Getting to Zero

Eliminating Blood Culture Contamination with an Initial-Specimen Diversion Device

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Disclaimers

No disclaimers to report

No honoraria or grant was received to support this study

Introduction – Blood Culture Contaminants

An estimated 25 - 50% of all blood cultures contain skin contaminants.

Microbial flora can contaminate blood samples obtained via venipuncture.

Common Contaminants

- Coagulase-negative staphylococci (CNS)
- *Corynebacterium* sp.
- *Cutibacterium acnes*
- *Micrococcus* sp.
- *Bacillus* sp.

Unless present in multiple blood cultures, these organisms are designated potential contaminants by the laboratory.

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Introduction – CLABSI Reporting

For central line patients, according to NHSN definitions…

If 1 of 2 bottles from a blood culture set are positive for CNS…

And if a second set drawn within 24 hours contains 1 of 2 bottles positive for CNS…

This is considered to represent a CLABSI.

If present in a single bottle from 2 sets (4 bottles) any of the following…

- **Enterococci (including VRE)**
- ***Candida* sp.**
- ***Clostridia* sp.**

… are also considered to represent a CLABSI.

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Contaminated Blood Cultures - Important Sequelae

- False-Positive CLABSIs
- Repeat Blood Culture Draws
- Inappropriate Antibiotic Usage
- Increased Length of Stay
- Misdiagnosis
- Acute Kidney Injury
- Risk of *C. difficile*

Rupp ME et al. Clinical Infectious Diseases 2017:65, 201-207.
Doern GV et al. Clinical Microbiology Reviews 2020:33, 1-21
Bell M et al. Journal of Emergency Nursing. 2018:44, 570-5.
Skoglund E et al. Journal of Clinical Microbiology 2019:57, 1-10.
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Contaminated Blood Cultures - Prevention

- Patient Selection
- Skin Antisepsis
- Blood Culture Bottle Disinfection
- Site of Collection (Percutaneous Venipuncture Superior to Line Draw)
- Sterile Gloves + Hand Hygiene + Mask
- Packaged Blood Culture Kits
- Trained Phlebotomists
- Initial Specimen Diversion

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Steripath® Gen2

Initial-Specimen Diversion Device

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Hypotheses

We predicted the number of contaminated 4-bottle sets drawn by phlebotomists using the Steripath® Gen2 ISDD would…

- **Result in a lower contamination rate than the contamination rate associated with traditional methods throughout the study period.**
- **Represent less than 3% of the total sets drawn using the ISDD.**

3% is the classically targeted benchmark rate for blood culture contamination.

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Hypotheses

For central line patients…

We hypothesized the number of blood culture sets obtained using the ISDD containing only 1 positive bottle (with either VRE or *Candida* sp.) would be lower than that observed during the pre-trial period.

If true, this could indicate VRE and *Candida* sp. may be superficial skin flora (and not evidence of true bacteremia) – implying many reported CLABSIs are false-positives.

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Study Aims

Compare the contamination rate of blood cultures drawn among…

- **Phlebotomy Staff Using the ISDD**
- **Phlebotomy Staff Using Traditional Methods**
- **RNs Using Traditional Methods**

Compare CLABSI incidence during the trial period to CLABSI incidence pre-trial.

Determine inappropriate vs. appropriate antibiotic usage for patients with contaminated blood cultures by chart review.

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Study Methods

Four-Month Trial of the ISDD (Steripath® Gen2)

March 15, 2019 - July 21, 2019

ISDD Usage/Non-Usage for Each Blood Culture Set Recorded

Laboratory Information System recorded culture results from every bottle in each 4-bottle "matched" set (Set #1 = 1 aerobic and 1 anaerobic BACTEC™ bottle; set #2 = 2 BACTEC™ aerobic bottles; two sets = 40 ml total blood volume) while data from single blood culture sets were not included.

Blood Culture Contamination Rates Recorded for…

- Phlebotomy Staff Using the ISDD
- Phlebotomy Staff Using Traditional Methods
- RNs Using Traditional Methods

Number of CLABSIs Attributed to Contaminated Blood Cultures Recorded

Antibiotic Usage in Patients with a Contaminated Blood Culture Recorded

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Study Design

Phlebotomy staff were trained in the use of the ISDD and encouraged to use the ISDD whenever possible, including on “hard stick” patients.

Phlebotomists were instructed to use different arms to obtain the two sets per our usual practice.

Patients’ arms were prepared by scrubbing with a ChloraPrep™ swab and phlebotomists wore sterile gloves and a face mask.

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Study Design

Phlebotomists drew blood cultures for most in-patient units of Stanford Hospital and in a significant proportion of patients presenting to the ED.

Nurses drew blood cultures from patients in the ED and from a few in-patients.

Infection Prevention department consultants evaluated every CLABSI containing "typical contaminants" using NHSN criteria.

The number of 4-bottle sets containing only one positive bottle with VRE or a *Candida* sp. was also recorded.

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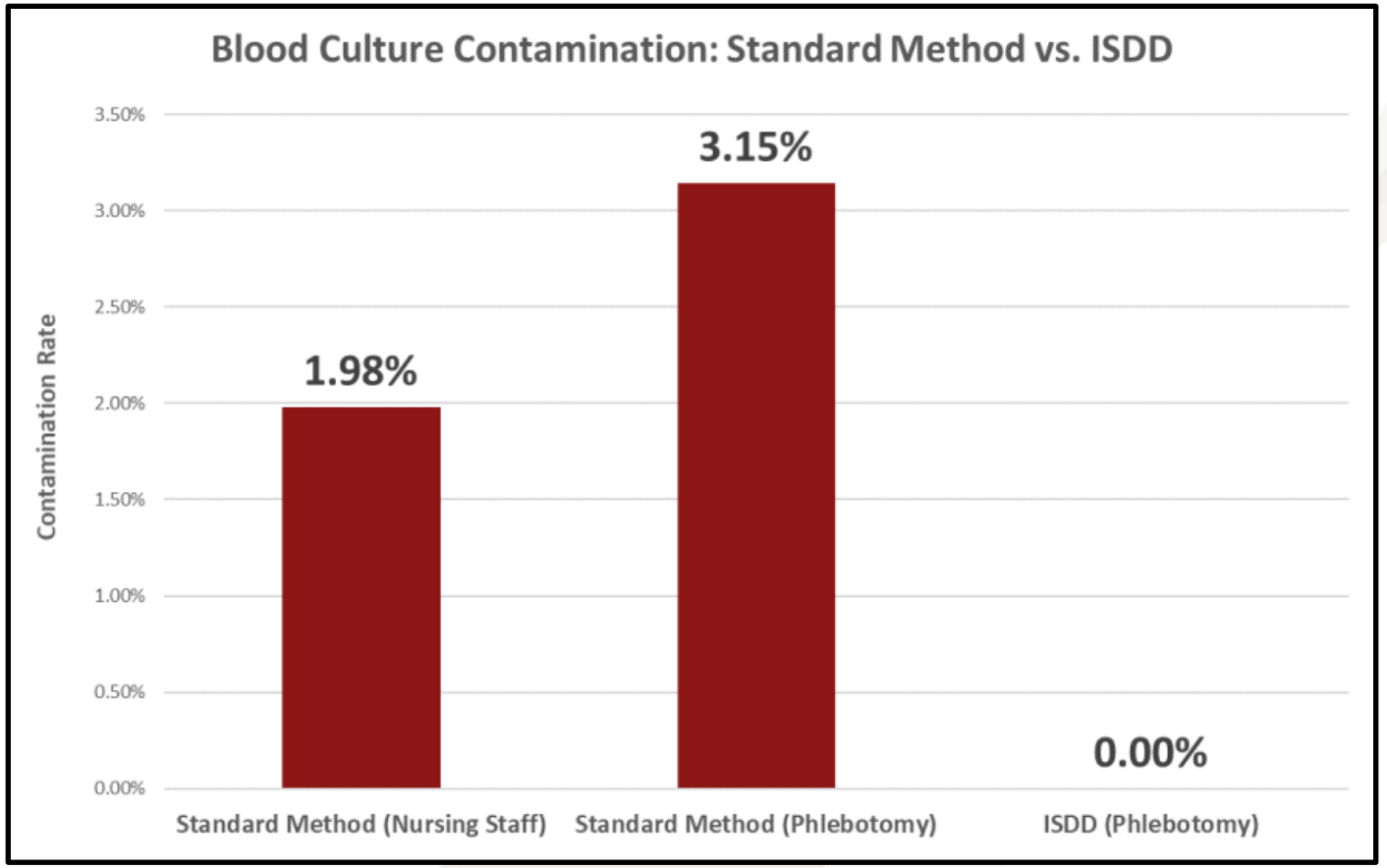
Table: Stanford Health Care blood culture collection methods and contamination events (March 15, 2019 - July 21, 2019)				
	Matched Sets	Contaminated Sets	Contamination Rate	False-Positive CLABSIs
Standard Method (Nursing Staff)	1,413	28	1.98%	0
Standard Method (Phlebotomy)	922	29	3.15%	1
Standard Method (Combined)	2,335	57	2.44%	1
ISDD (Phlebotomy)	4,462	0	0.00%	0



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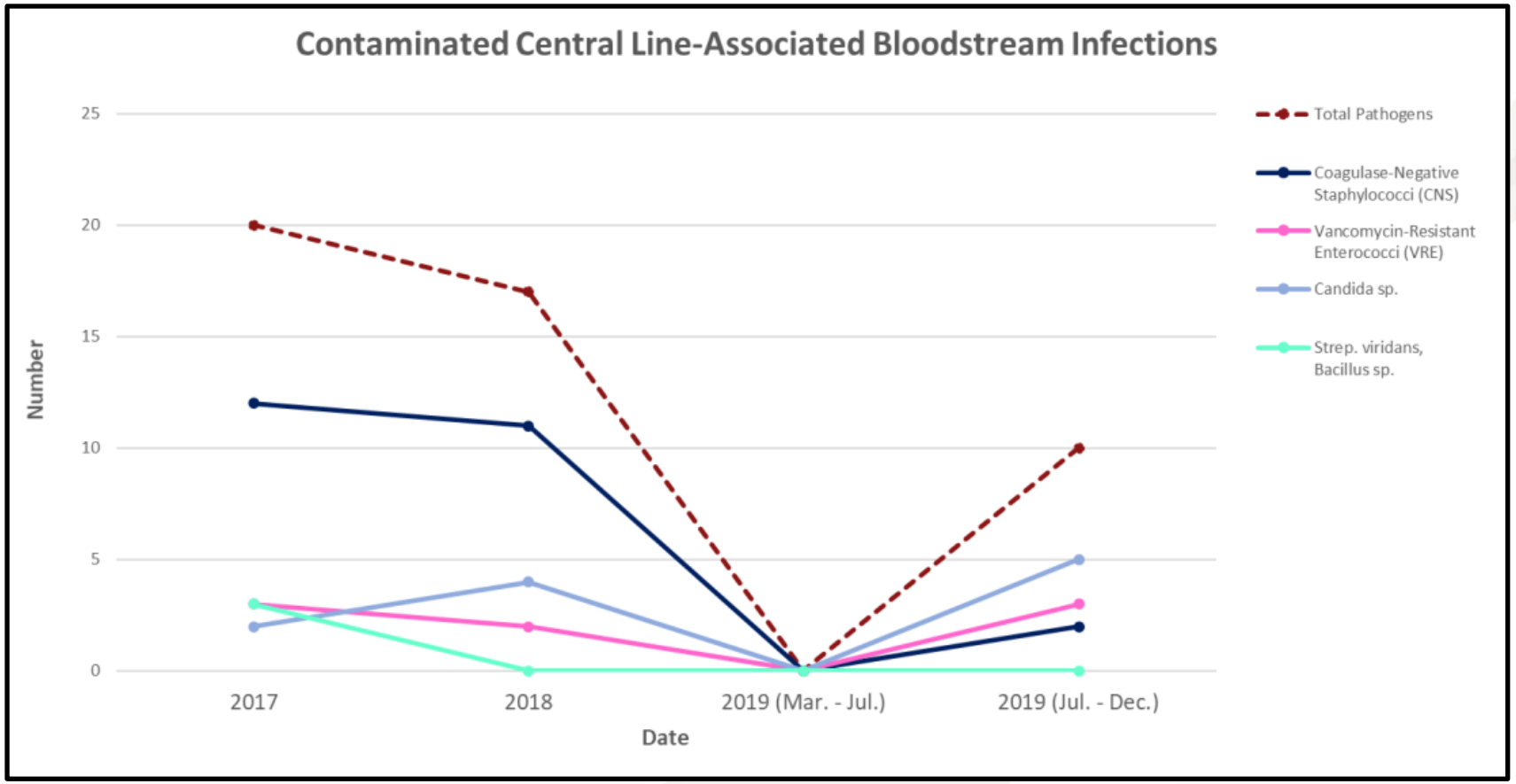
CLABSI Pathogen Count	2017	2018	2019 (Mar. - Jul.)	2019 (Jul. - Dec.)
Coagulase-Negative Staphylococci (CNS)	12	11	0	2
Vancomycin-Resistant Enterococci (VRE)	3	2	0	3
Candida sp.	2	4	0	5
Strep. viridans, *Bacillus* sp.	3	0	0	0
Total Pathogens	20	17	0	10



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Results Review

Phlebotomists drew 5,348 4-bottle blood culture "matched sets"

- **Among 4,462 sets drawn using the ISDD - ZERO contaminants**
  Contamination Rate = 0.00%

- **Among 992 sets drawn with traditional venipuncture - 29 contaminated sets**
  Contamination Rate = 3.15%

RNs drew 1,413 matched sets using traditional venipuncture - 28 contaminated sets
Contamination Rate = 1.98%

Zero false-positive CLABSIs were associated with the use of the ISDD

No matched sets with VRE or *Candida* sp. were observed with ISDD usage

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Antibiotic Utilization

Independent investigator performed a chart review for 42 unique patients
(48 total blood culture matched sets)

No antibiotics started or changed in 14 patients (32%)

Empiric antibiotics started but discontinued or narrowed within 48 hours in 23 patients (52%)
(empiric antibiotics being any antibiotic with/without vancomycin)

Antibiotics continued beyond 48 hours for treatment of a contaminant in 1 patient (2%)

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Antibiotic Utilization

Positive blood culture sets were treated as true infection in 9 patients (19%)
(8 out of 9 providers were infectious disease physicians)

Antibiotics continued beyond 48 hours for treatment of "true" infection in 6 patients (14%)
(one patient received 6 weeks of IV antibiotics for what was likely CNS-contaminated blood cultures)

Treatment rationale: most patients had hardware in place and providers felt that Rx was necessary

Contaminant Breakdown

- 90% CNS
- 6% *Micrococcus* sp.
- 4% Viridans streptococci
- 4% *Bacillus* sp.

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Study Strengths

- Same phlebotomy team used both ISDD and traditional venipuncture
- 4,462 blood culture sets were drawn using the ISDD (89% of total)
- Phlebotomists used the ISDD on many “hard stick” patients

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Study Limitations

- All 12% of contaminated blood cultures drawn by phlebotomists were drawn with traditional methods. Possibly, these were all “hard stick” patients on whom phlebotomists couldn’t or chose not to use the ISDD.

- The vacuum created by actuating “squeezing” the device to divert the initial 1.5 - 2 ml of blood may collapse small peripheral veins used on hard stick patients.

- Phlebotomists that experienced repetitive stress syndrome reported that use of the ISDD was a possible contributor. Others have not reported this problem. Possibly our phlebotomists drew many more blood cultures per day than has been previously reported.

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Future ISDD Studies at Stanford Hospital

New study design to evaluate an iteration of the Steripath® Gen2 ISDD with an integrated syringe.

Hypothesis is that the newer device will be more useful on “hard stick” patients and proportion of contaminants will be even lower.

ED nurses will be trained to use the Steripath® Gen2 ISDD with a universal Luer extension that facilitates collecting blood cultures when establishing an IV start, limiting the number of venipunctures on each patient.

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Summary

ISDD (Steripath® Gen2) usage by phlebotomists led to a substantial decrease in contaminated blood cultures: Zero Contaminants

ISDD usage led to substantial decrease in CLABSIs caused by skin organisms (VRE and *Candida* sp.)

Excess antimicrobial therapy was noted in a few patients who had contaminated blood cultures

ISDD usage can…

- **Impact inappropriate antibiotic usage**
- **Improve correct diagnoses**
- **Minimize patient discomfort**
- **Reduce HAIs related to longer lengths of stay**
- **Improve patient safety and outcomes**

Getting to ZERO is possible!

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