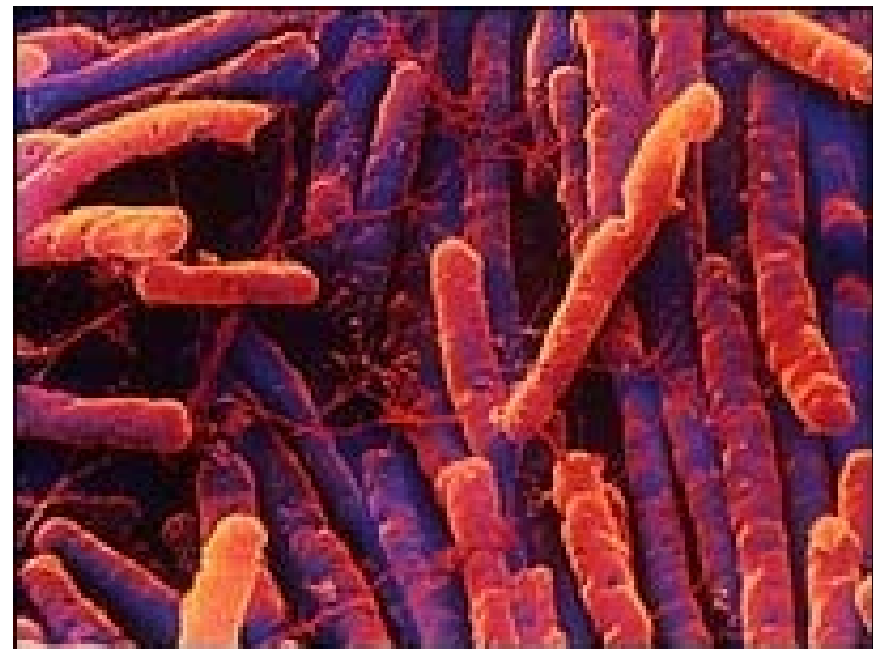


# Monitoring and surveillance of *Clostridium difficile*: an update

Andrew Pearson  
Health Protection Agency

[andrew.pearson@hpa.org.uk](mailto:andrew.pearson@hpa.org.uk)

28 November 2007



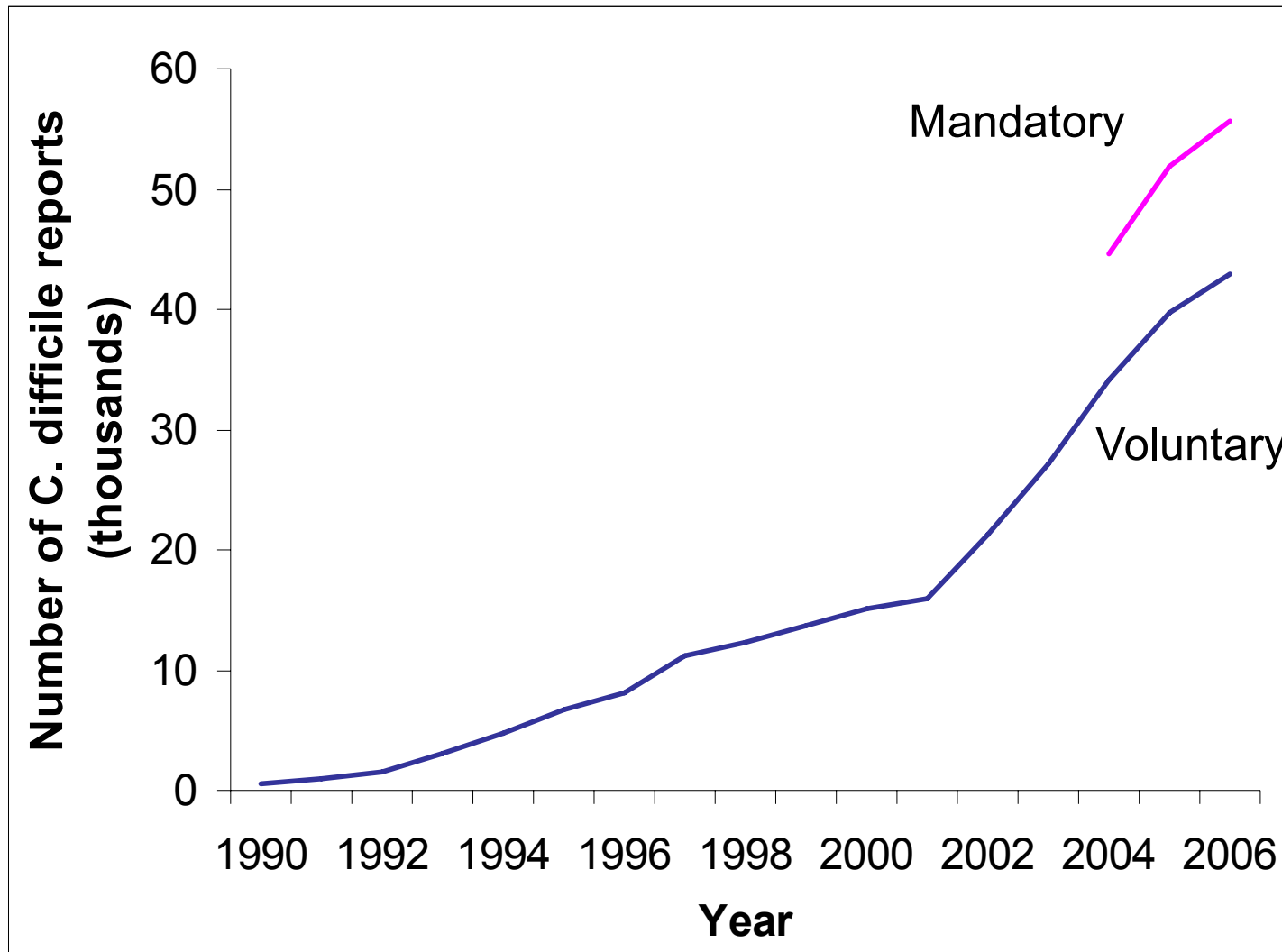
# Overview

- Monitoring and surveillance of *Clostridium difficile*: current issues
- National developments and implications for local systems
- Learning lessons from monitoring and surveillance: examples in practice

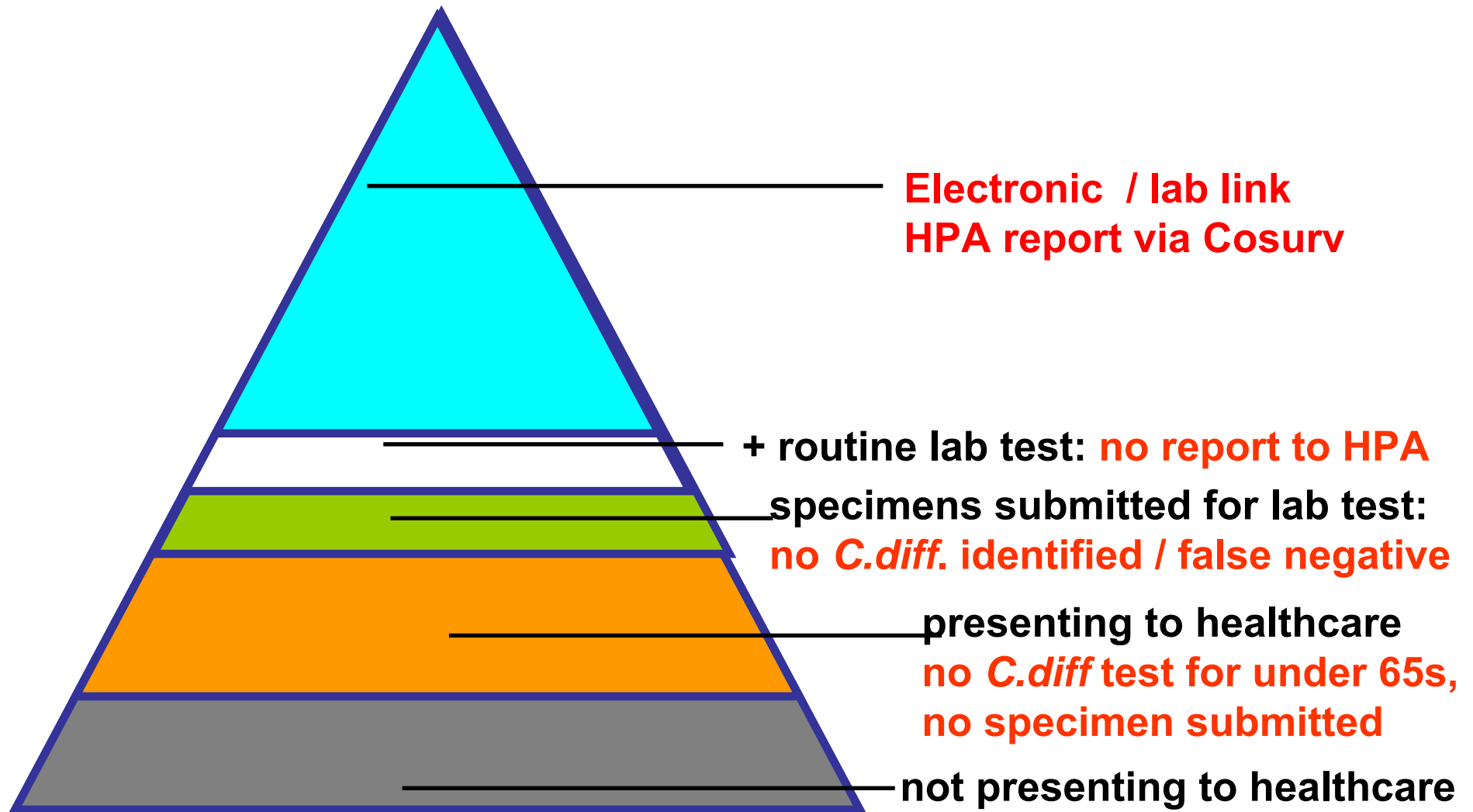
# Acknowledgments

- HPA, mandatory surveillance team at Centre for Infections
- Department of Health – Sally Batley, Michael Fleming, Brian Duerden, Sally Wellsted
- NHS – Trust infection control teams
- Regional HPA colleagues
- Damien Mack (Whittington Hospital)
- André Charlett (Statistics & Modelling Unit, CfI)
- Cereplex and Cardinal Health data mining surveillance systems
- Hereford, Oldchurch, Stoke Mandeville, Ashford NHS Hospitals
- Ed Kuijper (Leiden University Medical Centre)
- CDC team (Cliff McDonald, John Jernigan, Scott Fridkin,)

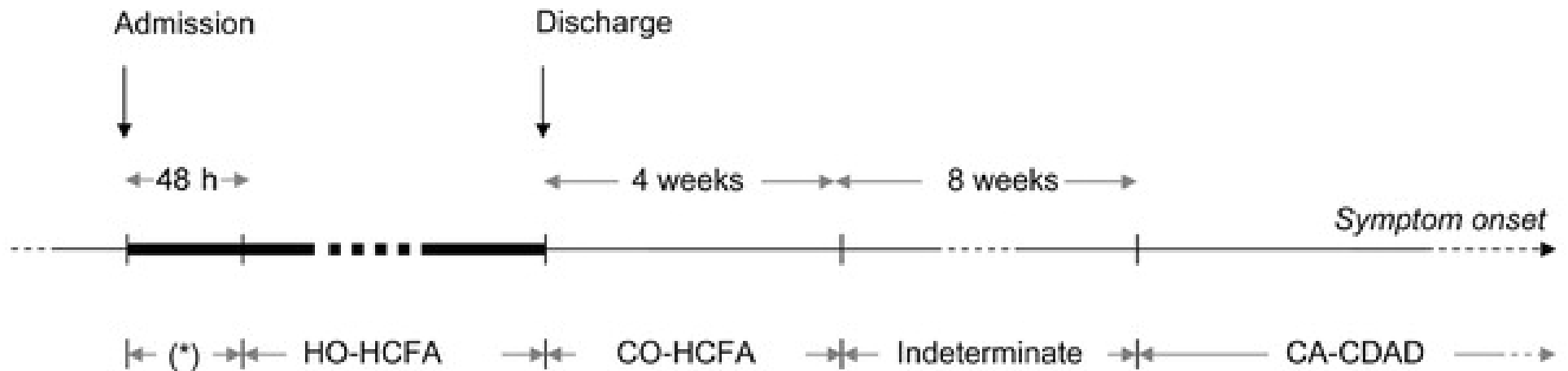
# *C. difficile* surveillance, England: 1990-2006



# Voluntary reporting

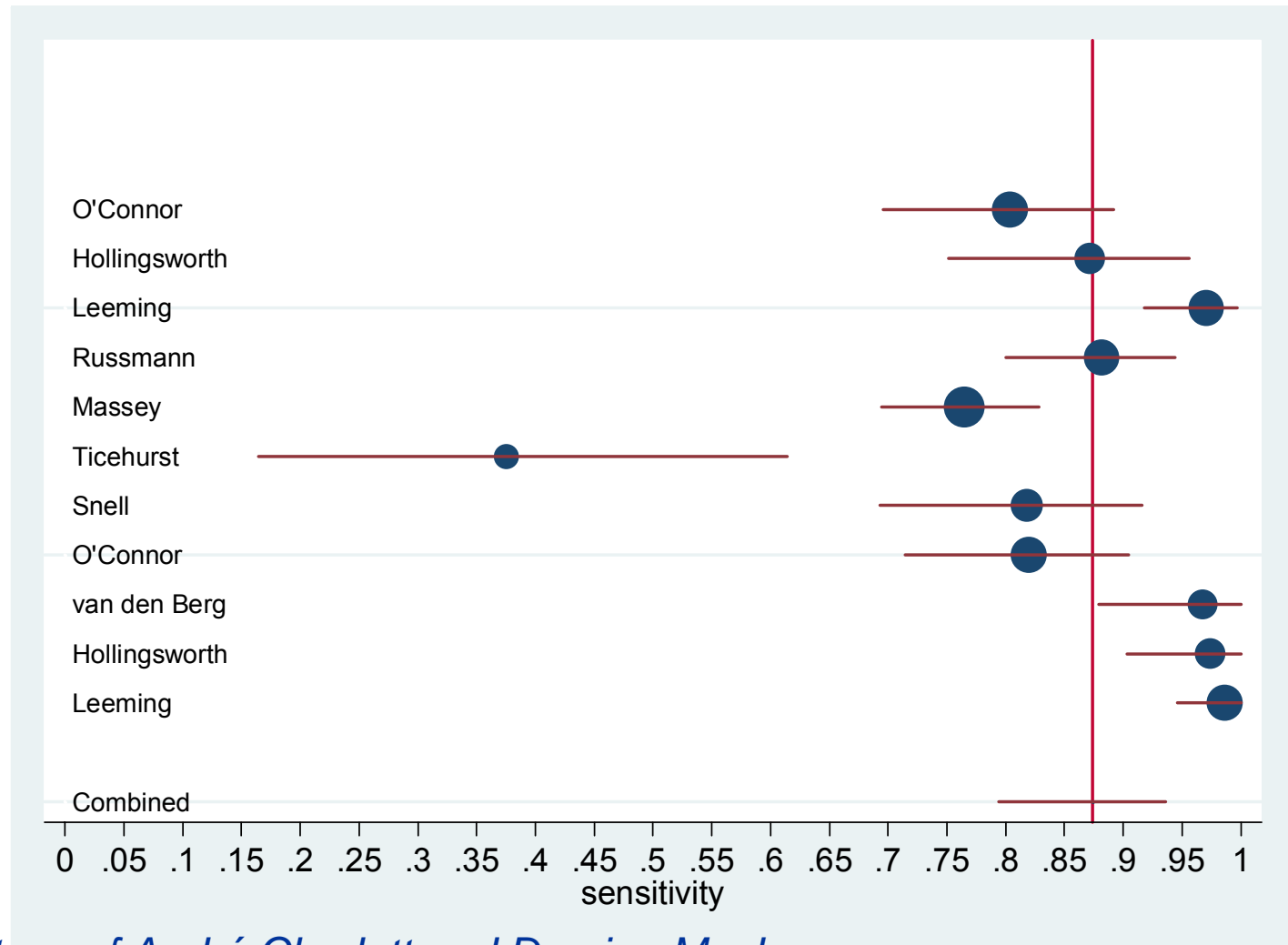


# Time line definitions for *Clostridium difficile*: associated disease (CDAD) exposures



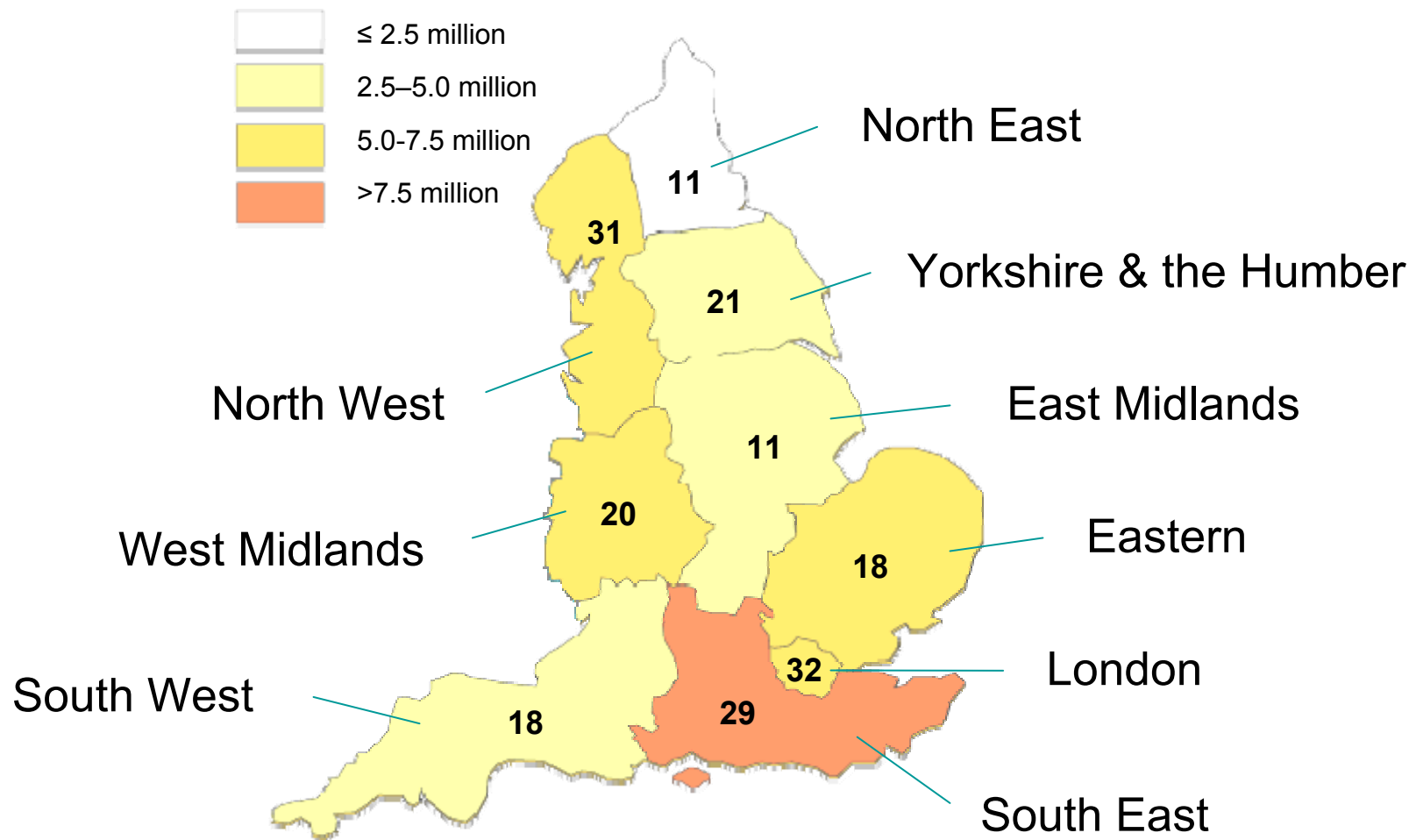
*McDonald et al Infection Control Hosp Epidemiol February 2007;28(2):140-5*

# Meta-analysis of ELISA tests: sensitivity



*Courtesy of André Charlett and Damien Mack*

# Number of laboratories reporting bacteraemia via CoSurv \*



\*provisional data

2002 mid-year resident population estimates from the Office of National Statistics (ONS)



# HCAI Data Capture System



Organism

NHS No. --  
Hospital No.  Lab No.   
Initial  Surname for soundex  Soundex   
DOB  /  /  Sex

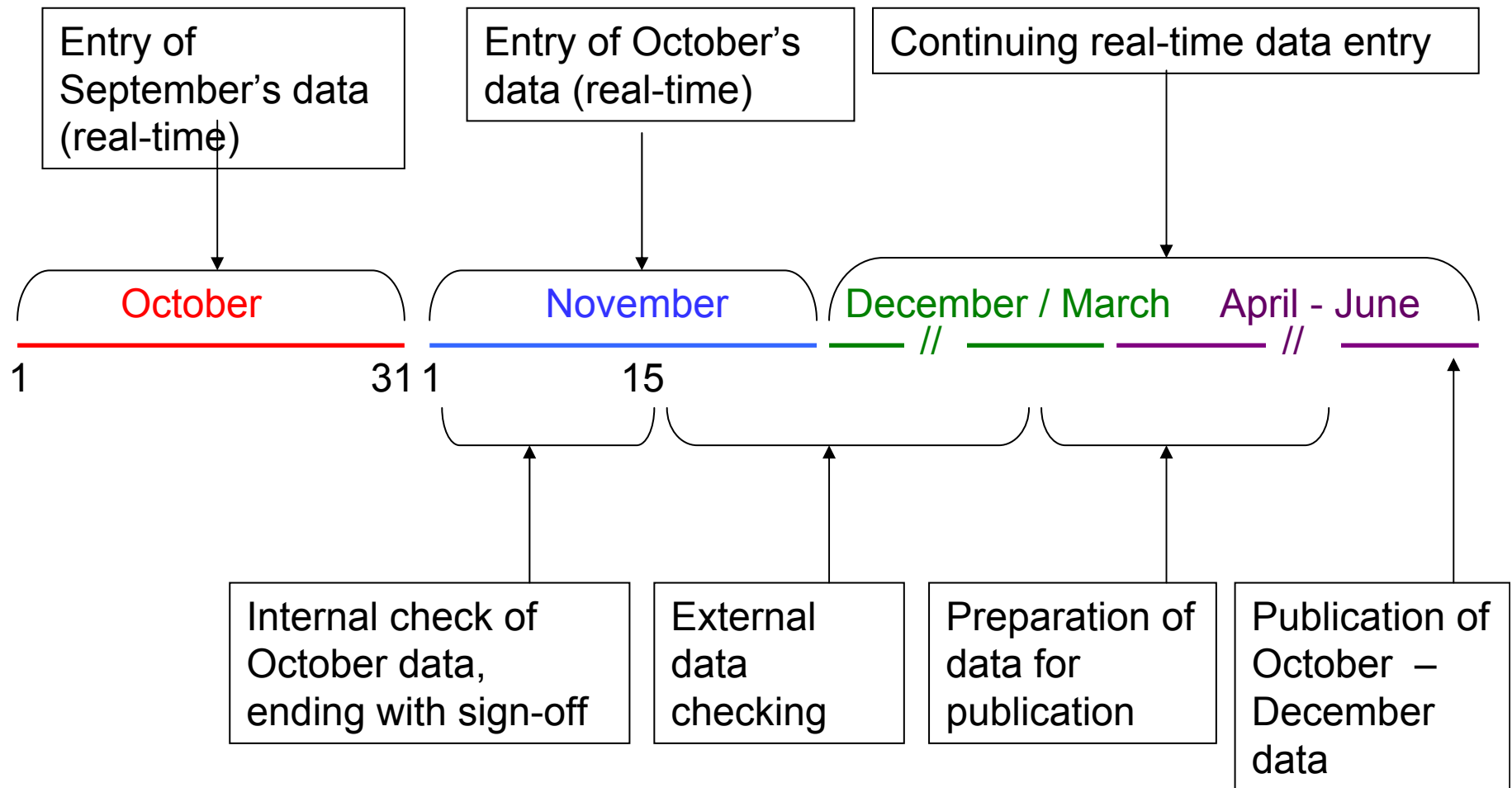
Region   
SHA   
Trust

Date specimen taken   Is this the date the specimen was taken  or received in lab   
Lab where specimen processed  Other lab

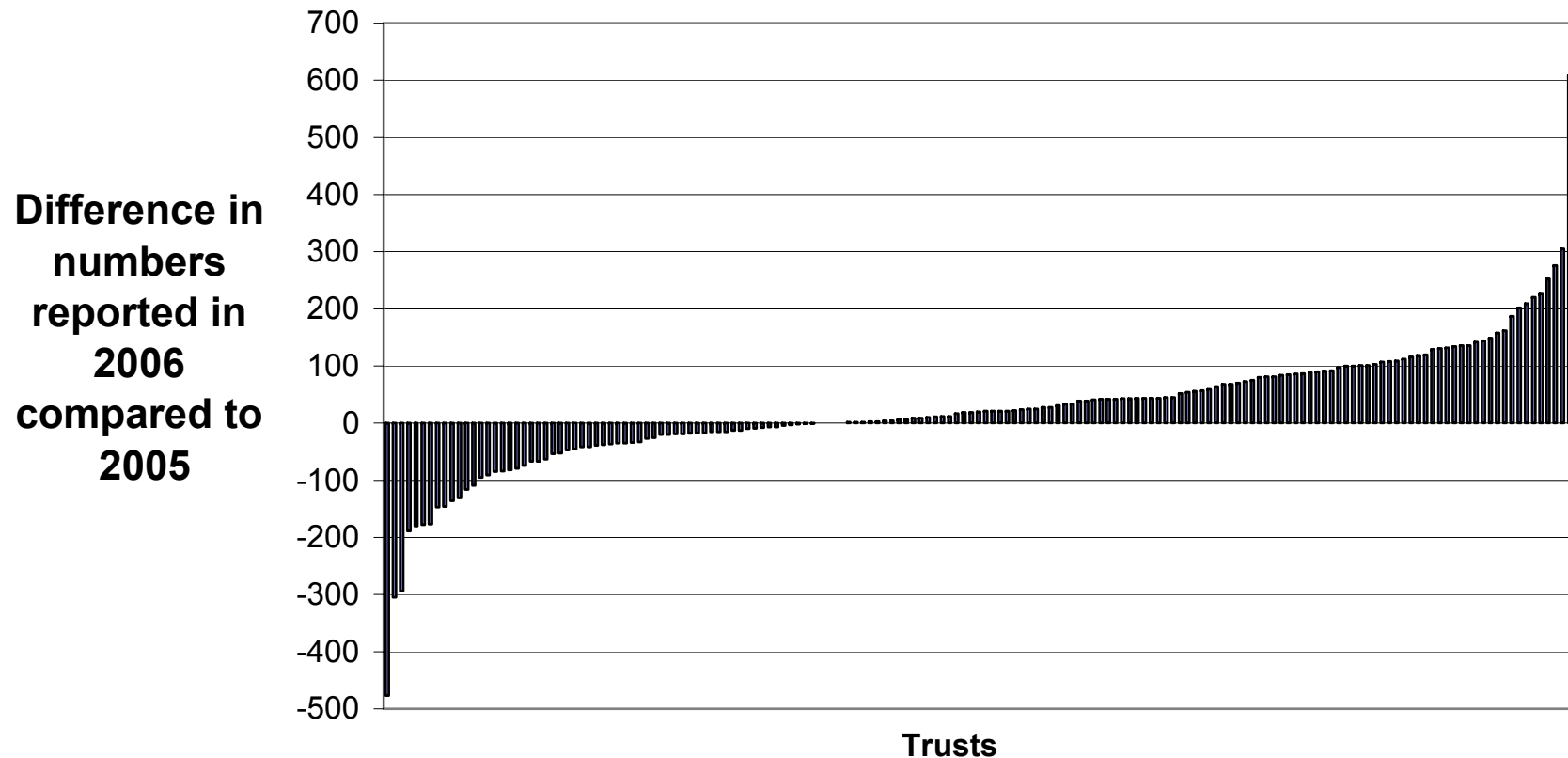
Patient location when specimen taken  Hospital name    
Other location  Is patient on dialysis?    
Patient category  Date of admission    
Other category

Comments

# Mandatory data entry and publication process

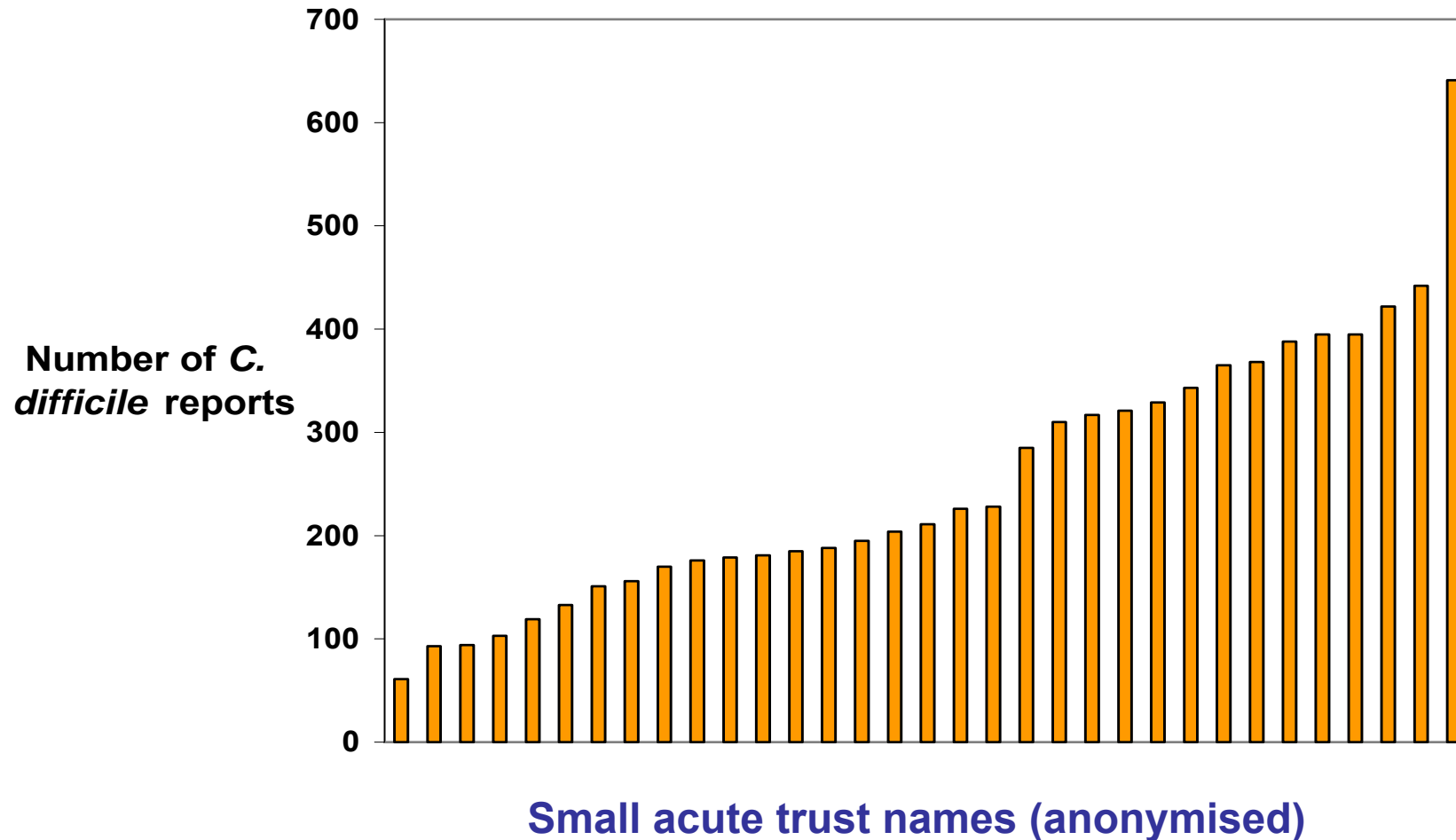


# ***C. difficile* mandatory reports from patients aged 65 years and over: 2006 compared to 2005 data by trust**



Contains data from 165 acute NHS trusts in England. Excludes 3 trusts with incomplete data and Children's Trusts. Data are provisional.

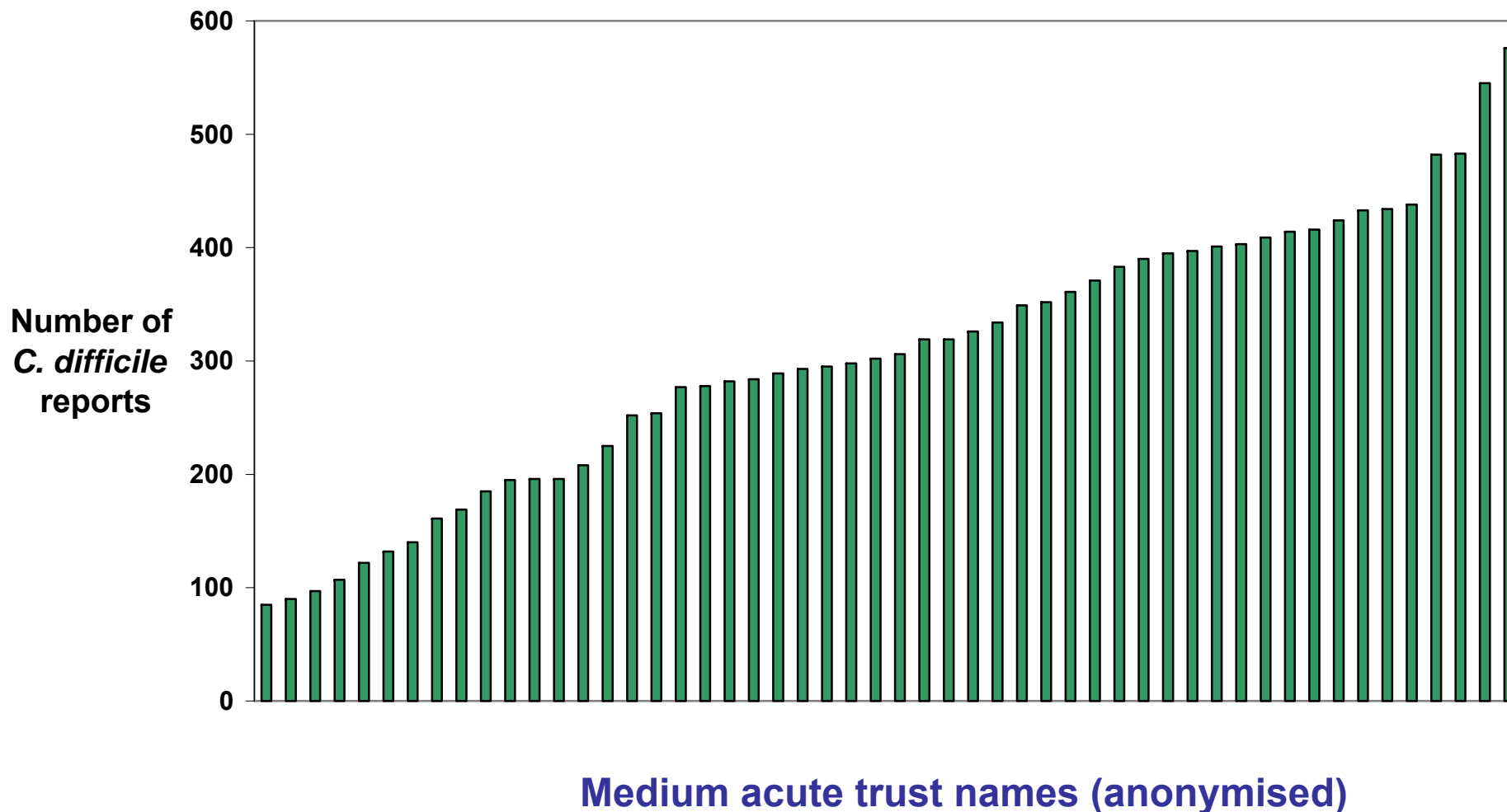
# *C. difficile* mandatory reports from small acute NHS trusts in 2006



Rate range: 0.70 – 6.78 reports per 1,000 bed-days

*Data are provisional*

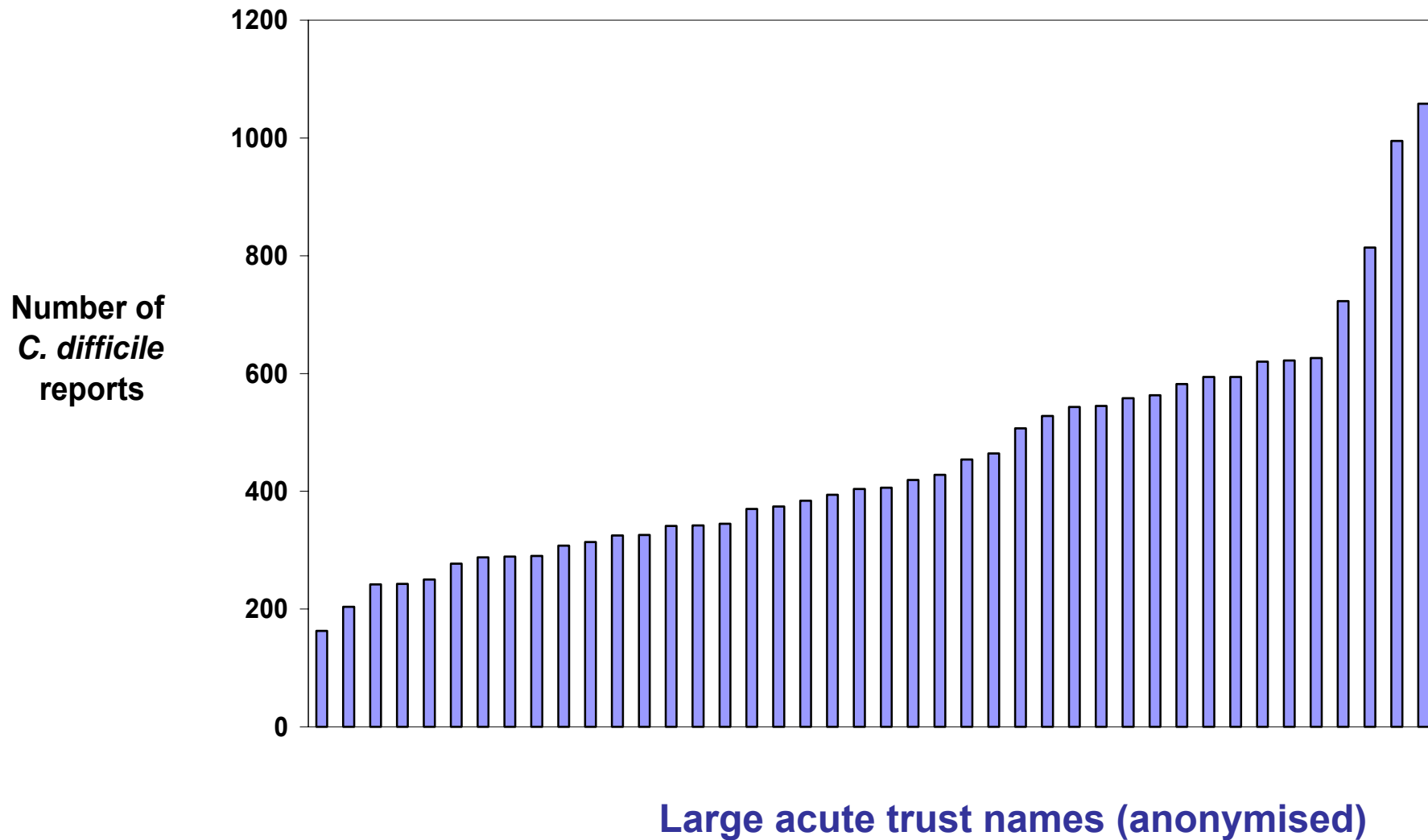
# *C. difficile* mandatory reports from medium acute NHS trusts in 2006



Rate range: 0.43 – 4.91 reports per 1,000 bed-days

*Data are provisional*

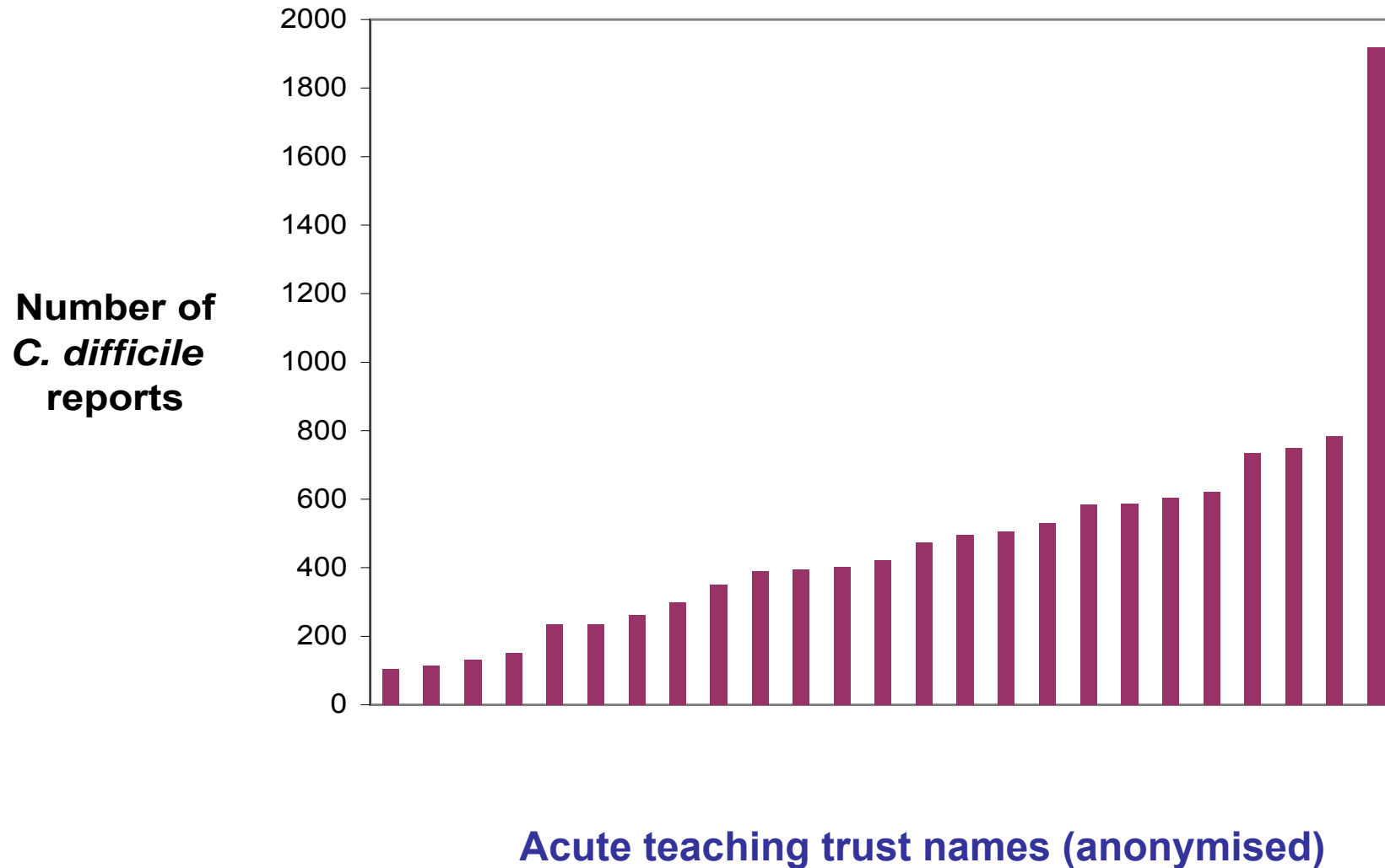
# *C. difficile* mandatory reports from large acute NHS trusts in 2006



Rate range: 0.81 - 5.18 reports per 1,000 bed-days

*Data are provisional*

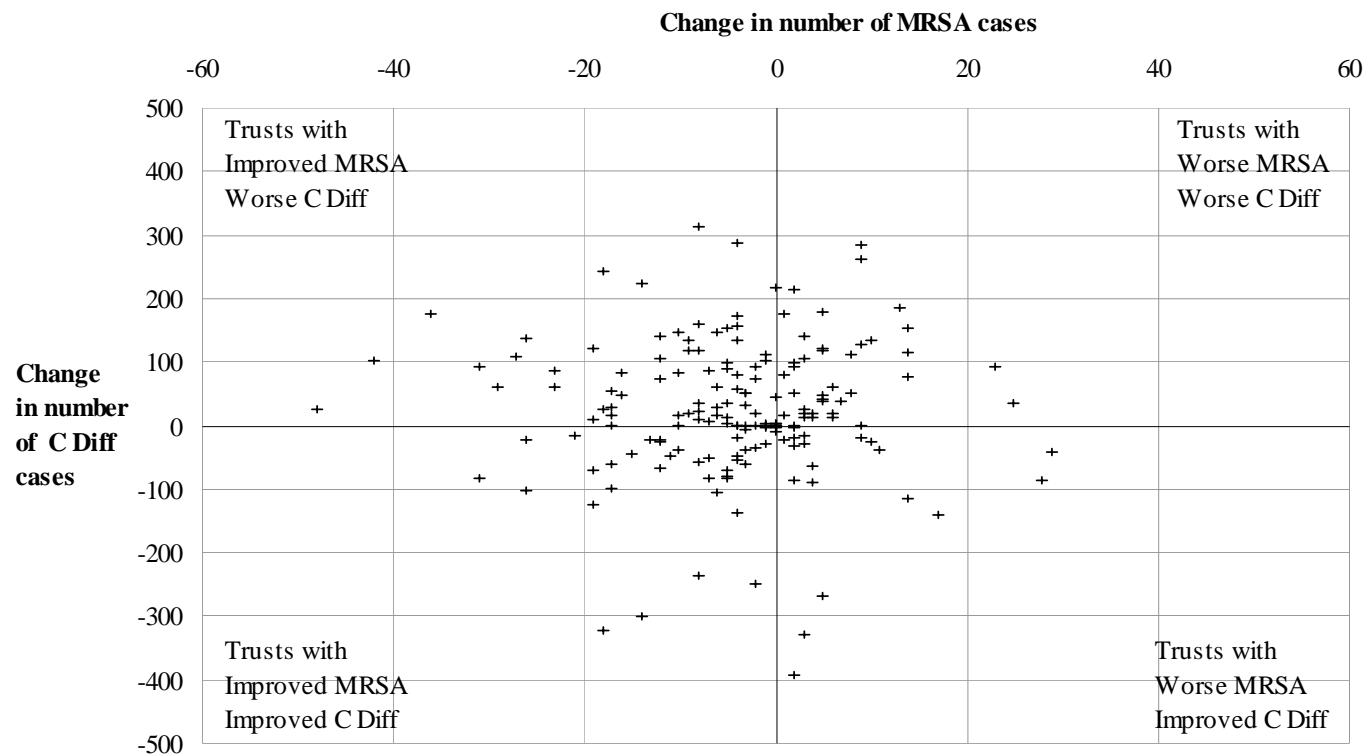
# ***C. difficile* mandatory reports from acute teaching NHS trusts in 2006**



**Rate range: 1.05 – 5.06 reports per 1,000 bed-days**

*Data are provisional*

# Relationship between changes in MRSA bacteraemia figures and changes in *C. difficile* figures between 2005/6 and 2006/7

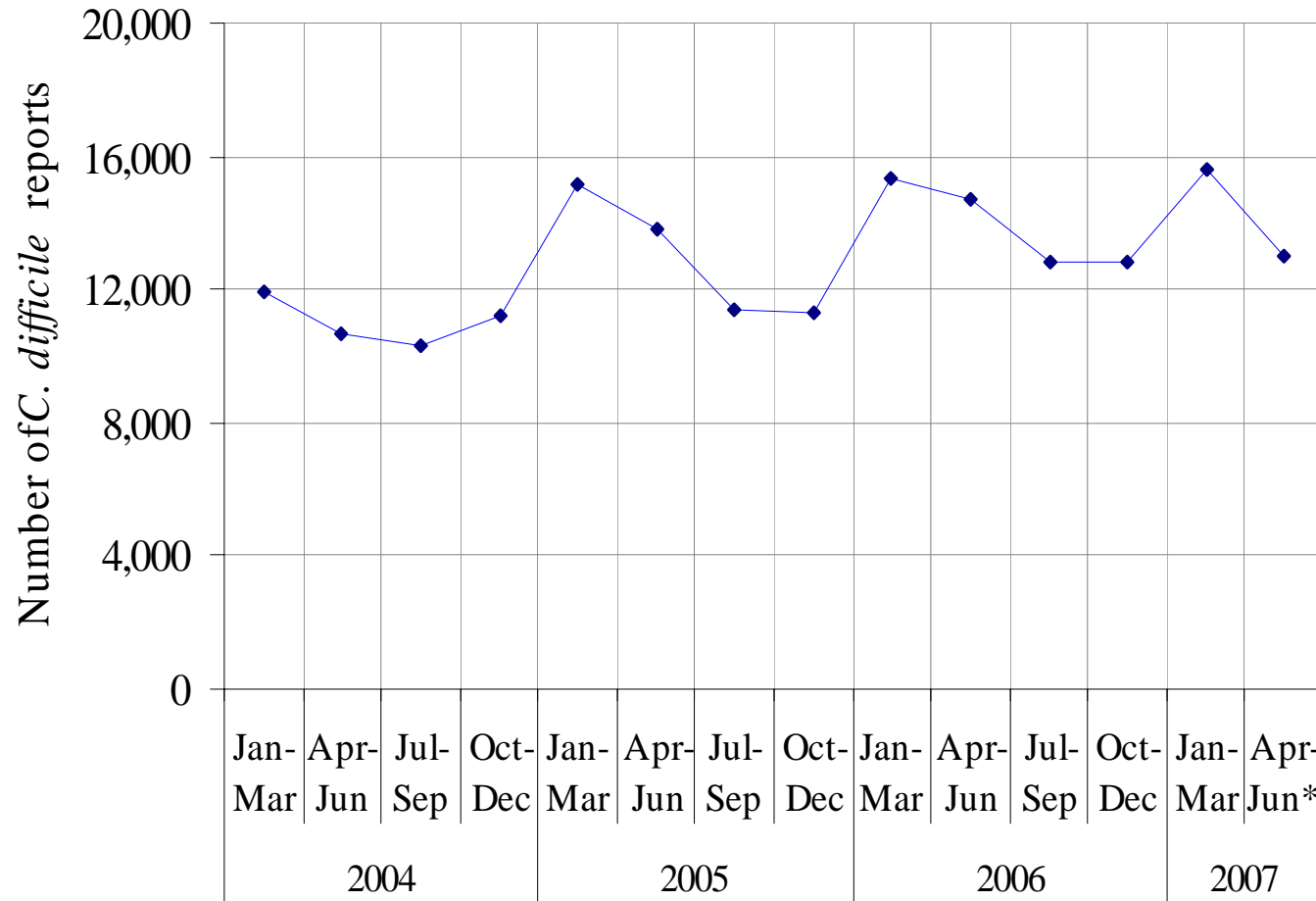


*Analysis courtesy of Michael Fleming, Department of Health*



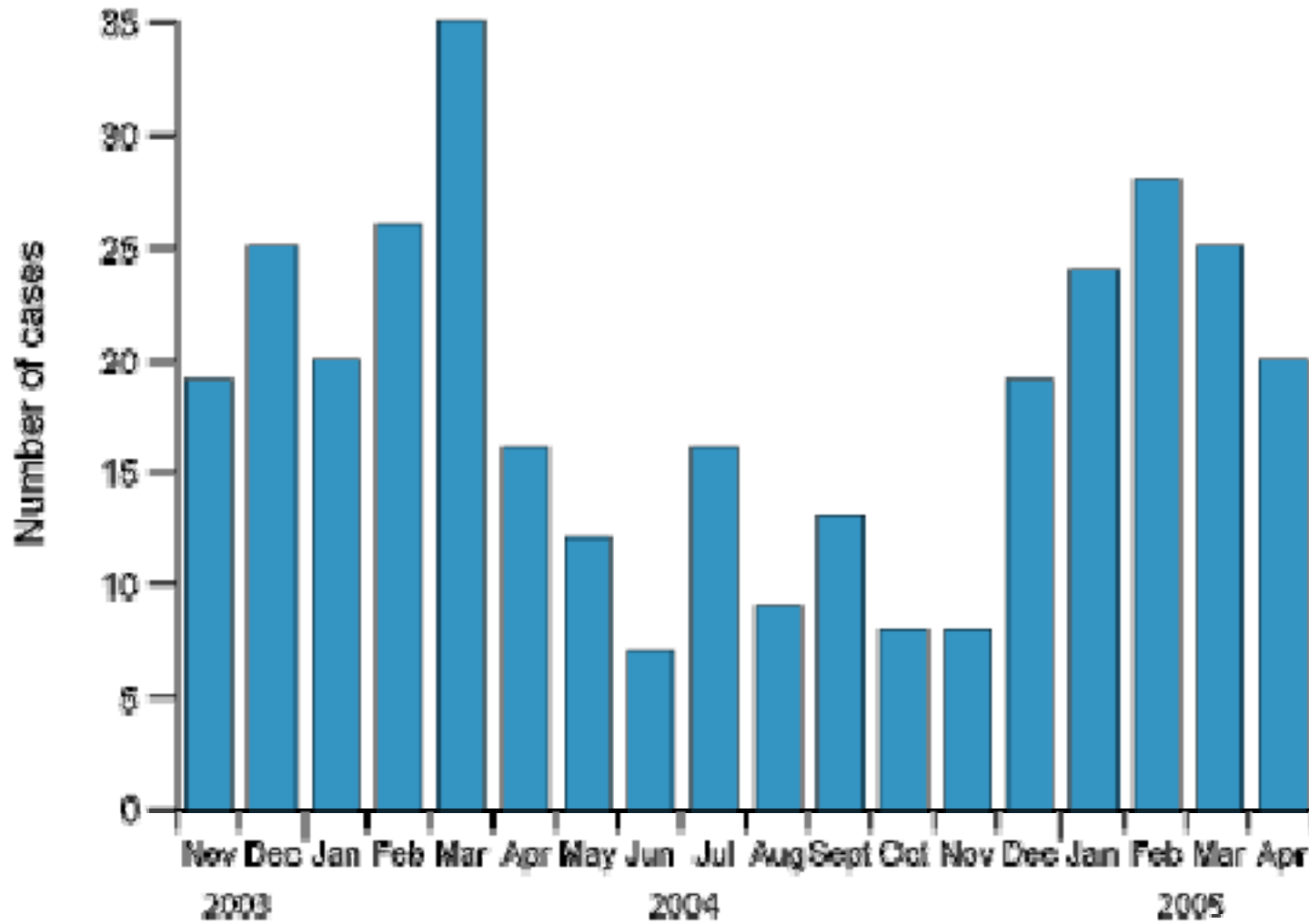


# England's Quarterly *C. difficile* Figures

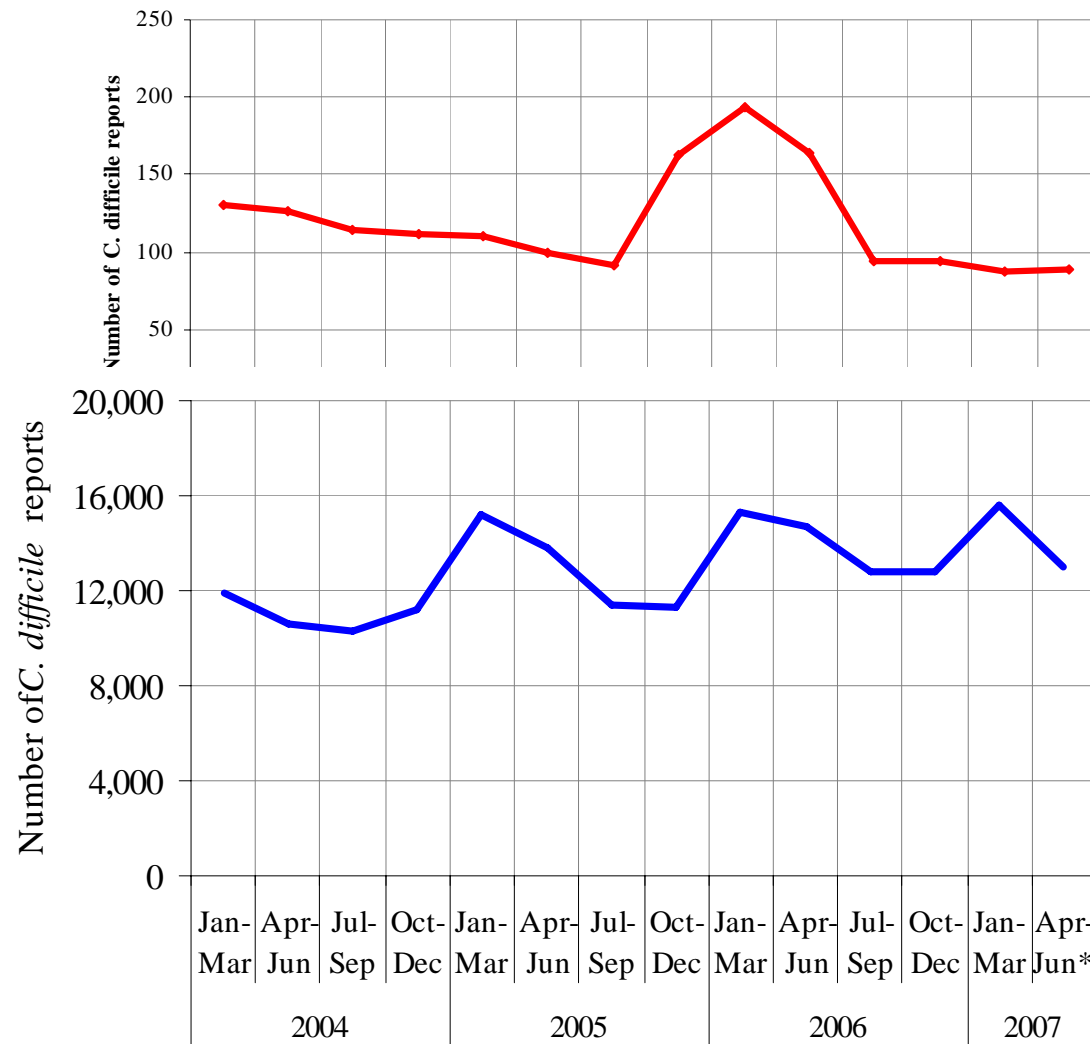


*Analysis courtesy of Michael Fleming, Department of Health*

# Stoke Mandeville



# Maidstone & Tunbridge Wells Quarterly *C. difficile* figures, compared with national figures



“The major increase between the September and December quarters is however not atypical of trusts. Roughly half of all trusts experienced bigger quarter on quarter increases at some time between January 2004 and March 2006.”

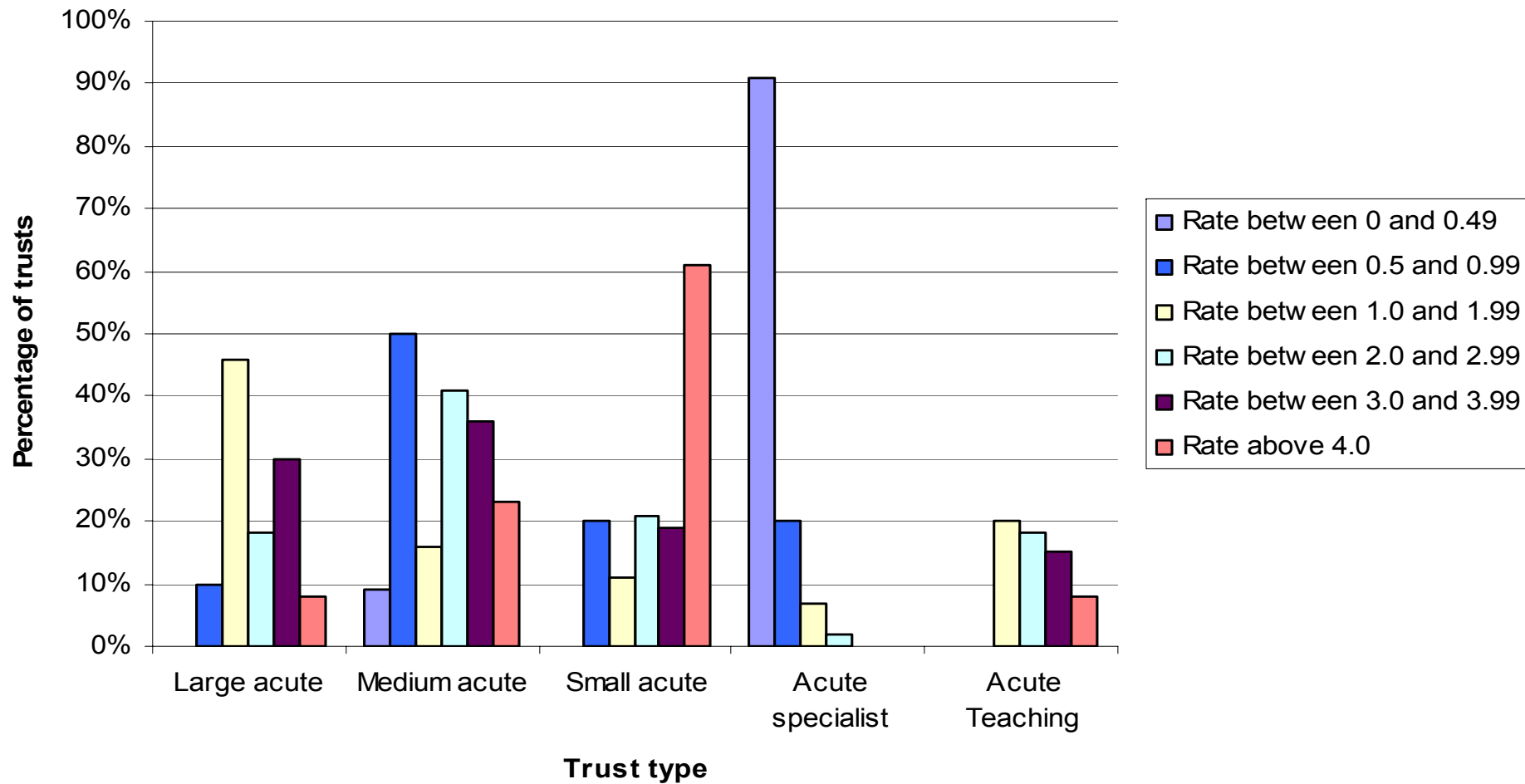
# *C. difficile* rates (per 1,000 bed-days) by Trust type



	2004	2005	2006
Large acute	1.90	2.18	2.24
Medium acute	1.88	2.25	2.38
Small acute	2.07	2.50	2.85
Acute teaching	1.97	2.21	2.47
Acute specialist	0.90	0.76	0.87

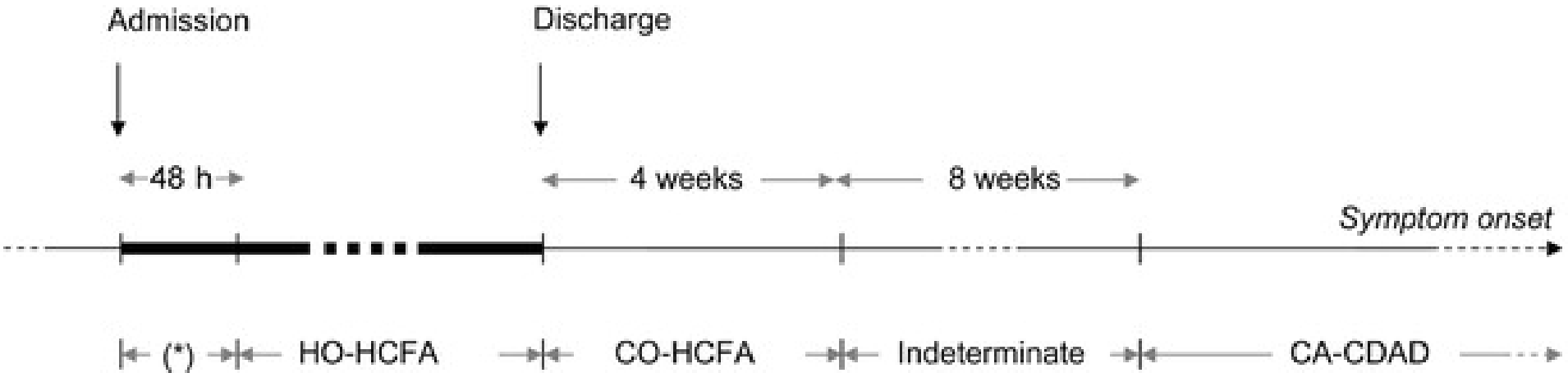
(Mandatory surveillance in patients aged 65 years and over)

# Variations in *C. difficile* rates by trust type in 2006



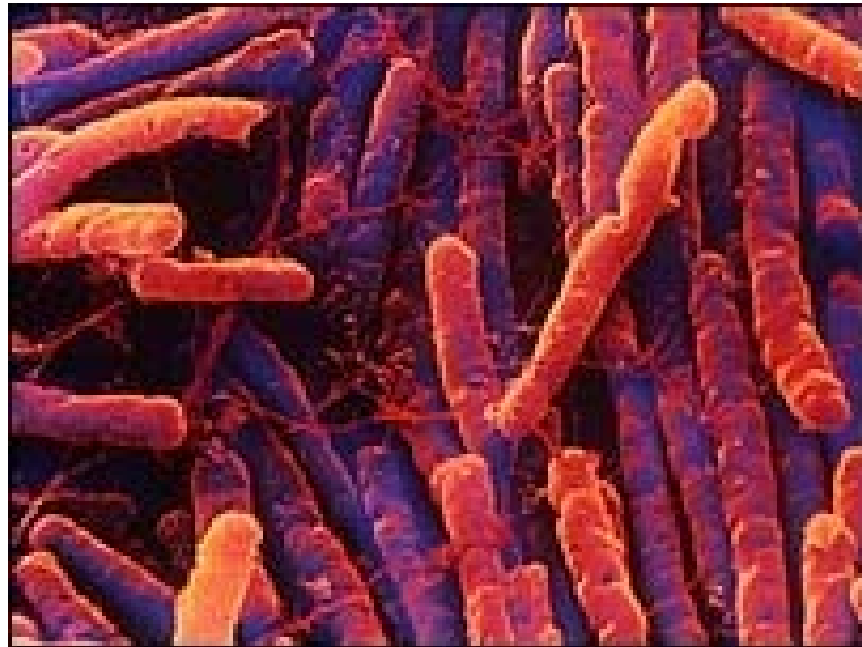


# Time line for definitions of *Clostridium difficile*-associated disease (CDAD) exposures



McDonald et al *Infection Control Hosp Epidemiol* February 2007;28(2):140-5

# National developments and implications for local systems



# Hospitals failing to reach target on endemic superbugs



## 116 die in London NHS trust after contracting superbugs

*Daily Telegraph, 2 November 2007*

*Financial Times, 2 November 2007*

*Evening Standard 1 November 2007*



# ***Clostridium difficile* national target**

“For *Clostridium difficile* the target is to deliver a 30 per cent reduction in the number of cases reported in 2010-11 compared to an agreed baseline in 2007-8.”

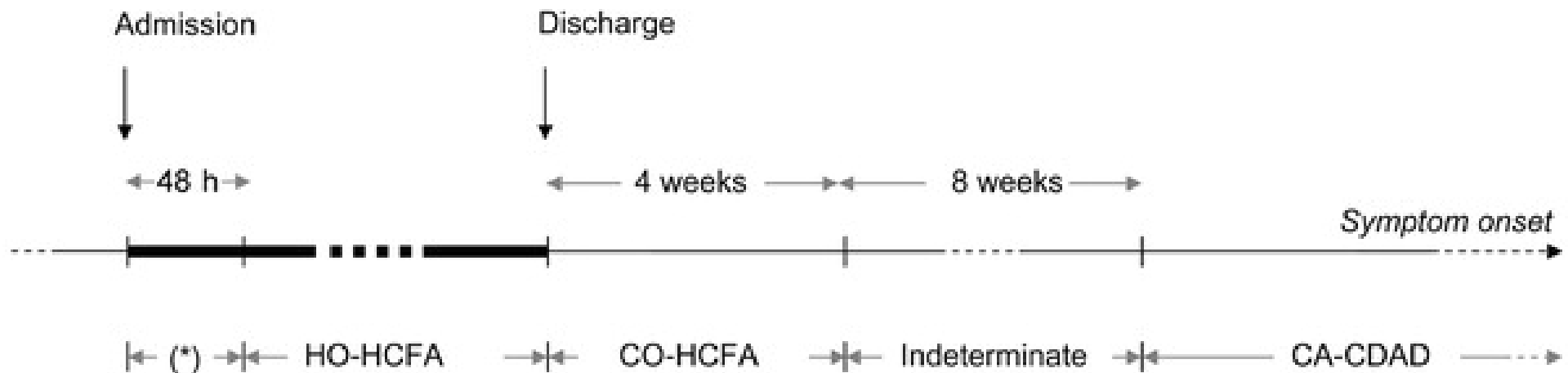
## **PSA Delivery Agreement 19:**

Ensure better care for all

October 2007

[http://www.hm-treasury.gov.uk/media/3/A/pbr\\_csr07\\_psa19.pdf](http://www.hm-treasury.gov.uk/media/3/A/pbr_csr07_psa19.pdf)

# Time line for definitions of *Clostridium difficile*-associated disease (CDAD) exposures



# Baseline options for CDAD target

**30% reduction for either total PCT cases or individual acute Trust acquired in the Trust**

- **PCT baseline** – total cases in health economy:  
age stratified population denominator
- **Acute Trust focus** - cases diagnosed post 48 hrs:  
age stratified Trust admissions as denominator

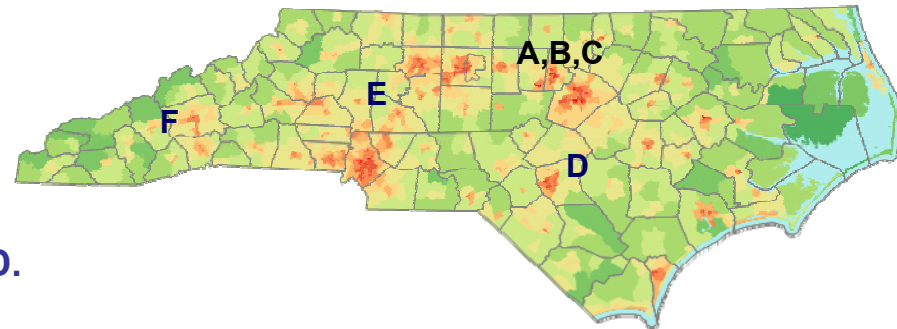
# Study setting: North Carolina

- **Study period: January through December 2005**
- **Study population:**  
**Outpatient and inpatient population served by**
  - **Two Durham County hospitals laboratories**
    - **One Regional [A]**
    - **One University [B]**
  - **Four Veterans Affairs hospital laboratories [C - F]**

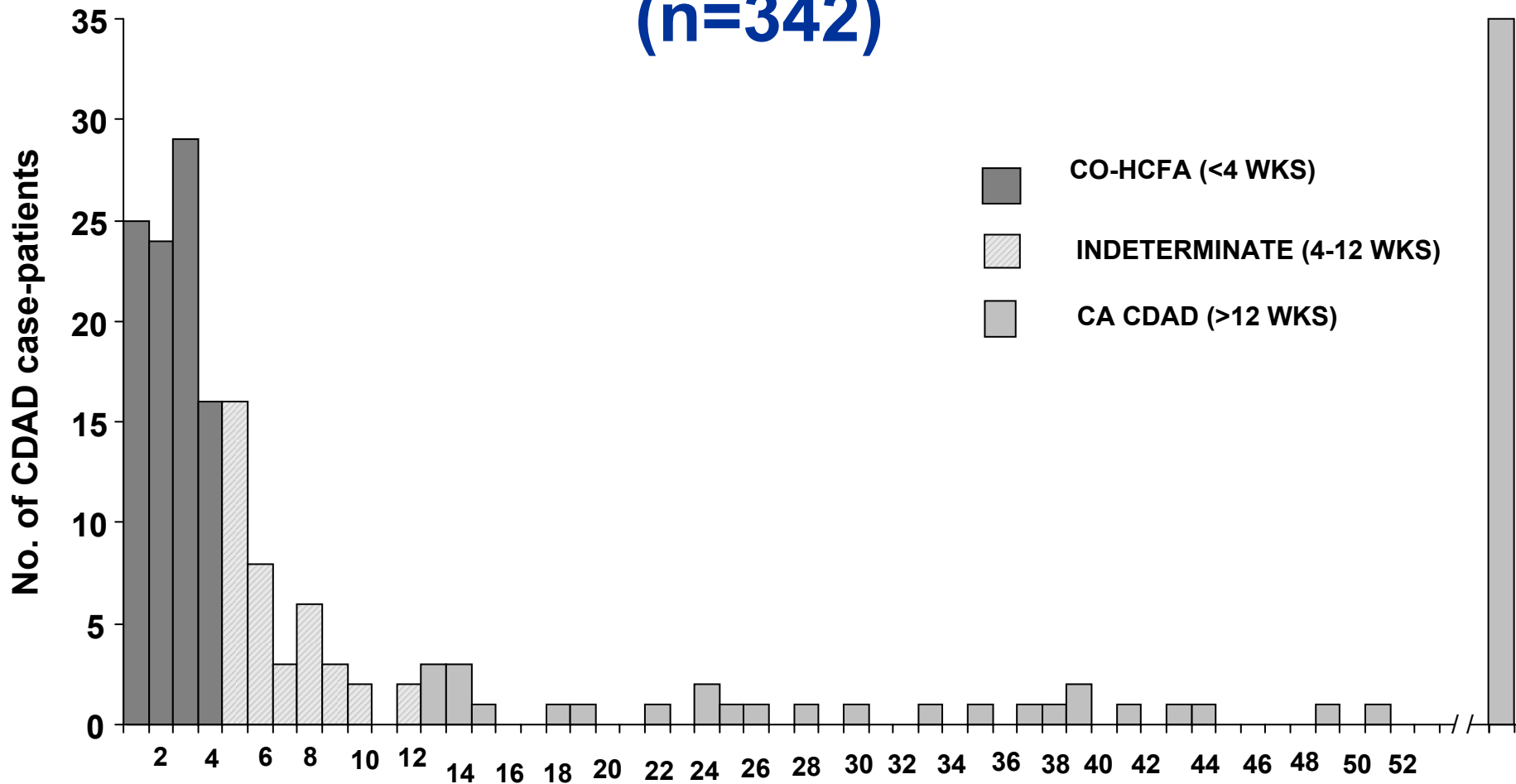
- **Adults (  $\geq 18$  years)**

Kutty et al. SHEA Meeting, 2007. Baltimore, MD.

*Courtesy of Cliff McDonald (CDC)*



# Community Onset CDAD Relative to Previous Discharge, North Carolina, 2005 (n=342)



\*abbreviated: 181 (53%) had a time lapse of more than one year

Kutty et al. SHEA Meeting, 2007. Baltimore, MD.  
 Courtesy of Cliff McDonald (CDC)

# Investigation of community-associated CDAD: CA-CDAD in North Carolina 2005

- Among a total 1,137 CDAD cases: 209 (18%) were CA-CDAD
- Population rates:

VA hospital catchments (males): overall = 21.5 /100,000

18 - 44 years = 18.4 / 100,000

**45 - 64 years = 30.8 / 100,000**

≥ 65 years = 15.7 / 100,000

Durham County: overall = 25.67 /100,000

**Females = 36.49 / 100,000**

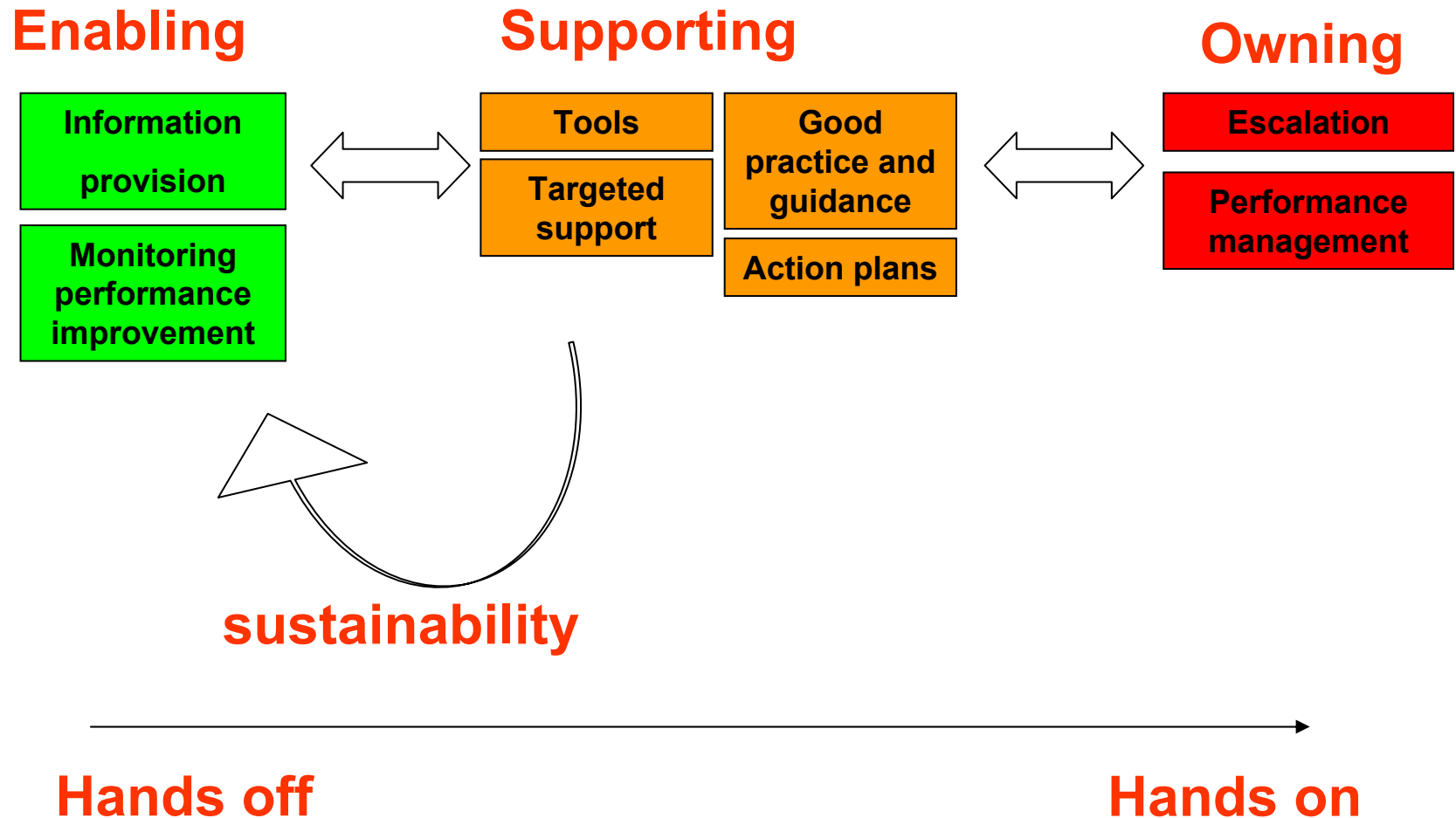
Males = 13.48 / 100,000

18-44 years = 15.98 / 100,000

**45-64 years = 42.48 / 100,000**

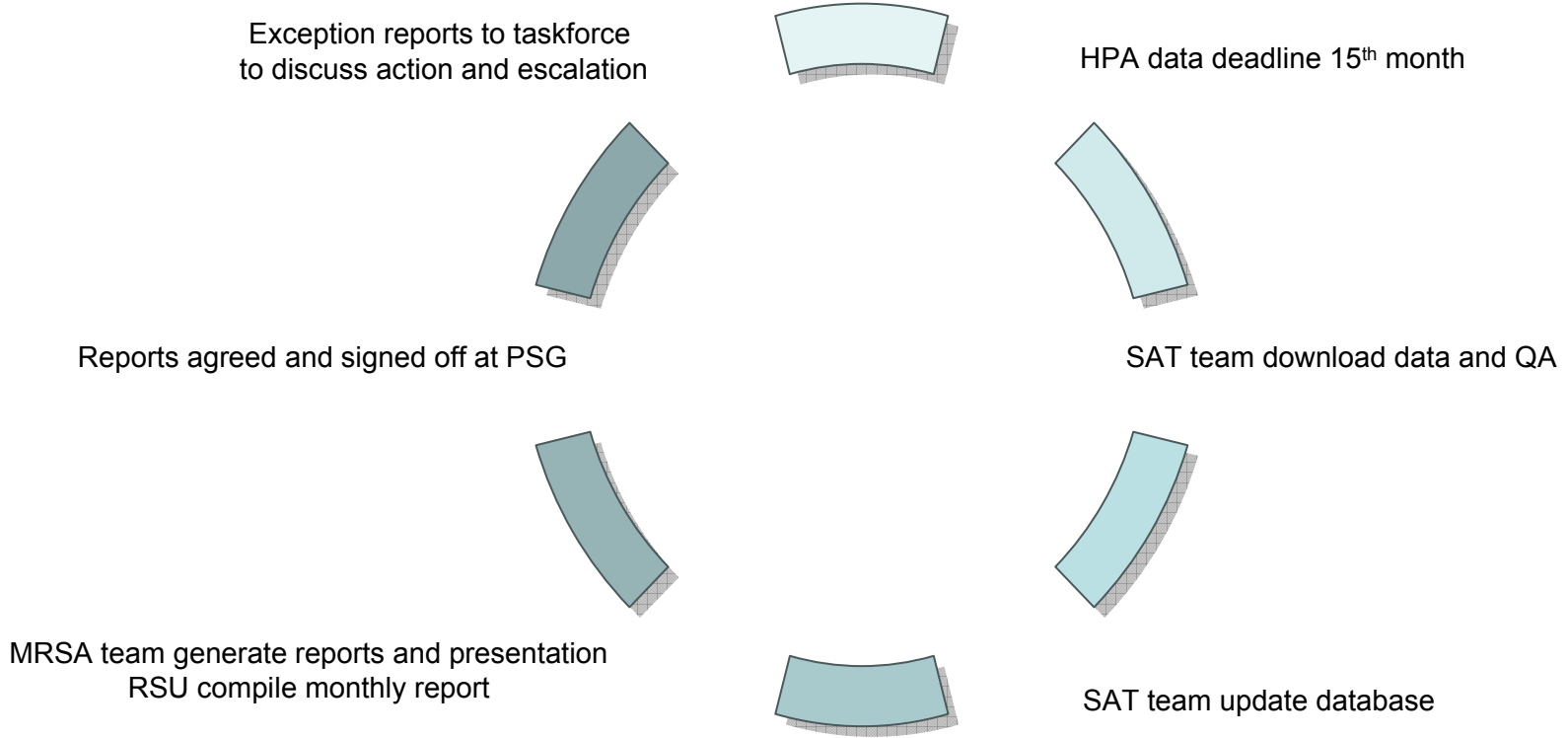
≥ 65 years = 23.57 / 100,000

# Supporting local behavioural change to enable delivery



*Courtesy of Sally Batley (Department of Health)*

# Data Cycle



*Courtesy of Sally Batley (Department of Health)*



## Saving Lives

A delivery programme to reduce healthcare associated infection including MRSA



Click once on the relevant links below to view each of the tools or documents

### High Impact Interventions

The aim of the Five High Impact Interventions is to make the clinical processes function reliably, thus reducing microbial contamination and the risk of infection. Each of the excel tools below should be saved to your local PC before you start to use them.

#### Introduction, Method and Approach

#### Instructions for using High Impact Interventions

#### High Impact Interventions and review tools

**No1:** Preventing the Risk of Microbial Contamination

**No2:** Central Venous Catheter Care

**No3:** Preventing Surgical Site Infection

**No4:** Care of Ventilated Patients (or tracheostomy where appropriate)

**No5:** Urinary Catheter Care

[Main menu](#) | [Exit](#)

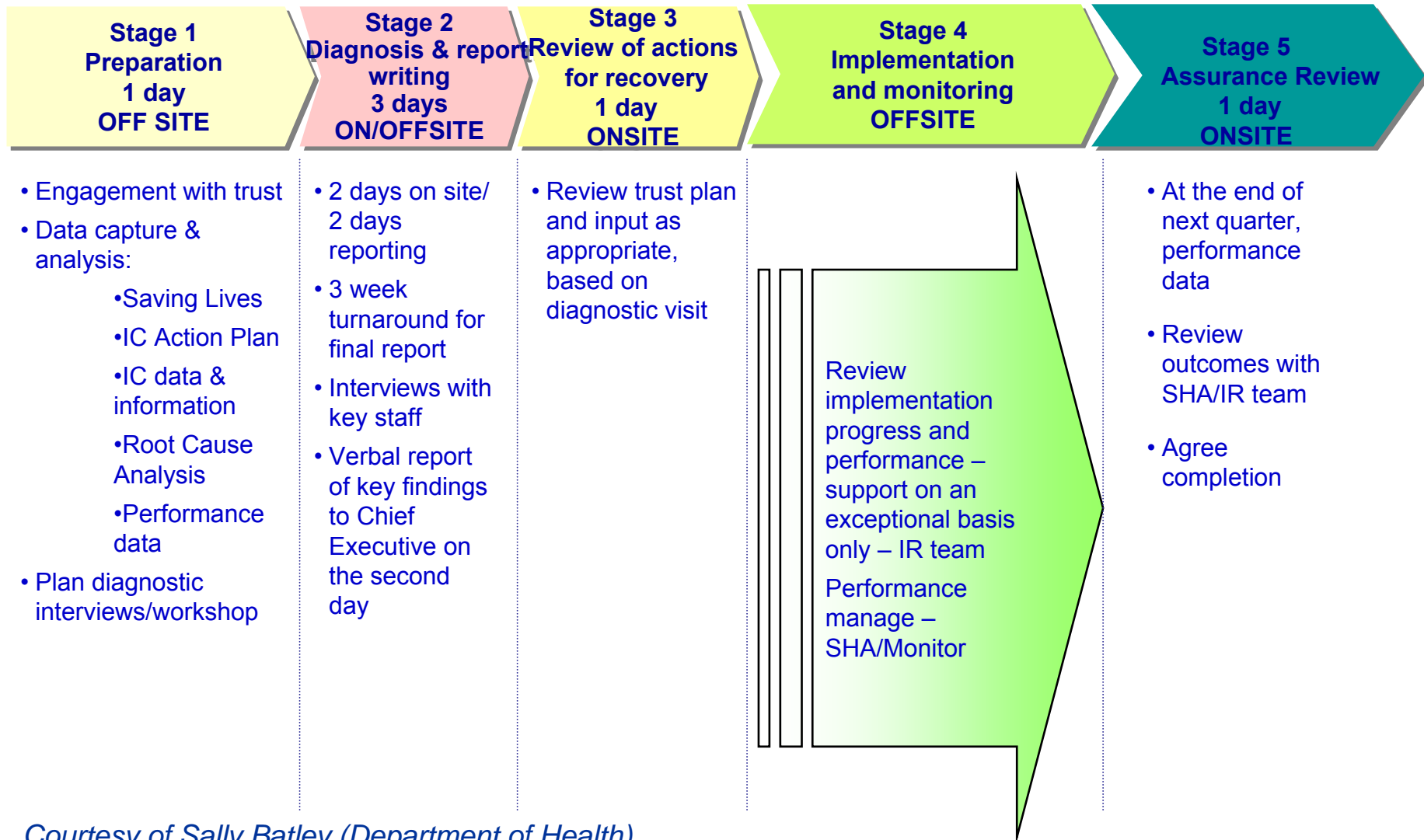
**High Impact Interventions**

Check the Saving Lives  
website for updates



*Courtesy of Sally Batley (Department of Health)*

# Outline approach: Improvement Review



Courtesy of Sally Batley (Department of Health)

# How does it all fit together?


**Implement best  
practice  
eg Saving Lives**


Raise the profile  
eg  
With NHS managers

Targeted support for  
NHS organisations  
eg  
Improvement Teams,  
PIN

**Performance  
management  
of  
organisations**

# Mandatory *C. difficile* data collection: 2008 changes

HCAI Data Capture System 



Organism

ID    Date entered

---

NHS No. --

Hospital No.  Lab No.

Initial  Surname for soundex  Soundex

DOB  /  /  Sex

Region

SHA

Trust

---

Date specimen taken   Is this the date the specimen was taken  or received in lab  Episode category

Lab where specimen processed  Other lab

---

Patient location when specimen taken  Hospital name

Other location  Is patient on dialysis?

Patient category  Date of admission   Admission method

Other category

Main speciality   Treatment speciality

Augmented Care

---

Provenance of patient  If hospital, details

Other

If non-UK, country




---

Comments

# C. difficile risk factor data collection: 2008 changes

Health Protection Agency

## HCAI Data Capture System

cases duplicates reports logoff  

ID  Date entered

---

**Onset of diarrhoea (this episode)**  
Best estimate of date of onset of diarrhoea

**Antibiotic Usage**

a) Was patient on antibiotics when specimen was taken     
If "Yes"

b) Was patient on any other antibiotics in preceding 7 days     
If "Yes"

---

**In-patients only**

**Specialty where infection thought to have been acquired**

Augmented Care   Date from:

or  
Treatment specialty    Show all Date to:

Type of accommodation   Total number of beds   Other

No. of new cases of CDAD between  and   Other

Maximum number of symptomatic CDAD cases between  and   Other

---

**Other patients**

Known exposure to person with CDAD   If "Yes" or "Possibly", how many   Other

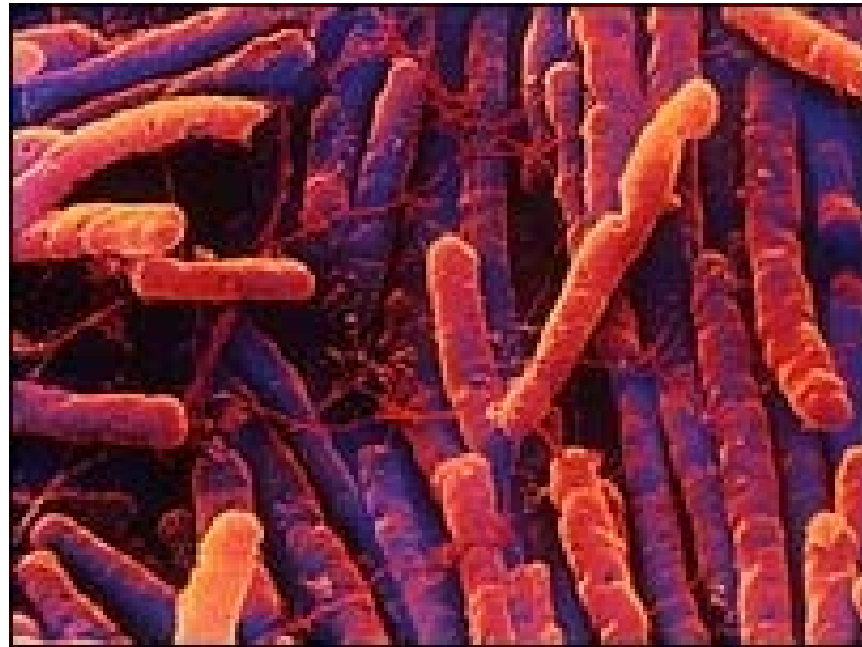
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**Reference laboratory result**

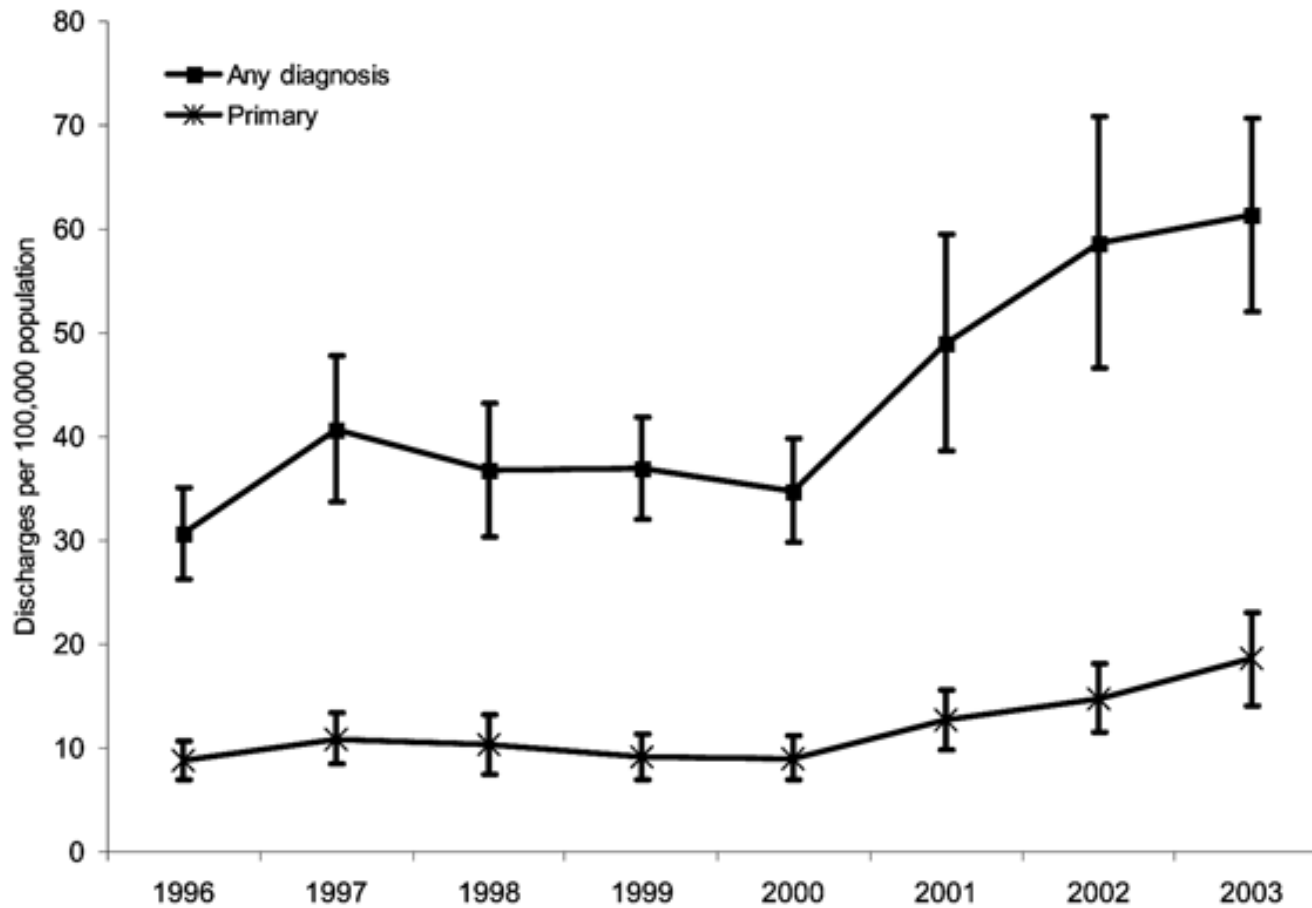
Was this specimen sent for typing   If "Yes", date sent

Result  Date

# Learning lessons from monitoring and surveillance

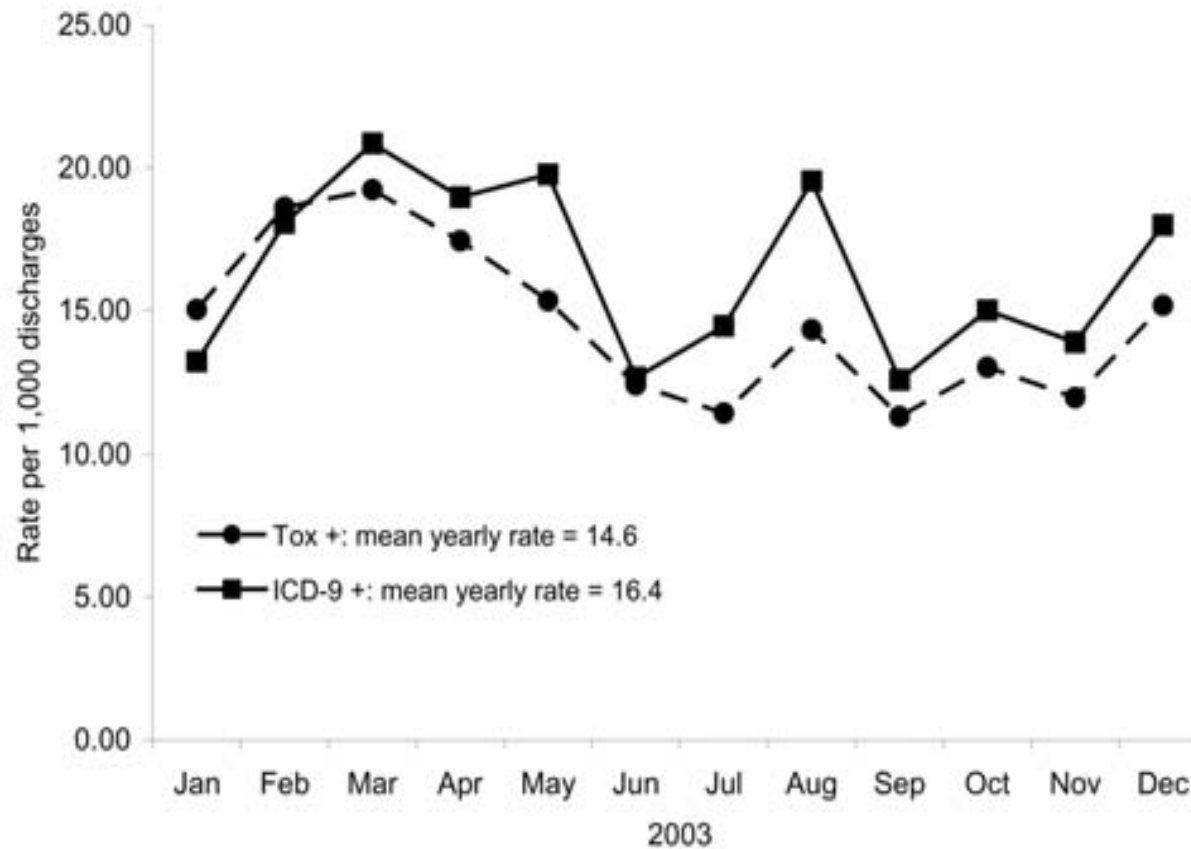


# National Estimates of US Short-Stay Hospital Discharges with *C. difficile* as First-Listed or Any Diagnosis



From McDonald LC, et al. *Emerg Infect Dis.* 2006;12(3):409-15

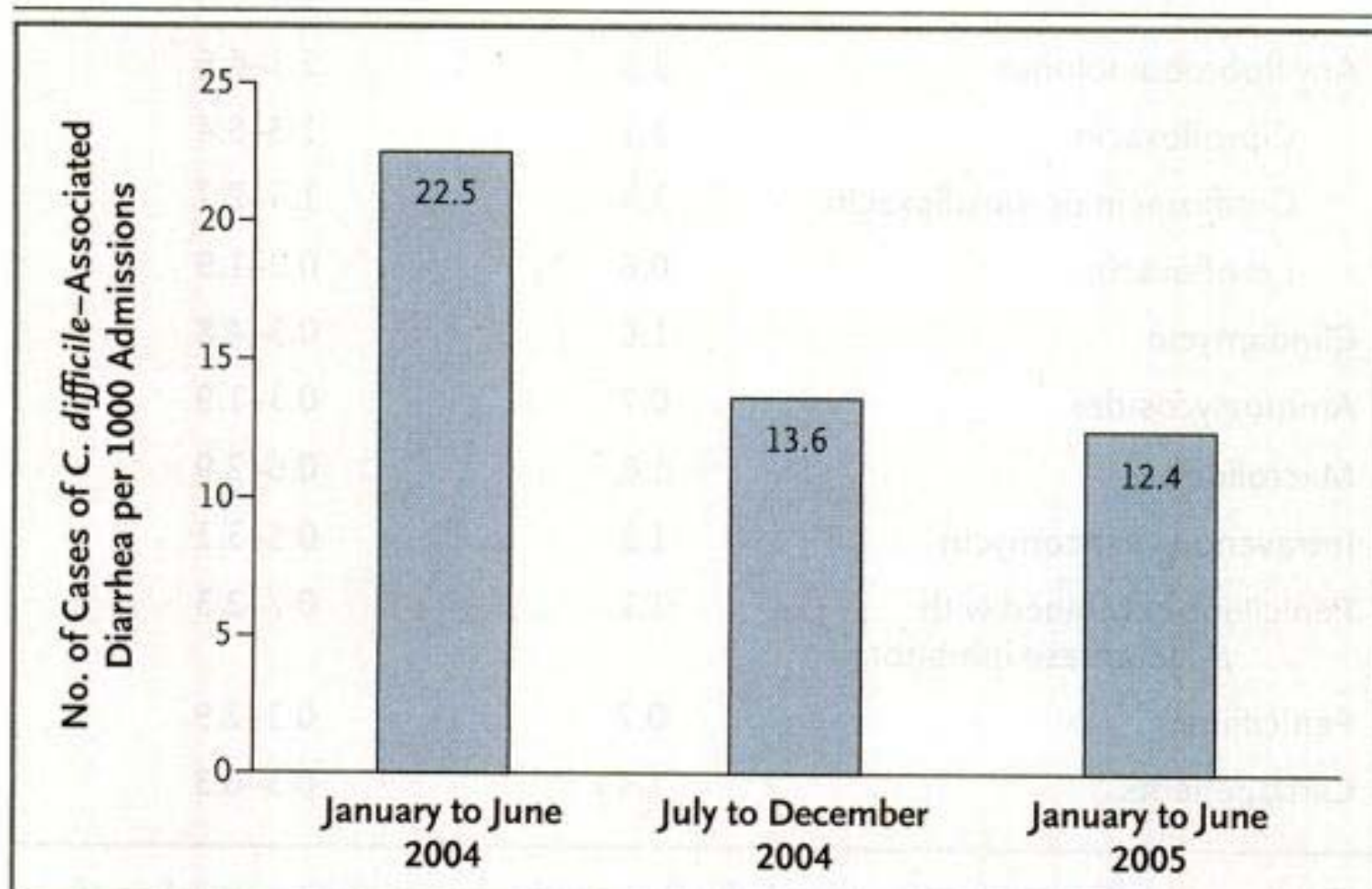
# Monthly rates of *Clostridium difficile*: associated disease by diagnosis type, Washington University Hospital, St.



Dubberke ER et al. *Emerg Infect Dis* 2006;12: 1576-9.



# Incidence of nosocomial CDAD among the 12 study hospitals in Quebec, Canada



Loo et al NEJM 2005;353:2442

# Case study from Canada

**Table 2.** Age-Specific Incidence and Mortality Attributed to *Clostridium difficile*-Associated Diarrhea.

Age	No. of Cases	No. of Cases/ 1000 Admissions*	Attributable 30-Day Mortality Rate
yr			%†
<40	76	3.5	2.6
41–50	85	11.2	1.2
51–60	191	20.0	3.2
61–70	272	24.4	5.1
71–80	523	38.3	6.2
81–90	458	54.5	10.2
>90	114	74.4	14.0

\* Values are based on 1719 episodes of nosocomial *C. difficile*-associated diarrhea.

† Values are based on data from 1703 patients with nosocomial *C. difficile*-associated diarrhea.

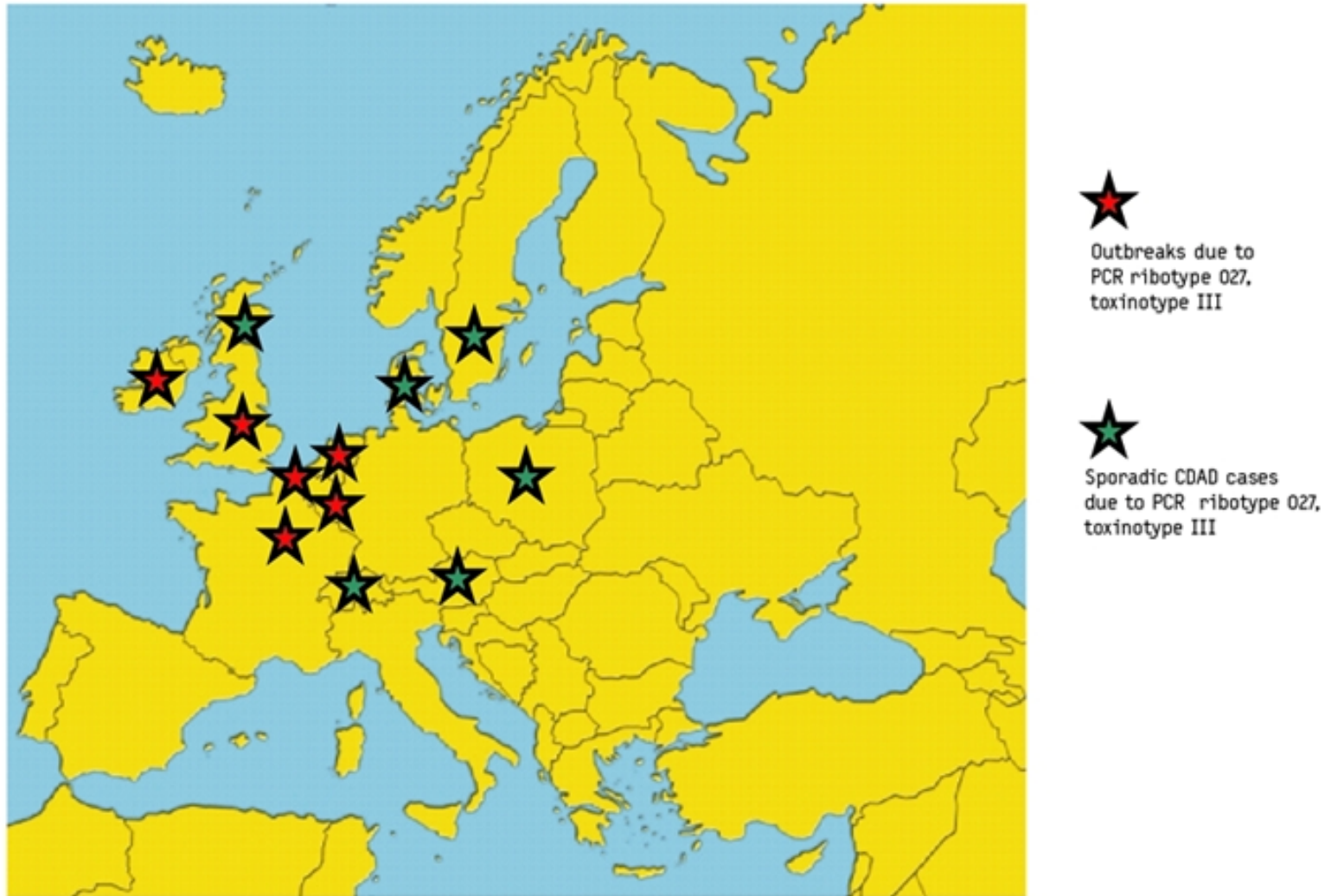
# Characteristics of case patients and control patients



Characteristics	Patients (N=237)	Controls (N=237)	p value
No. of antibiotics received	1.9±1.1	1.3±1.3	<0.001
Any exposure to antibiotics — no. (%)	188 (79.3)	141 (59.5)	<0.001
Cephalosporins	115 (48.5)	65 (27.4)	<0.001
Clindamycin	19 (8.0)	6 (2.5)	0.007
Fluoroquinolones	128 (54.0)	75 (31.6)	<0.001

**FIGURE**

Distribution of *C. difficile* ribotype 027 in Europe\* as of June 2007



\* Not all countries have performed surveillance studies to *C. difficile* type 027 and this figure may underestimate the number of affected countries



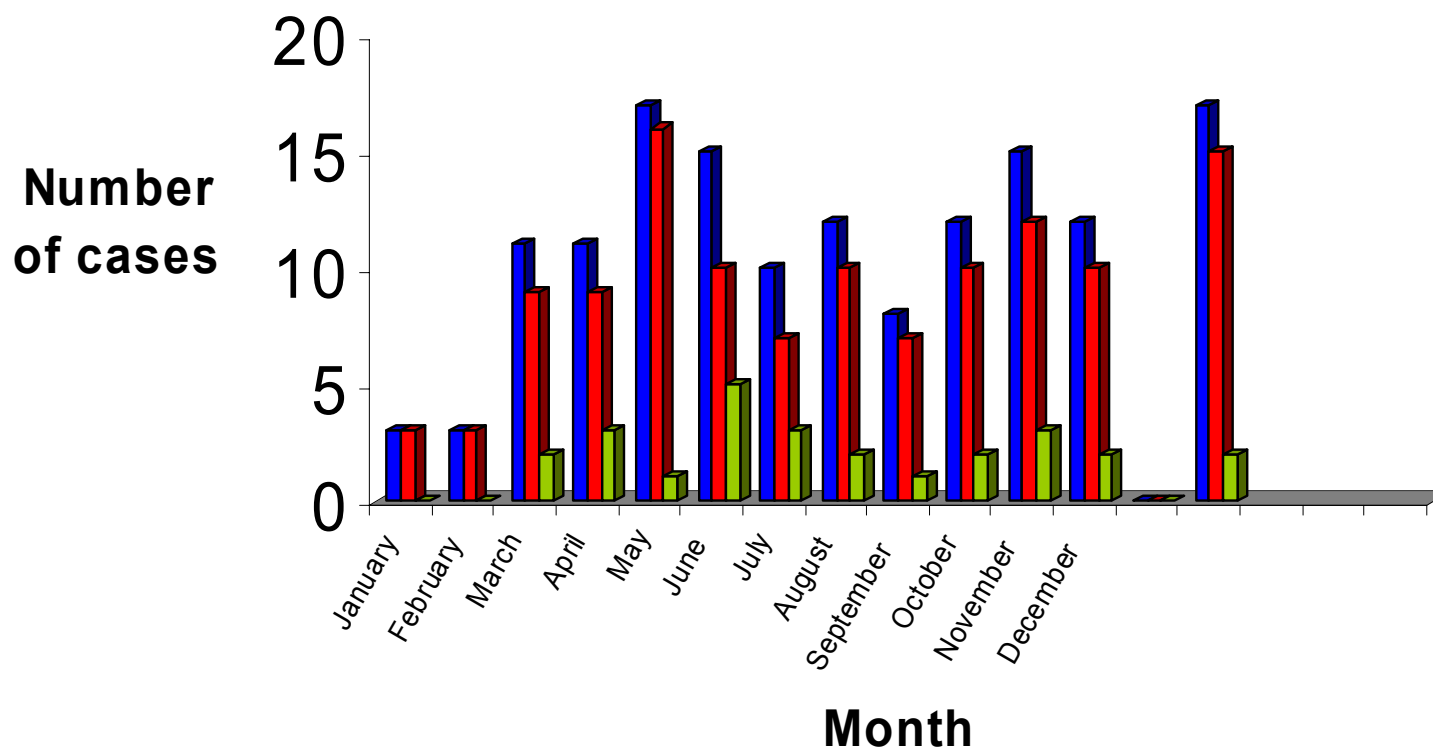
## CDAD cases: Hereford

- 1990 – no data
- 1991 – 1
- 1992 – no data
- 1993 – 3
- 1994 – 9
- 1995 – 16
- 1996 – 21
- 1997 – 34
- 1998 – 11
- 1999 – 14
- 2000 – 38
- 2001 – 24
- 2002 – 12
- 2003 – 32
- 2004 – 45
- Jan'05-Mar'06 – 145

# Hereford Hospitals Trust cases per month January 2005 – January 2006



- Total trust cases
- Hospital acquired infection
- Community acquired infection

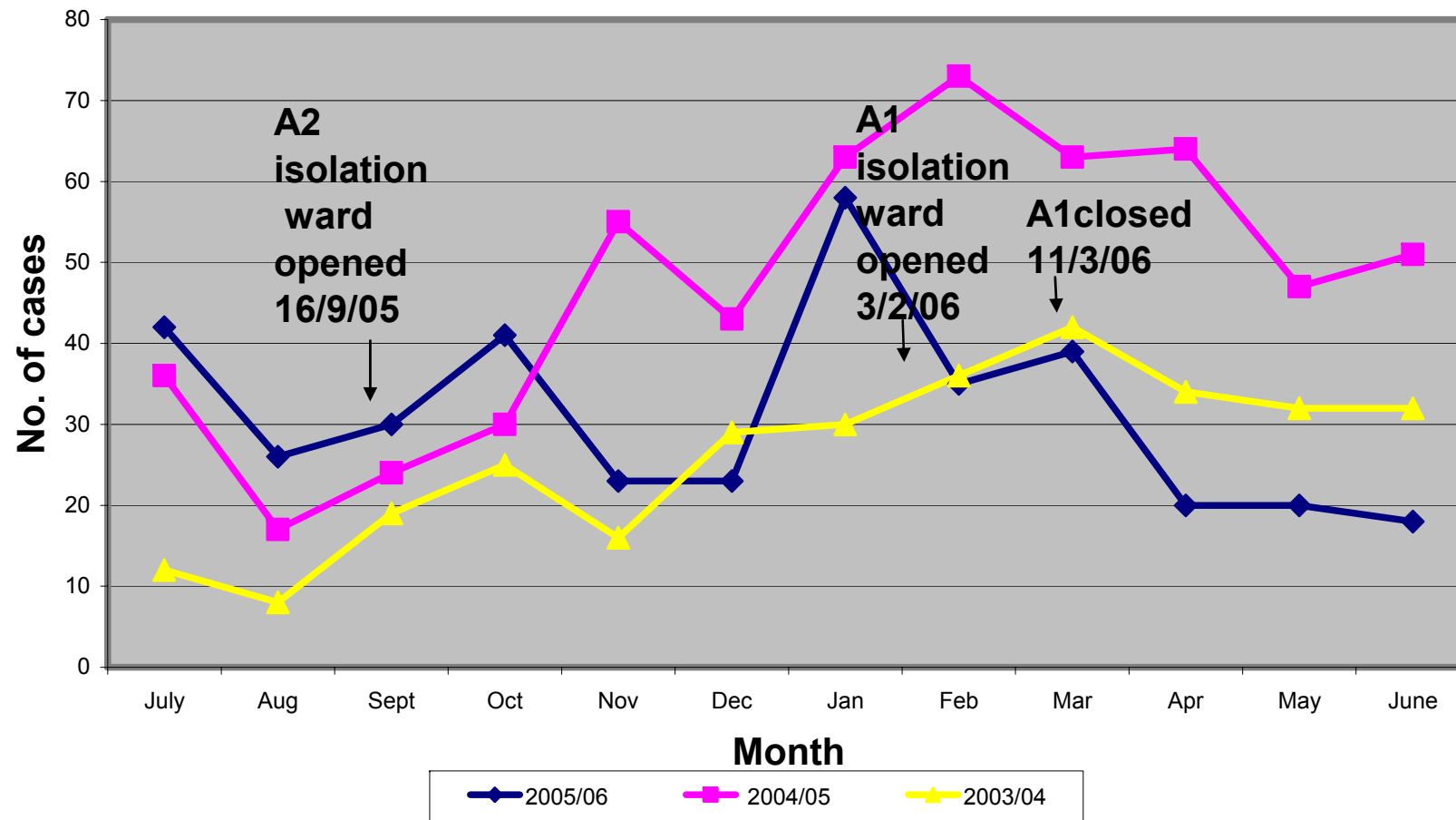




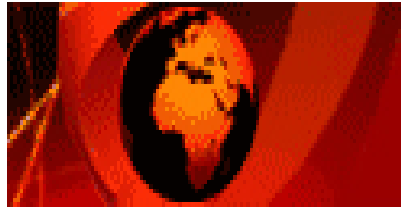
## CDAD cases: BHRT

- 1990 – 1
- 1991 – no data
- 1992 – 2
- 1993 – 15
- 1994 – 1
- 1995 – no data
- 1996 – 1
- 1997 – 31
- 1998 – 79
- 1999 – 123
- 2000 – 197
- 2001 – 32
- 2002 – 1
- 2003 – 310
- 2004 – 400
- 2005 ~ 850

# C.difficile at Oldchurch from July 2003 to June 2006







**BBC NEWS**

- **Inquiry ordered into deadly bug**
- The health secretary has ordered an independent inquiry into an outbreak of a virulent new strain of hospital bug in which 12 elderly patients have died



# Stoke Mandeville outbreak: control measures

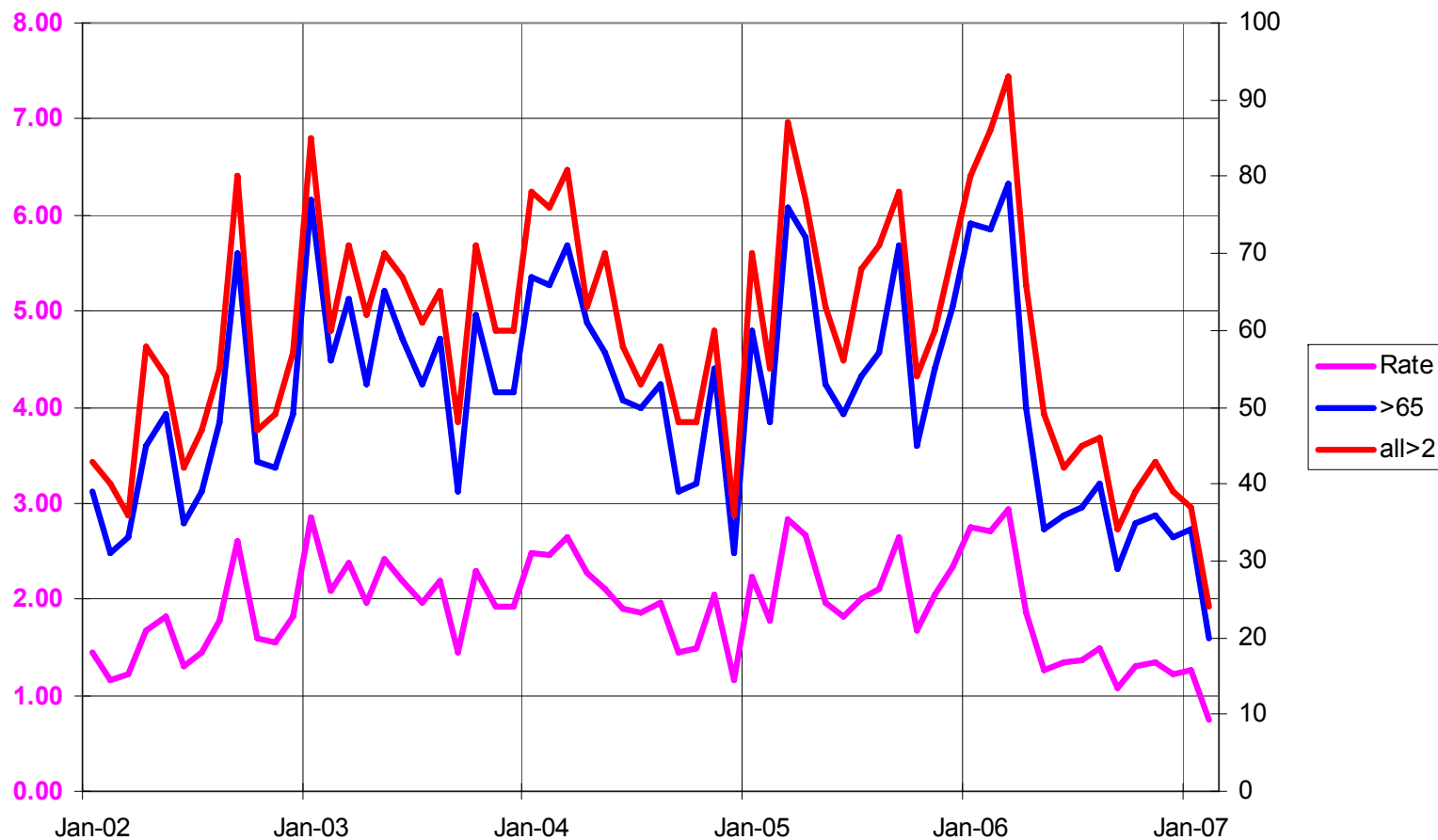


- Cohort areas
- Rigorous bed management for patients with diarrhoea
- Hypochlorite disinfectants for environmental cleaning
- Hand hygiene with soap and water
- Protective clothing
- Patient quarantines for exposed bays
- Antibiotic restrictions
- Bed cleaning prior to bed moves

# Cases of *C. difficile* in three East Kent hospitals meeting mandatory surveillance definition



EK monthly cases all ages V >65 + rate /1,000 bed days



Data courtesy of James Nash

# Antibiotic policy revision



- Cephalosporins            Restricted
  - Co-Amoxiclav            Restricted
  - Ciprofloxacin            Restricted [much opposition]
  - Gentamicin            Promoted [much opposition]
- 
- **Major cultural change for both clinicians and microbiologists ....**

# VA case control study – Antimicrobials

	Cases (n=50) n(%)	Controls (n=100) n (%)	Crude OR (95% CI)	p value
Penicillins	12 (24)	2 (2)	15.5 (3.3-72.4)	0.0005
Quinolones	6 (12)	1 (1)	13.5 (1.6 – 115.5)	0.02

# Denmark: consumption of antibacterials (kg) for systemic use in hospitals & community



	1997	1999	2001	2003	2005
• penicillins • ext.spectrum	5,525	5,202	5,385	5,295	5,561
• $\beta$ -lact.sens. • penicillins	18,840	18,825	20,730	21,630	22,520
• $\beta$ -lact.resist. • penicillins	1,919	2,425	3,230	4,075	4,564
• <b>cephalosporins</b>	<b>626</b>	<b>650</b>	<b>739</b>	<b>830</b>	<b>1,475</b>
• macrolides	3,093	3,075	3,020	2,889	2,881
• <b>fluoroquinolones</b>	<b>384</b>	<b>383</b>	<b>398</b>	<b>611</b>	<b>866</b>

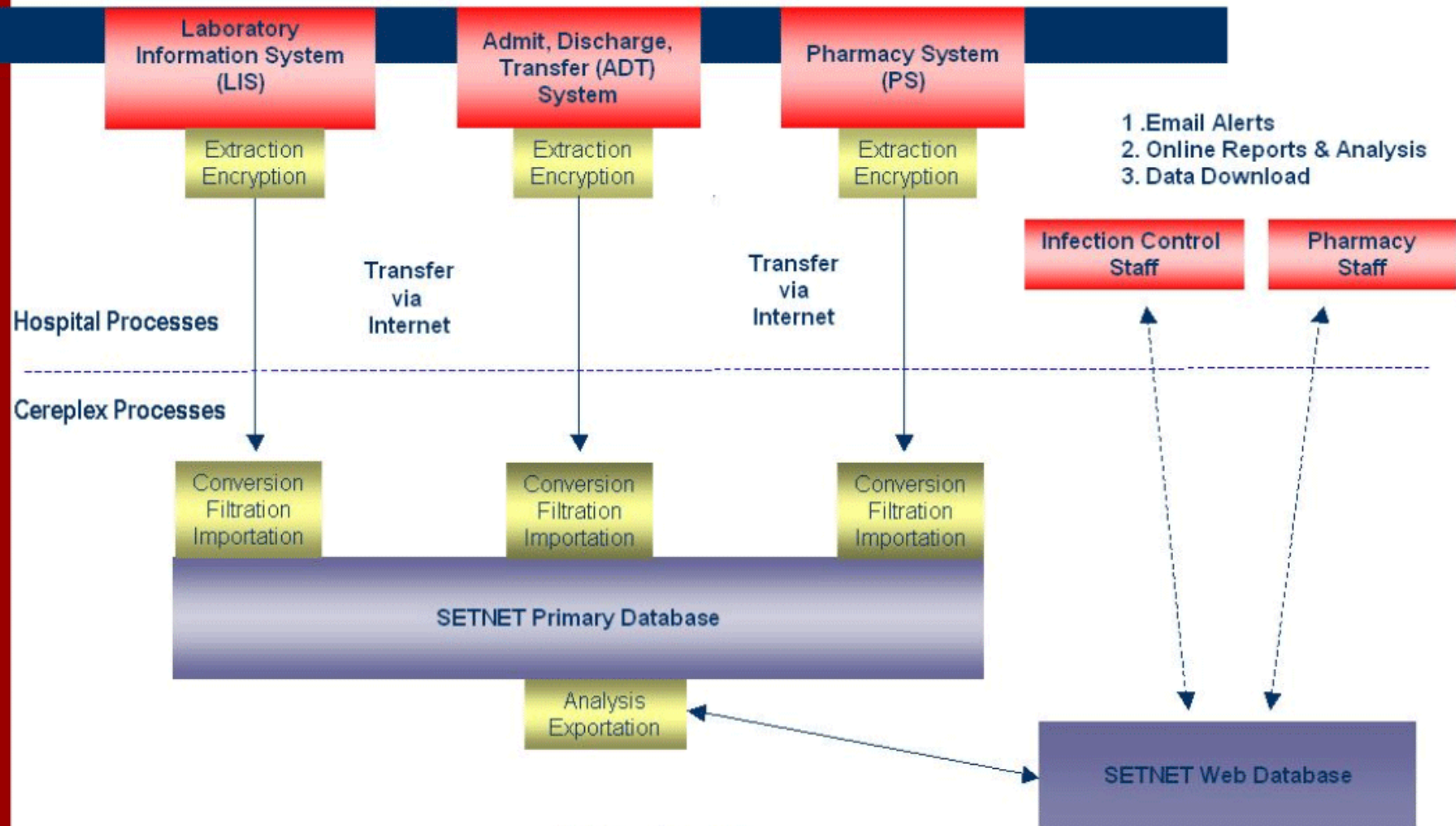
# Denmark: trends in antimicrobial consumption in 2005



- Increase from: 2004 = 3.4%, 1997 = 17.8%
- 76% increase 04-05 due to macrolide use
- Consumption of fluoroquinolones continued to increase: 0.28DDD/1,000 inhabitant days in 2004 to 0.32 in 2005
- Likely explanation is the price reduction due to opening the market to generic ciprofloxacin

# Data Architecture

## Single Hospital View





- [Pharm Watch](#)
  - [Event Detection](#)
  - [Line Listing](#)
  - [Scheduled Reports](#)
  - [Real-time Reports](#)
  - [Utilities](#)
- 
- [Options](#)
  - [FAQ](#)
  - [What's New](#)
  - [Sign Out](#)

**DEMO**

**Last Session:**  
 Sep 15, 2005  
**Session Count:**  
 866  
**Today's Date:**  
 Sep 15, 2005

**Event Detection Main**

You are currently viewing the main SETNET Event Detection page where you can review your alerts (both [Single Event Alerts](#) and [Control Chart Alerts](#)) and instantly view events placed on your [Favorites List](#).

**Single Event Alerts:** [ [View Master Single Event Log](#) ] [ [TOP](#) ]

**There were no Single Event alerts since your last session.**

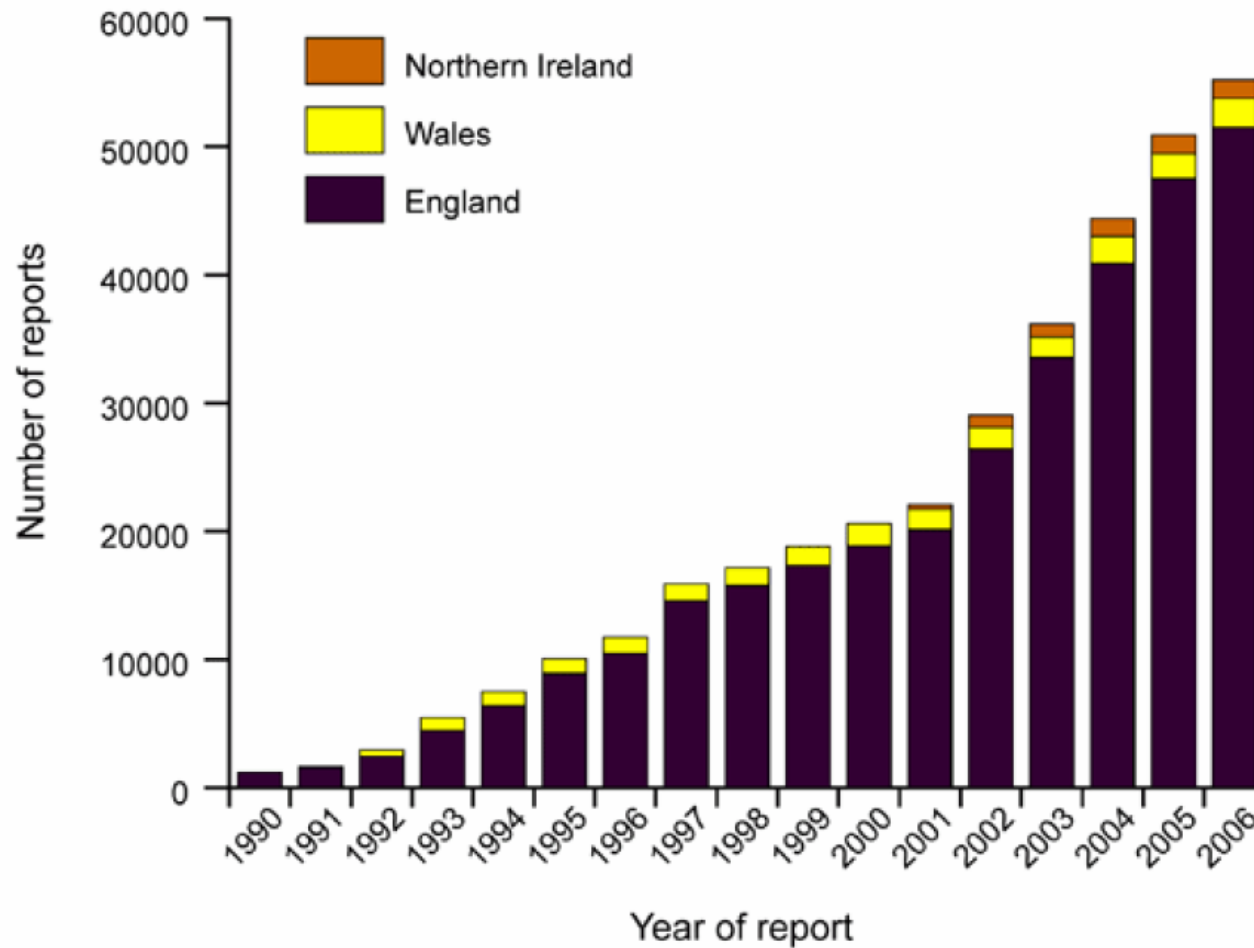
Single Event Alerts						
Event Name (click to view Single Event log)		Patient ID	Patient Name	Alert Date	Patient Viewed	Remove
<a href="#">Cardiac Surgery SSI</a>	<a href="#">Details</a>	<a href="#">7577366</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">Cardiac Surgery SSI</a>	<a href="#">Details</a>	<a href="#">7577366</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">USH-VAP</a>	<a href="#">Details</a>	<a href="#">7690777</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">USH-VAP</a>	<a href="#">Details</a>	<a href="#">7690777</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">USH-VAP</a>	<a href="#">Details</a>	<a href="#">7690777</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">USH-VAP</a>	<a href="#">Details</a>	<a href="#">7690777</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">USH-VAP</a>	<a href="#">Details</a>	<a href="#">7277871</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">USH-VAP</a>	<a href="#">Details</a>	<a href="#">7277871</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>
<a href="#">VRE Housewide</a>	<a href="#">Details</a>	<a href="#">7099927</a>	[CONFIDENTIAL]	09/14/2005	No	<a href="#">Remove</a>
<a href="#">VRE Housewide</a>	<a href="#">Details</a>	<a href="#">7504853</a>	[CONFIDENTIAL]	09/14/2005	No	<a href="#">Remove</a>
<a href="#">VRE Housewide</a>	<a href="#">Details</a>	<a href="#">7613987</a>	[CONFIDENTIAL]	09/14/2005	No	<a href="#">Remove</a>
<a href="#">WCH MRSA</a>	<a href="#">Details</a>	<a href="#">7644040</a>	[CONFIDENTIAL]	09/14/2005	Yes	<a href="#">Remove</a>
<a href="#">USH-VAP</a>	<a href="#">Details</a>	<a href="#">7556145</a>	[CONFIDENTIAL]	09/15/2005	No	<a href="#">Remove</a>

# Antimicrobial Management Service

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- ***Identifies instances of antimicrobial misuse***
  - Through integration of Microbiology and Rx data
- ***Focused patient intervention***
  - Automatic alerts identify opportunities for clinical intervention
- ***Improves formulary management***
  - Reports and graphs provide pharmacists objective information related to improper application of the formulary
- ***Documents impact with financial analysis***
  - Annual financial analysis will highlight the positive impact that pharmacy interventions contribute to the bottom line

# Questions re surveillance of *C. difficile*: international perspective on local surveillance and intervention monitoring



\*Data from 2006 are provisional

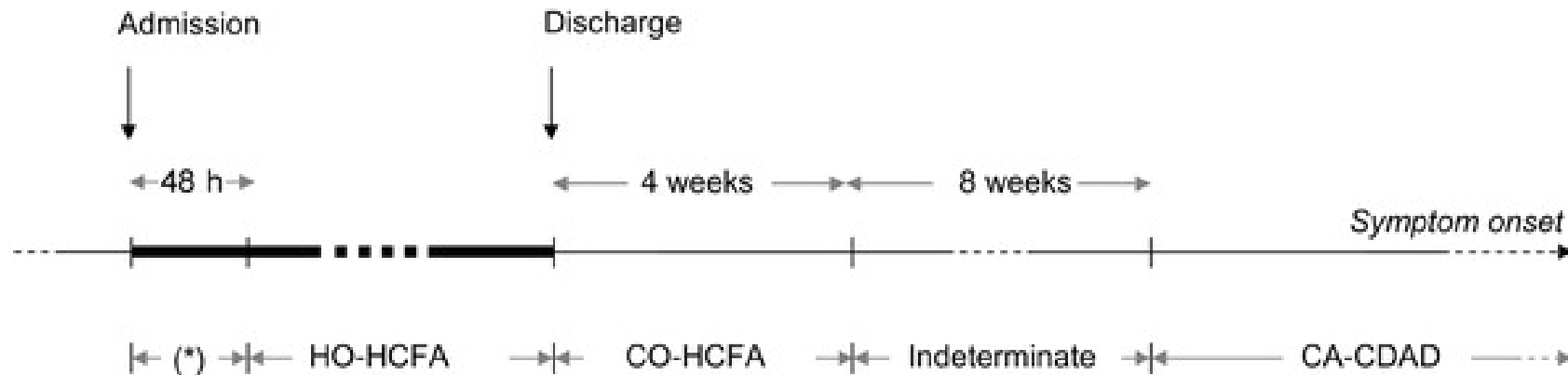
† Data for Northern Ireland only included from 2001 onwards

# Acknowledgments

- HPA, mandatory surveillance team at Centre for Infections
- Department of Health – Sally Batley, Michael Fleming, Brian Duerden, Sally Wellsted
- NHS – Trust infection control teams
- Regional HPA colleagues
- Damien Mack (Whittington Hospital)
- André Charlett (Statistics & Modelling Unit, CfI)
- Cereplex and Cardinal Health data mining surveillance systems
- Hereford, Oldchurch, Stoke Mandeville, Ashford NHS Hospitals
- Ed Kuijper (Leiden University Medical Centre)
- CDC team (Cliff McDonald, John Jernigan, Scott Fridkin,)

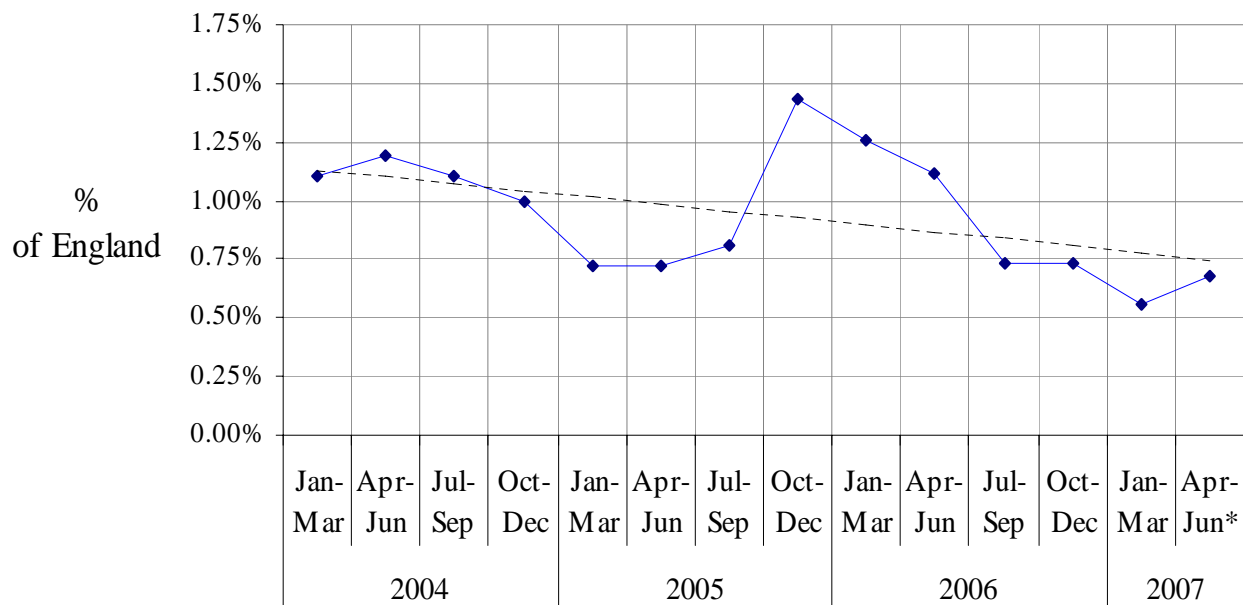
# QUESTIONS

# Time line for definitions of *Clostridium difficile*–associated disease (CDAD) exposures.



Case patients with symptom onset during the window of hospitalization marked by an asterisk (\*) would be classified as having community-onset, healthcare facility–associated disease (CO-HCFA), if patient was discharged from a healthcare facility within the previous 4 weeks; would be classified as having indeterminate disease, if the patient was discharged from a healthcare facility between the previous 4-12 weeks; or would be classified as having community-associated CDAD (CA-CDAD), if the patient was not discharged from a healthcare facility in the previous 12 weeks. HO-HCFA, healthcare facility–onset, healthcare facility–associated CDAD.

### Maidstone & Tunbridge Wells as a proportion of the England Total



This chart shows that as a proportion of England, Maidstone & TW in the "outbreak" period between October 2005 and March 2006 was not very much greater than it had been in early 2004.

An imposed trend line might even suggest that there were simply random variations around a linear decreasing trend.

Note that the peak quarter as a proportion of England was in October to December 2005, whereas in volume terms the peak quarter was between January and March 2006. (First graph).

Note that the third table shows that in both 2005 and 2006 Maidstone & TW formed less of a proportion of the England total than it had done in 2004.

*Analysis courtesy of Michael Fleming, Department of Health*