



# **Bacterial Screening of NHSBT Platelet Components**

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# Overview

- **Impact of bacterial transmission**
  - **Why PCs are the greatest risk**
  - **NHSBT Strategy**
  - **Impact diversion and improved donor arm disinfection**
  - **NHSBT protocol Bacterial Screening**
  - **NHSBT results Bacterial Screening**
  - **Added value Bacterial Screening**
  - **Future development**
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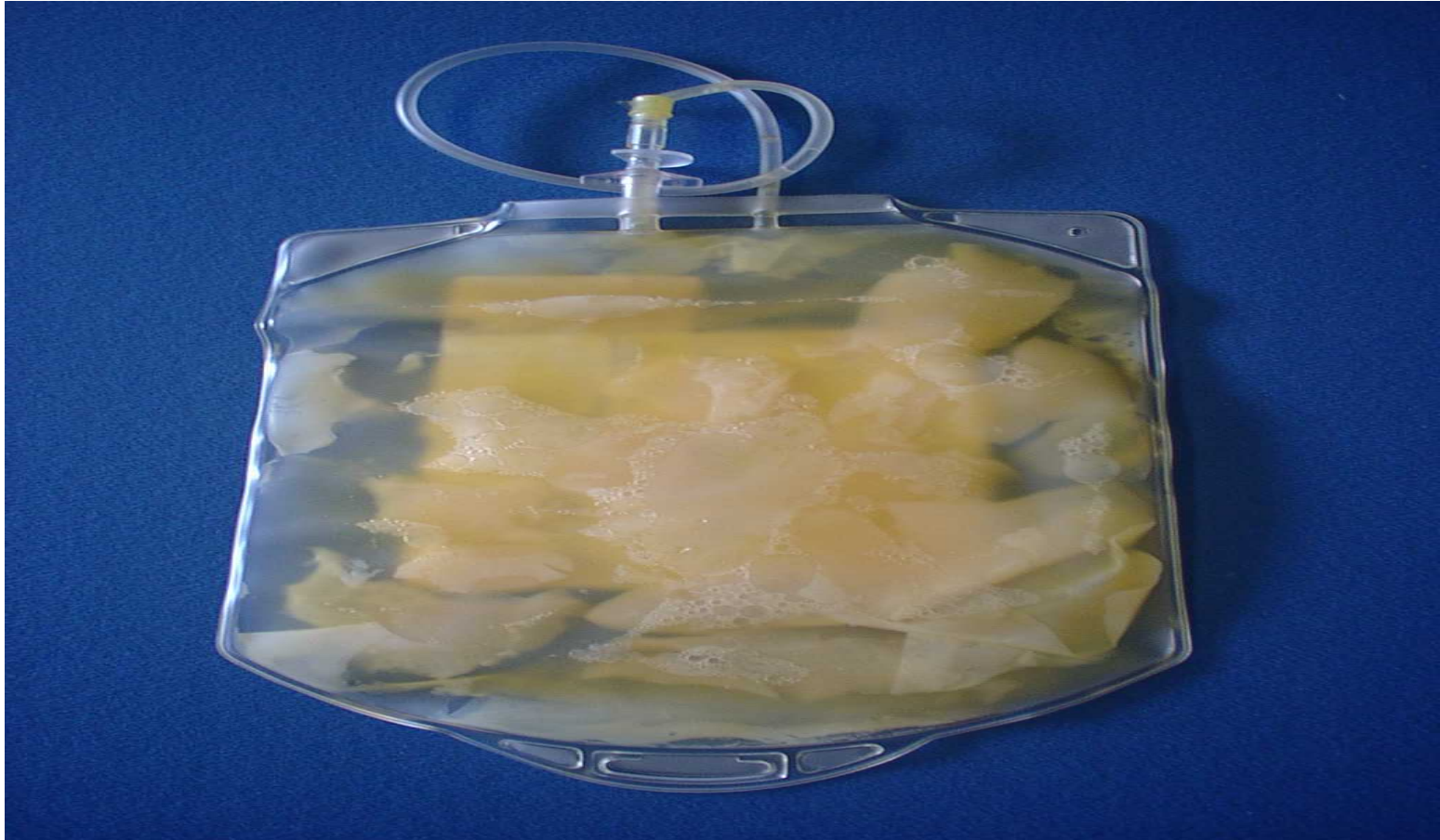
# Bacterial Mortality Worldwide

<b>USA</b>	<b>2005-2015</b>	<b>38 deaths</b>	<b>(FDA)</b>
<b>France</b>	<b>1994-2015</b>	<b>36 deaths</b>	<b>(Haemovigilance)</b>
<b>Germany</b>	<b>1997-2014</b>	<b>14 deaths</b>	<b>(Haemovigilance)</b>
<b>U.K.</b>	<b>1994</b>	<b>3 deaths</b>	<b>(Pre-SHOT)</b>
<b>U.K.</b>	<b>1996-2016</b>	<b>11 deaths</b>	<b>(SHOT)</b>


# Platelet Components Are The Greatest Risk!

- **USA: (FDA) 2005 – 2015 platelet components comprised 87% (33/38) bacterial fatalities**
  - **UK: (SHOT) 1996 – 2016 platelet components comprised 84% (37/44) cases**
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# *Klebsiella oxytoca*



# NHSBT Strategy

- **Improved donor arm disinfection**
  - **Diversion**
  - **Bacterial Screening**
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# Interventions Introduced


- **Improved Donor Arm Disinfection – implemented nationally 2007**
- **Diversion – implemented nationally 2003**
- **In combination 77% reduction in contamination**

McDonald, C.P. *et al.*, Relative Values of the Interventions of Diversion and Improved Donor-Arm

Disinfection to Reduce the Bacterial Risk from Blood Transfusion: *Vox Sanguinis* (2004), 86:178-182



# Post Implementation Improved Donor Arm Disinfection and Diversion (2006 – 2010)


- **7 contamination incidents in PC**
  - **10 patients affected**
  - **3 deaths**
  - **5 near misses**
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# **NHSBT Bacterial Screening**

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# Bacterial Screening of Platelet Components in NHSBT

- NHSBT Board Meeting in January 2010
  - Decision was made to implement bacterial screening within 12 months
  - February 2011 rolled out
  - July 2011 all components screened
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# BacT/ALERT System



# Bacterial Screening Laboratory





# Bacterial Screening Laboratory




# Bacterial Screening Laboratory




# **NHSBT Test Protocol**

## **(1 test, Extension Shelf Life to 7 Days)**

- 1. Platelet components held for  $\geq$  36hrs – 48hrs after collection**
  - 2. Platelet components sampled and tested**
  - 3. Held for 6hrs**
  - 4. Released with a 7 day shelf life**
  - 5. Monitored for the component shelf life**
  - 6. Positives recalled**
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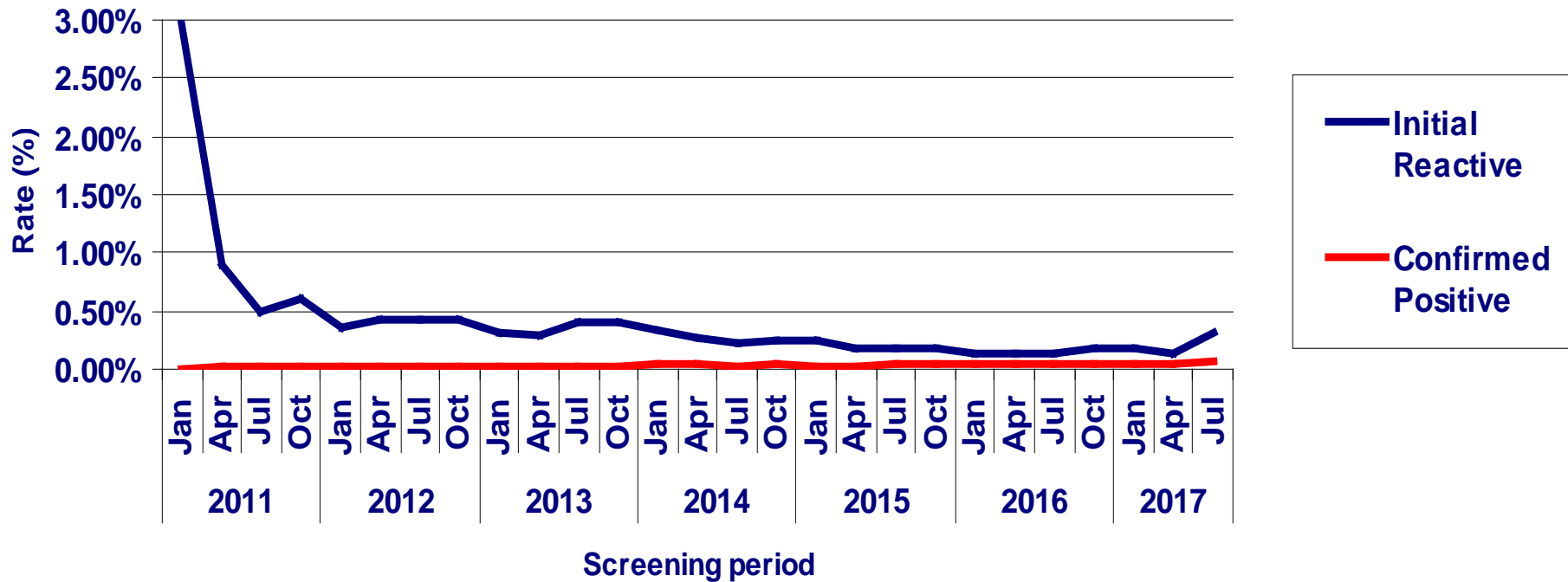


# What Happened?

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# Quarterly Bacterial Screening Rates (February 2011 - Sept 2017)



# Initial Reactive and Confirmed Positive Rates (Cumulative Feb 2011 – Sept 2017)

	Number	Initial Reactive Rate	Confirmed Positive Rate
Apheresis*	1,285,959	0.33%	0.02%
Pooled*	530,804	0.25%	0.07%
Total	1,816,763	0.31%	0.04%

\*Apheresis platelets screened from Feb 2011

\*Pooled platelets screened from May 2011

# Initial Screen: Bottle Reactivity


(February 2011 – Sept 2017)

<b>Bottle Type</b>	<b>Initial Reactive</b>	<b>False Positive</b>
<b>Anaerobic</b>	<b>73.8%</b>	<b>77.9%</b>
<b>Aerobic</b>	<b>21.3%</b>	<b>21.7%</b>
<b>Both</b>	<b>4.8%</b>	<b>0.4%</b>

# Confirmed Positives - Bottle Type (February 2011 – Sept 2017)

- Anaerobic bottle 65%
  - Aerobic bottle 7%
  - Both bottles 28%
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# Confirmed Positives (February 2011 – Sept 2017)

- 666 confirmed
  - 640 Gram positives
  - 26 Gram negatives
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# Confirmed Organisms (February 2011 – Sept 2017)

## Gram Positives (n=640):

*Propionibacterium spp.* = 346  
*Staphylococcus spp.* = 163  
*Streptococcus spp.* = 105  
*Gemella spp.* = 6  
*Listeria monocytogenes* = 4  
*Corynebacterium spp.* = 3  
*Enterococcus spp* = 3  
*Lactobacillus casei* = 2  
*Bacillus cereus* = 2  
*Granulicatella adaciens* = 2  
*Lactococcus lactis* = 1  
*Peptostreptococcus micros* = 1  
*Finnegoldia magna* = 1  
Misc. Gram Positive bacilli = 1

## Gram Negatives (n=26):

*Escherichia coli* = 9  
*Serratia marcescens* = 5  
*Klebsiella spp.* = 5  
*Enterobacter spp* = 2  
*Pseudomonas aeruginosa* = 1  
*Haemophilus aphrophilus* = 1  
*Bacteroides vulgatus* = 1  
*Proteus mirabilis* = 1  
*Campylobacter lari* = 1



# Confirmed Positive Gram Positive 'Pathogenic' Organisms (Feb 2011 – Sept 2017)

Organisms	n	Detection Time Range (hours)	Total Contaminated Components
<i>Streptococcus dysgalactiae</i> (Group G/C)	24	2-19	32
<i>Staphylococcus aureus</i>	17	2-21	21
<i>Streptococcus pneumoniae</i>	12	10-13	16
<i>Streptococcus agalactiae</i> (Group B)	6	6-16	5
<i>Listeria monocytogenes</i>	4	14-20	5
<i>Bacillus cereus</i>	2	11-14	2

Total cases with pathogenic organisms: 65  
Total number of contaminated components: 81

# Confirmed Positive Gram Negative 'Pathogenic' Organisms (Feb 2011- Sept 2017)

Organisms	n	Detection Time Range (hours)	Total Contaminated Components
<i>Escherichia coli</i>	9	3-14	19
<i>Serratia marcescens</i>	5	3-13	8
<i>Klebsiella oxytoca</i>	3	3-10	4
<i>Klebsiella pneumoniae</i>	2	4-11	3
<i>Proteus mirabilis</i>	1	14	1
<i>Pseudomonas aeruginosa</i>	1	15	1
<i>Campylobacter lari</i>	1	32	1

Total cases with pathogenic organisms: 22  
Total number of contaminated components: 37

# Number of Splits Contaminated in Confirmed Positive Apheresis Donations (Feb 2011 – Sept 2017)


Splits per donation	Total number of splits positive per investigation		
	1	2	3
2	47.9% (69)	52.1% (75)	N/A
3	50% (16)	18.8% (6)	31.2% (10)

**NB: when all components returned for confirmatory/reference testing**


# Near Misses and Transmissions

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# Transmissions and Near Misses

- 1 transmission: 1 x *Staphylococcus aureus*
  - 4 near misses: 3 x *S. aureus*  
1 x *Serratia marcescens*
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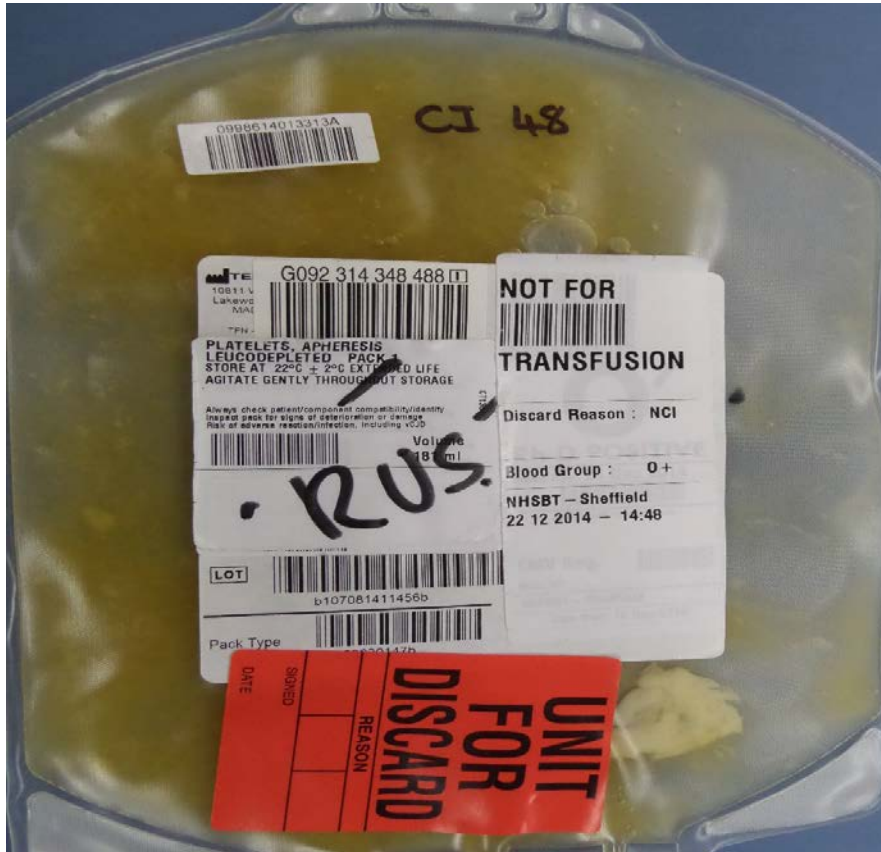
# Near Miss 1: 2013

- Apheresis platelet donation (2 splits)
  - Large clumps reported in pack 2 by Hospital A
  - Pack 1 issued to Hospital B but not transfused. No clumps present
  - Both units received by NBL
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# Near Miss 1: 2013 (cont'd)

- No clumps visible in pack 2, but were present in pack 1
  - BacT/ALERT cultures for both units positive in 3.8hr
  - *Staphylococcus aureus* isolated
  - Investigation of donor found *S. aureus* colonisation
  - Strain typing of PC and donor isolates were indistinguishable
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# Near Miss 3






# BacT/ALERT Culture Bottles



# Near Miss 4: 2015

- **Apheresis unit – 2 splits**
  - **Clumps observed in split 1 by SHU**
  - **Packs and BacT/ALERT screening bottles sent to NBL**
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# Near Miss4: 2015


Pack 1



Pack 2



# Near Miss 4: 2015 (cont'd)

- Gram from pack 1 – Gram negative rods
  - Gram from pack 2 – negative
  - Clotted pack 1 – positive on BacT/ALERT 3.7h
  - Unclogged pack 2 – negative on BacT/ALERT
  - *S. marcescens* identified from pack 1
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# Near Miss 4: 2015




Inoculated

Uninoculated

# Near Miss 4: 2015 (cont'd)

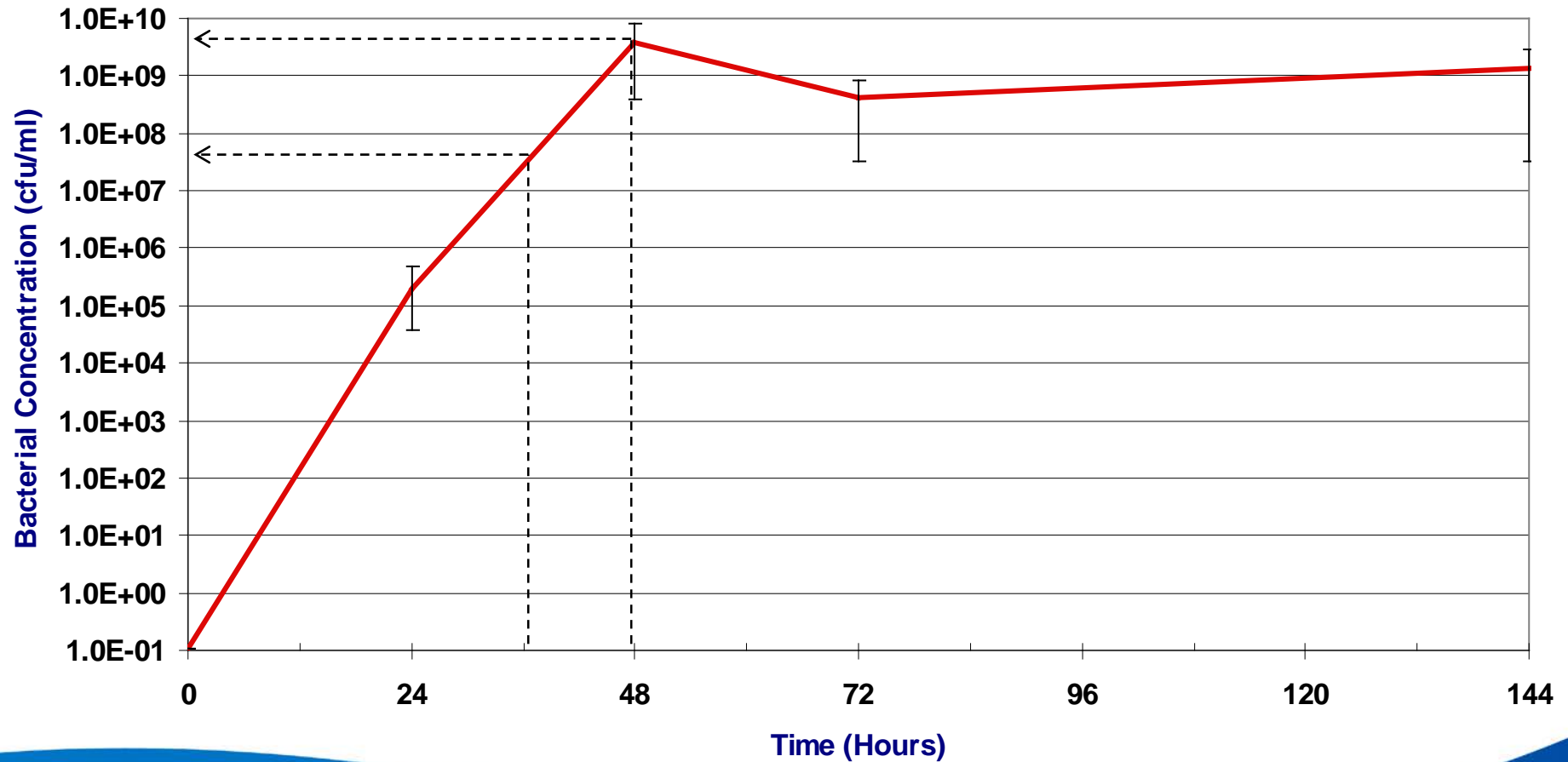
- **BacT/ALERT bottles – Gram stain negative (both packs)**
  - **BacT/ALERT bottles subcultured into new bottles – negative**
  - **Screening bottles inoculated *S. marcescens* – positive**
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# Near Miss 4: Conclusion

- **Not a BacT/ALERT failure**
  - **Insufficient bacteria at sampling time?**
  - **Contamination post screening?**
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## Growth Kinetics of *S. marcescens* in Platelets Suspended in Plasma





# Confirmed Transfusion-Transmitted Infection (TTI) 2015


- Pooled platelet unit transfused into AML patient
- After 15 mins, the patient became agitated and suffered rigors, tachycardia and pyrexia
  - Temperature rose to 38.7°C, then 40°C overnight
- Patient cultures grew *Staphylococcus aureus*

# Confirmed TTI: 2015 (cont'd)

- Platelet unit received by NBL
- Unit was leaking through open port, sealed with a capped needle
- Remaining contents (~3ml) appeared 'cloudy'
- Gram stain showed heavy contamination with GPC
- BacT/ALERT cultures positive in 3.8h



# Confirmed TTI: 2015 (cont'd)

- *S. aureus* isolated, strain type matched the patient isolate
  - All 4 associated red cells units were cultured by NBL and remained negative after 7 days incubation
  - 2/4 Donors investigated – both had *S. aureus* in multiple sites
  - Strain typing of 1<sup>st</sup> donor isolates showed a distinct strain (no match)
  - Strain typing of 2<sup>nd</sup> donor showed closely-related Spa type and matching DNA fingerprint
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# **Bacterial Screening: Added Value**

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# Donor Healthcare Benefits

## Bacterial Screening


- ***Streptococcus bovis* (n=4):** donor's colonic polyps
- ***Streptococcus constellatus* (n=3) and *P. micros*:** dental

McDonald, C. *et.al.*, *Transfusion*, 2013,53:2117-2119

Lee, CK. *et.al.*, *Transfusion*, 2013,53:2205-2208



# Bacterial Screening Provides Insight into Possible Source of Contamination

- **Pseudomonas spp. – poor hygiene facilities**
  - **Staphylococcus spp. – inadequate donor arm disinfection**
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# Future




# BacT/ALERT Virtu







# Virtuo Advantages

- **Superior performance to BacT/Alert 3D**
    - **Faster detection times**
    - **Potentially lower false positive rates**
    - **Automated loading and unloading**
- 

# NHSBT Screening (February 2011 to March 2017)


- 1 transmission in >1.8million PC screened (*S.aureus*)
  - 4 near misses (3 *S. aureus* and *S. marcescens*)
  - False negative rate 1 in 360,000 (0.0003%)
  - 1 CP in 6015 TE platelets screened (*S. pneumoniae*)
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# Success NHSBT Bacterial Screening

- **Delayed sampling**
  - **High volume tested (5-7%)**
  - **Screening of apheresis splits**
  - **Use of a two bottle system**
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# Conclusion

**Bacterial Screening  
within NHSBT has  
proven to be extremely  
successful risk  
reduction intervention!**



# **Bacterial Screening of Platelet Components by National Health Service Blood and Transplant, an Effective Risk Reduction Measure**

**C. McDonald, J. Allen, *et al.*,**

**Transfusion 2017;57;1122-1131**



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# THANK YOU

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