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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

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

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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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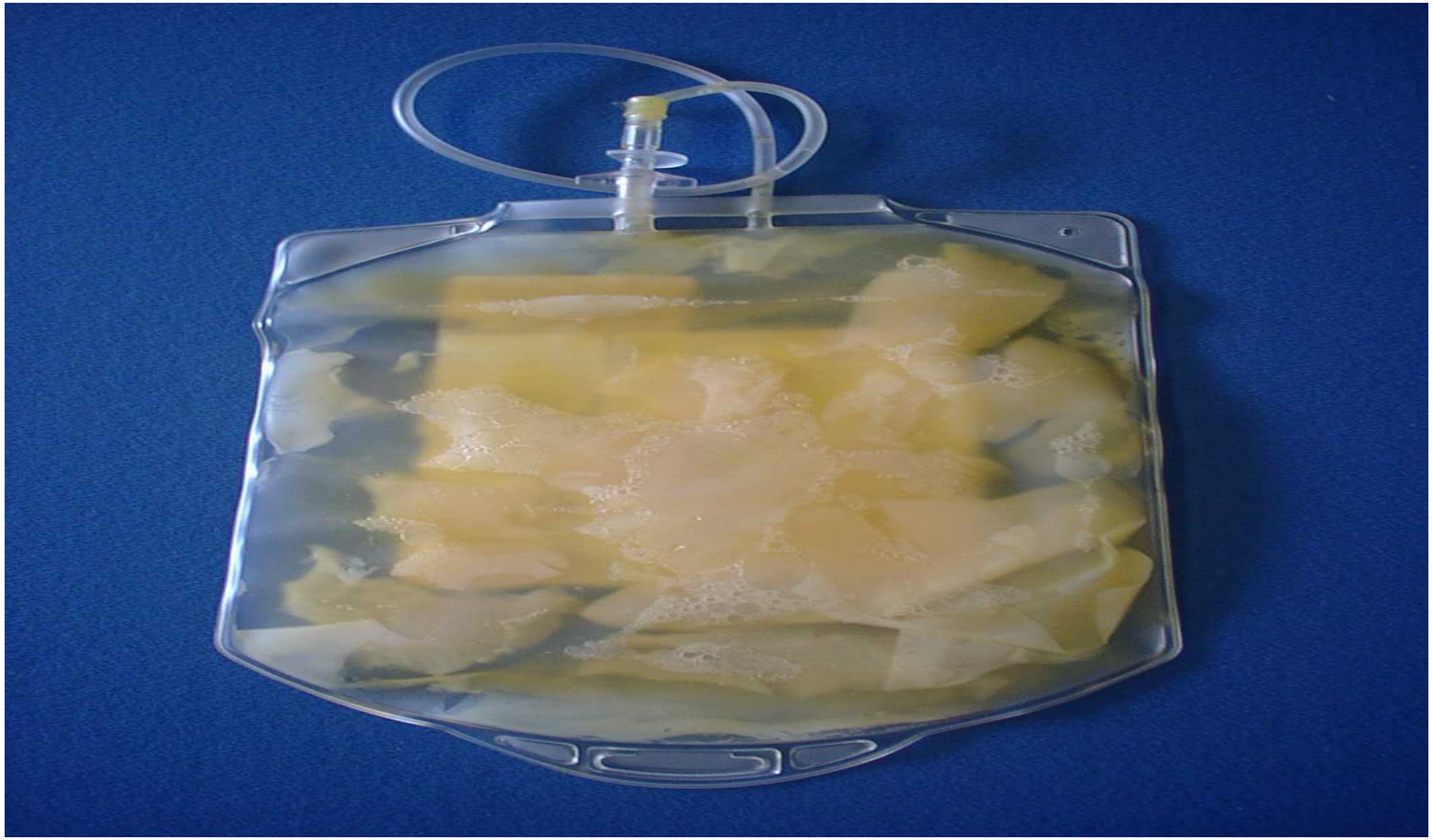
Klebsiella oxytoca



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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

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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

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Bacterial Screening Laboratory

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NHSBT Test Protocol
(1 test, Extension Shelf Life to 7 Days)

1. Platelet components held for ≥ 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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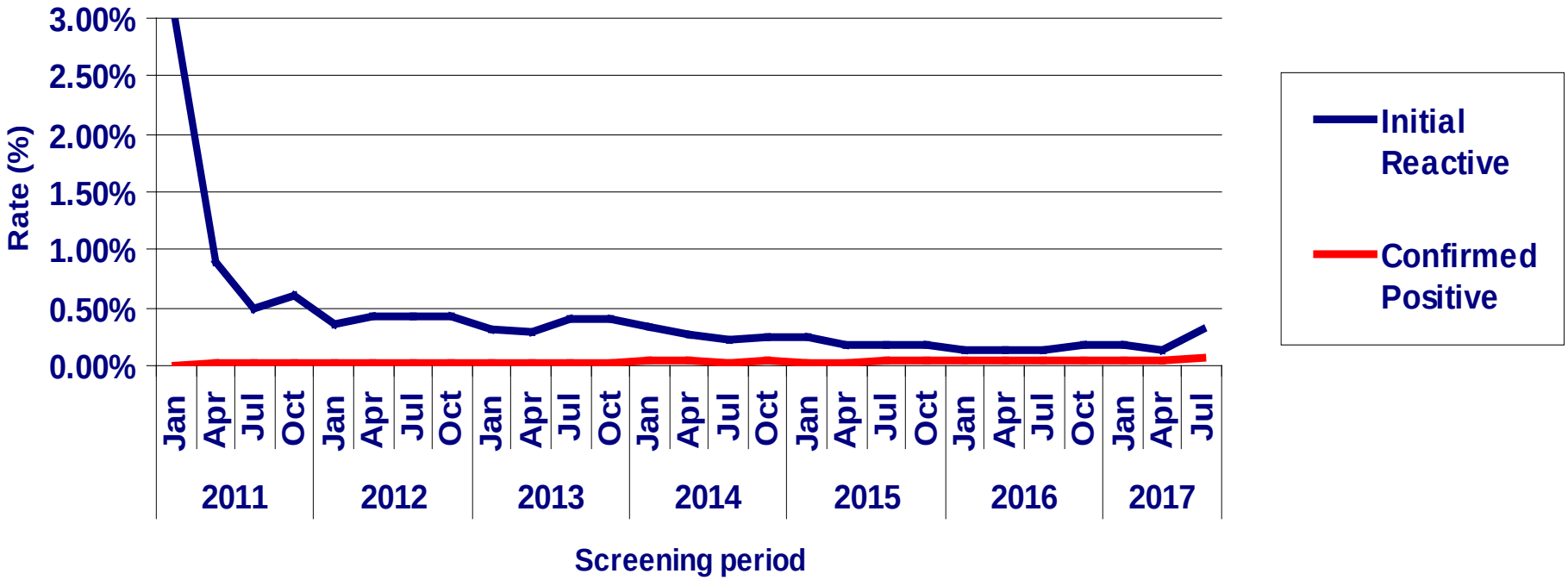
Quarterly Bacterial Screening Rates (February 2011 - Sept 2017)



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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

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Initial Screen: Bottle Reactivity

(February 2011 – Sept 2017)

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

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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

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
Finegoldia 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

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

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

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

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

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

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

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

	Total number of splits positive per investigation		
Splits per donation	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

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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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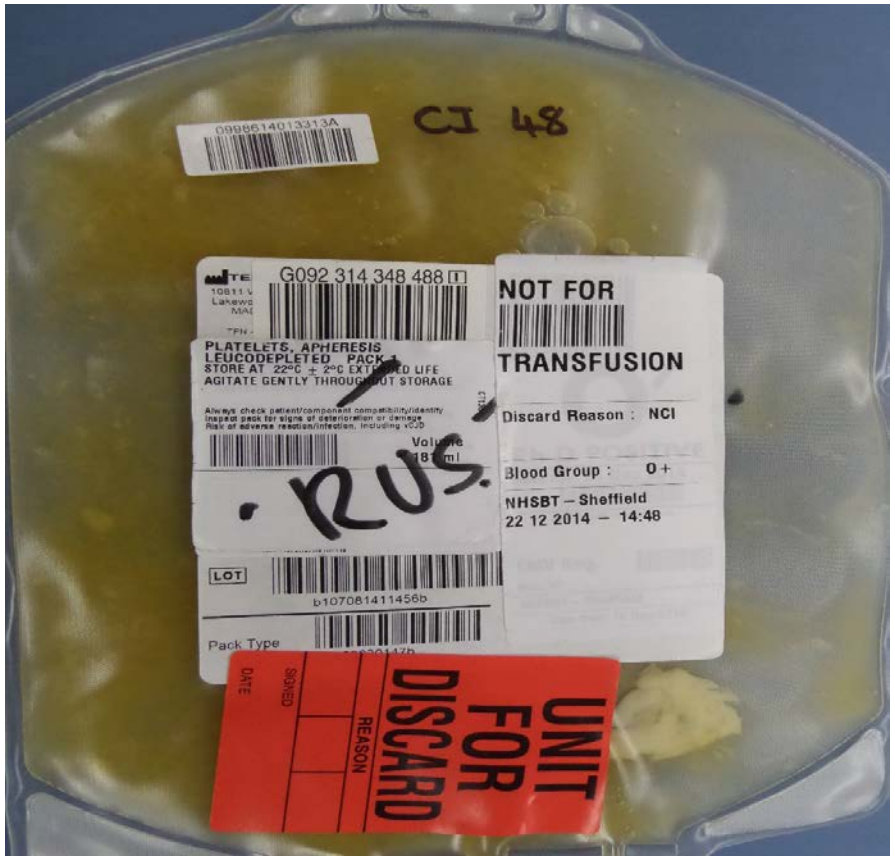
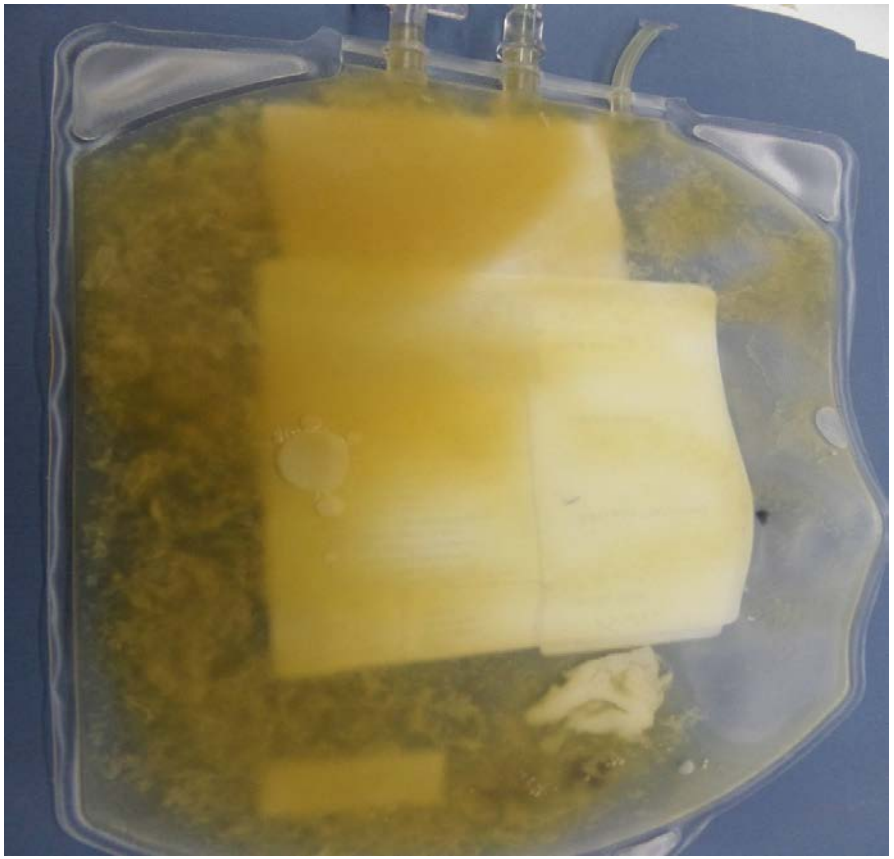
Near Miss 3





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BacT/ALERT Culture Bottles

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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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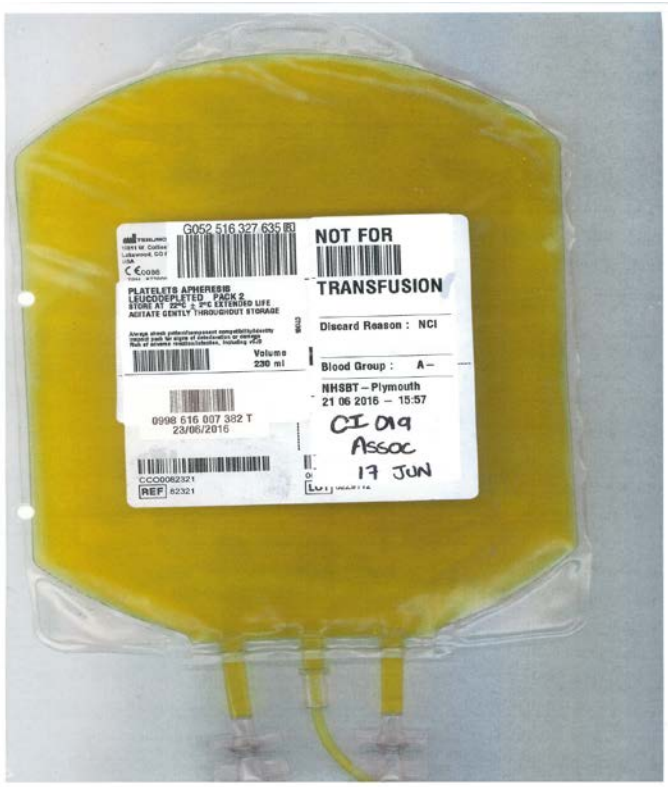
Near Miss4: 2015

Pack 1

Pack 2



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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**
- **Unclotted pack 2 – negative on BacT/ALERT**
- ***S. marcescens* identified from pack 1**

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Near Miss 4: 2015

Inoculated **Uninoculated**

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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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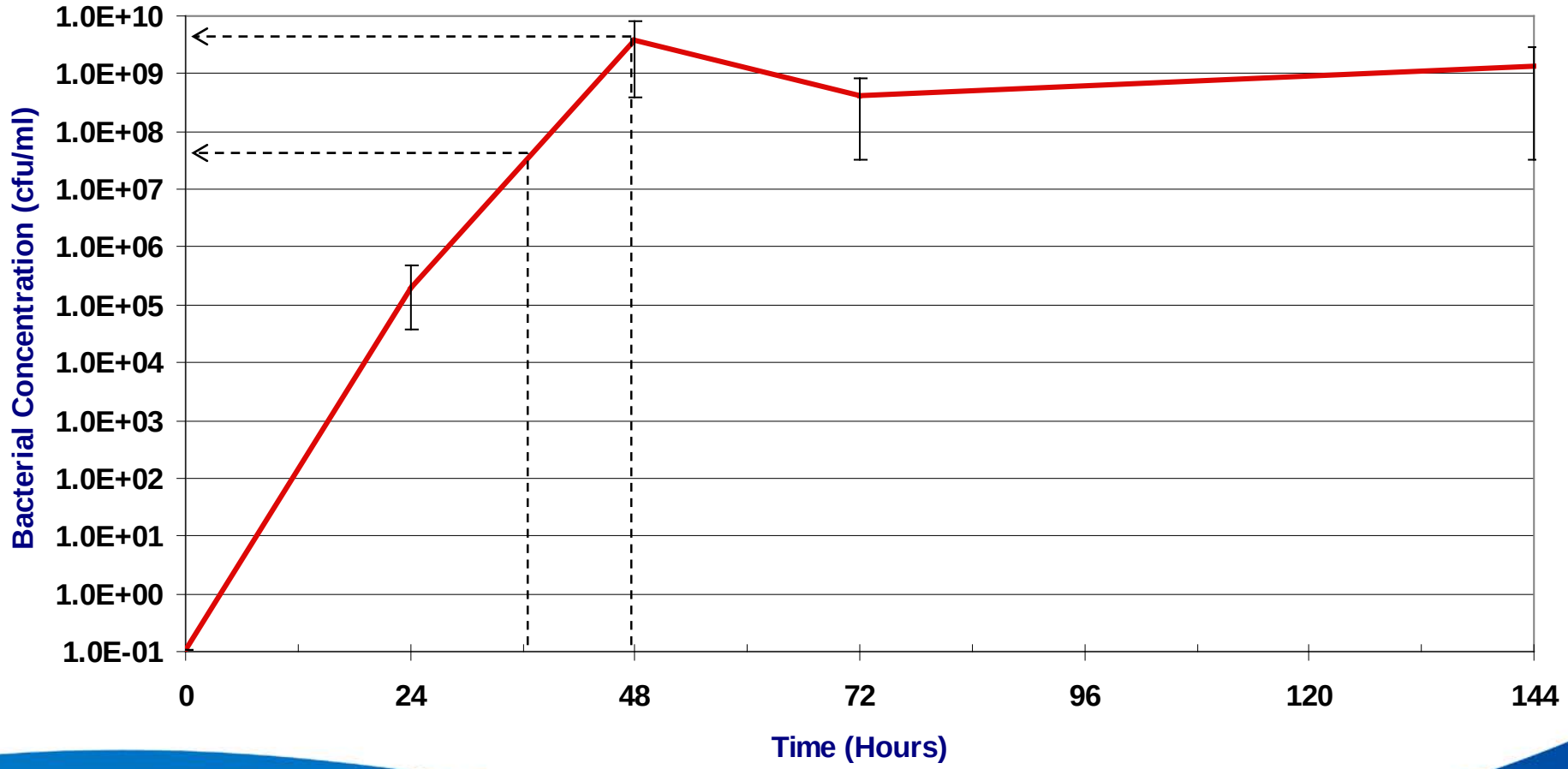
Growth Kinetics of *S. marcescens* in Platelets Suspended in Plasma



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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*

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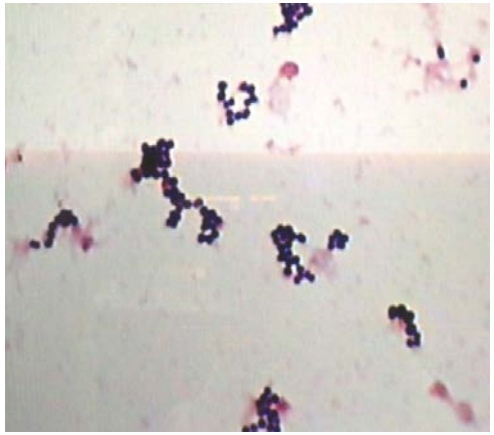
Confirmed TTI: 2015 (cont'd)

- 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



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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 1st donor isolates showed a distinct strain (no match)**
- **Strain typing of 2nd 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

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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

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BacT/ALERT Virtuo

Virtuo Advantages

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

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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!

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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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