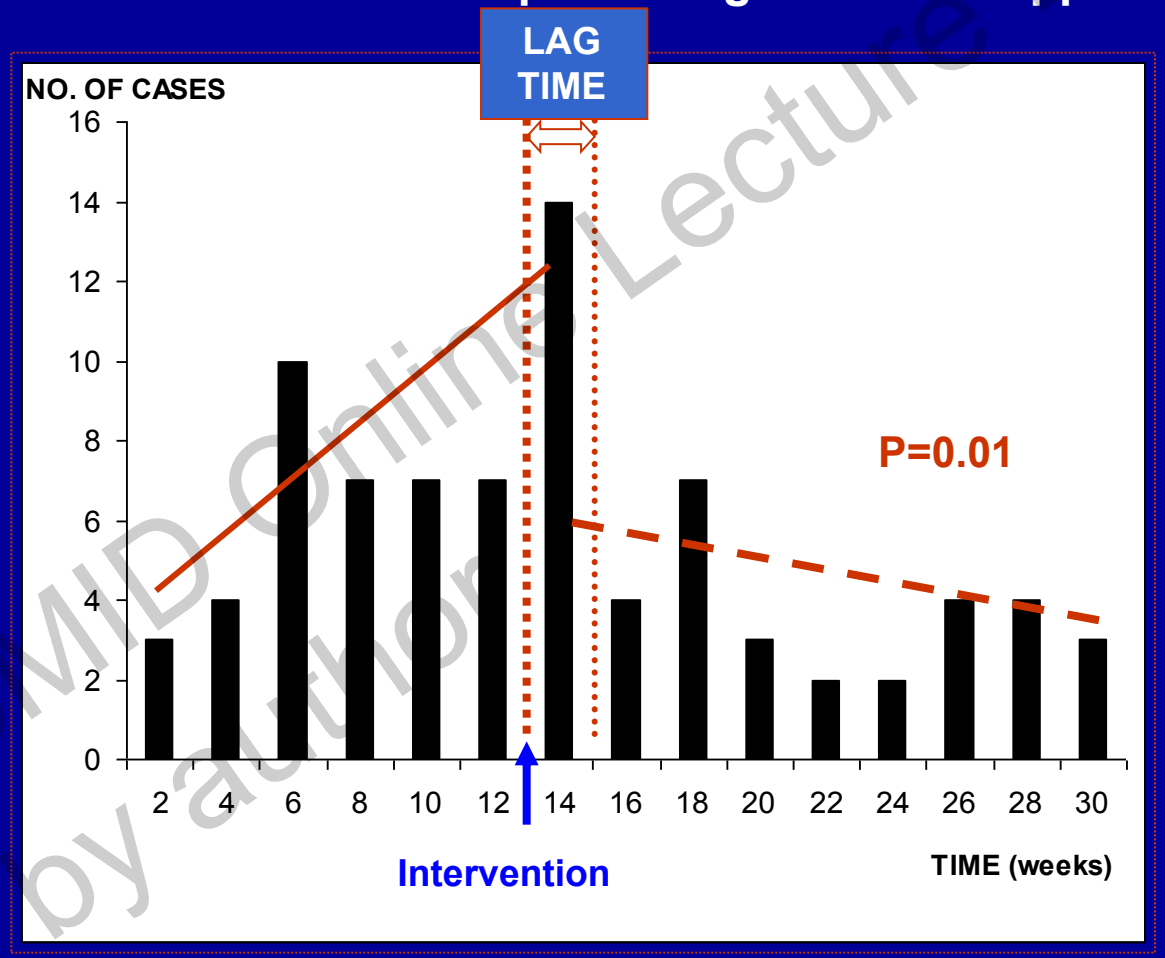
Potential Role of Active Surveillance in the Control of a Hospital-Wide Outbreak of Carbapenem-Resistant *Klebsiella pneumoniae* Infection



Ben-David D. ICHE 2010

One hospital's experience –moving from single room contact to cohorting and dedicated staff

Incidence of KPC-producing *Klebsiella* spp.



Schechner V, unpublished

Screening strategy

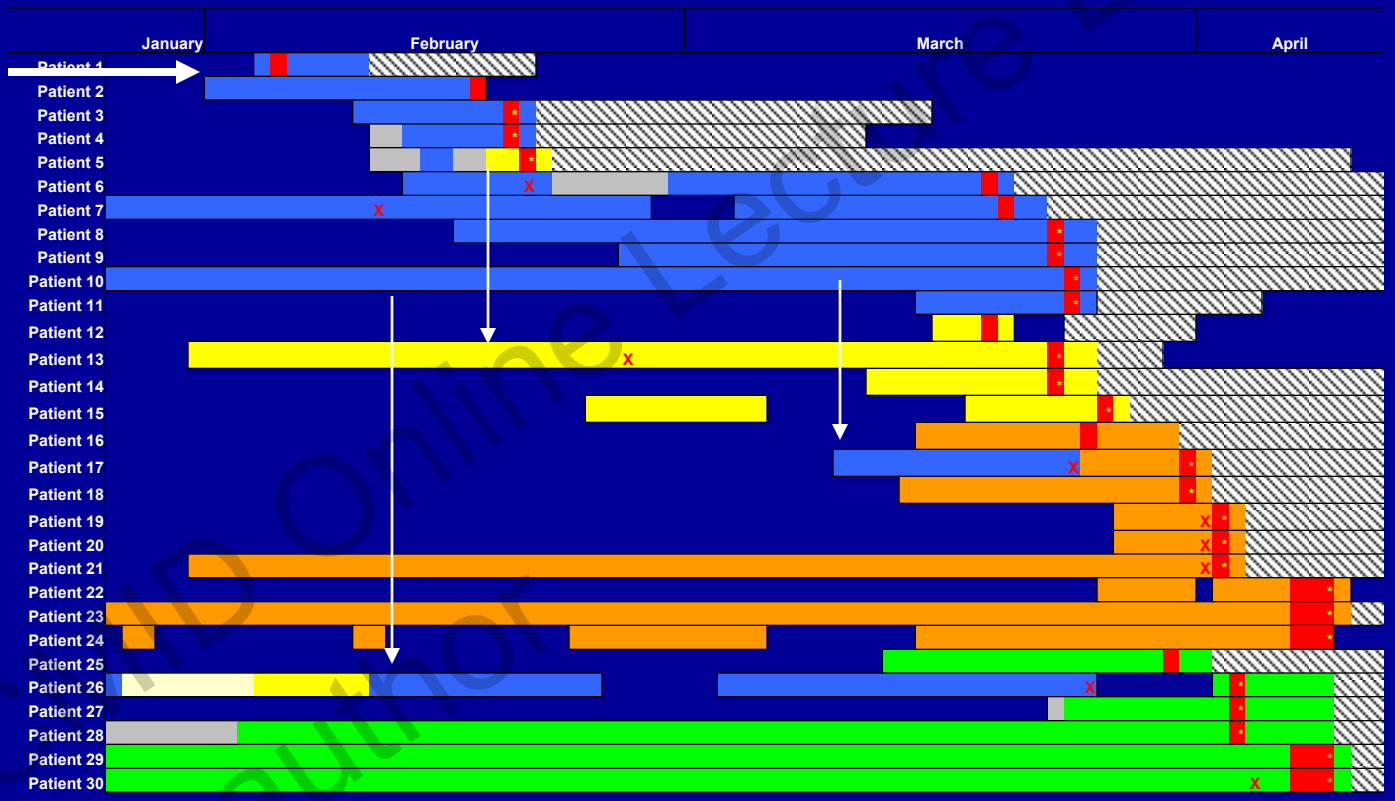
- Targeted contacts of positive = “patients treated by the same nurse” or in the same high risk unit (ICU)
  - 4-14 patients usually screened
  - 15% of screened contact patients were positive
  - Repeated screening until one cycle negative
- In non-contact wards 0-1% positivity

Consequences of not acting immediately

- Admission of an unidentified carrier of KPC Klebsiella and 5 days delay until cohorting led to a difficult to control outbreak, involving 30 patients (6 clinical infections) in 4 wards[1]
- Transfer overseas of a known carrier, but failure to isolate immediately, resulted in 9 additional clinical cases

1 Schechner V. ICAAC/IDSA 2008, paper 3806
2 Morris M. ICAAC/IDSA 2008, paper 1015

The movement of KPC Kp through 30 patients in 4 different wards



Note:

- Internal medicine X
- Internal medicine Y
- Internal medicine Z
- Internal medicine W
- Positive KPC Kp clinical culture
- Positive KPC Kp surveillance culture
- Negative surveillance culture
- Dedicated KPC Kp ward

Schechner V. ICAAC 2008

Body site to be screened

- Enterobacteria – GI tract is the reservoir. >95% of positive patients will have also a positive stool sample
- Acinetobacter - skin / pharynx / tracheal aspirate
- Pseudomonas ?

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Target screening 4/08

- All patients who have been hospitalized during the last year (or from LTCF) are screened for CRE upon admission
- All contacts of positive are screened
- If more than 1 pts is found positive, repeated wide screen is performed
- Swabs plated directly on selective media, if growth is observed subject to PCR to reduce time to result

PCR vs Culture based rectal swab screening

TABLE 2. Comparison of culture-based identification and PCR-based identification of bla_{KPC}-producing CRE after second analysis (755 rectal specimens)

bla_{KPC} CRE	No. of swabs with result determined by:					
	Microbiological identification[a]			Molecular identification[b]		
	Positive	Negative	Total	Positive	Negative	Total
Positive	56	8	64	59	5	64
Negative	4	687	691	3	688	691
Total	60	695	755	62	693	755

[a] Sensitivity, 87.5%; specificity, 99.4%; PPV, 93.3%; NPV, 98.8%.
[b] Sensitivity, 92.2%; specificity, 99.6%; PPV, 95.2%; NPV, 99.3%.

Time to result: PCR 30h
Culture based: 60h for negative, 75h for positive

Schechner V. JCM 2009

Accuracy of patient allocation

- Determined by
  - the screening test characteristics (sensitivity and specificity)
  - Prevalence among the screened population
  - The proportion screened
- When cohorting – false positive has serious implication (risk of acquisition)
- When trying to control an outbreak false negative has serious implications

False allocation for 1,000 screened

	Prevalence 2%	
Sensitivity/specificity	False negative (sensitivity driven)	False positive (specificity driven)
No screen	20	
99%	0.2	9.9
95%	1	51
85%	3.5	172

FN, False negative= (TP) * (1 – (sensitivity)) / (sensitivity)
FP, False positive = (TN) * (1 – (specificity)) / (specificity)

Action after 1,000 screening with 2% prevalence

True positive		20
Best test*	FN/ FP	0.2 / 9.9
	Action	30
	No action	0.2
2nd best*	FN/ FP	1 / 51
	Action	70
	No action	1

Best test - 99% sensitivity and specificity
2nd best - 95% sensitivity and specificity

Action after 1,000 screening: 2% prevalence 99% specificity, 95% sensitivity

TRUE Positive	20
False positive	9.9
False negative	1
Action	30
No action	1

Best test - 99% sensitivity and specificity
2nd best - 95% sensitivity and specificity

No action for True Positive, effect fo compliance with screening

% screened	Number missed
100%	0.2
90%	2.18
80%	4.16
70%	6.14
60%	8.12
50%	10.1

99% specificity
20 /1000 true positive patients

What is needed?

- Policy whom to screen
- System that confirms that this is implemented
- Sensitive method for screening
- Rapid result
- Policy of allocation until results
- Confirmatory test
- On going evaluation of the strategy and performance

Summary

- Screening is part of an integrated approach
- Collaboration between microbiology laboratory and infection control
- Part of institutional/country strategy
- Cost and benefit need to be evaluated taking long term approach