Implementation of the T2 Biosystems T2Bacteria RUO Panel in a Level-One Trauma, Safety Net Hospital

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Background

The Center for Disease Control and Prevention estimates that each year 1.7 million adults in America develop sepsis. Of those, 270,000 American's die as a result of the infection, an estimated 1 in 3 of hospital deaths in America. [3] Therefore, rapid detection and identification of sepsis causing pathogens are critical for optimizing antimicrobial therapy to improve patient survival and reduce healthcare costs . [4] Blood cultures are routine and well-established diagnostic tools in all hospitals, however they are rarely treated as urgent. [5] For the past 30 years there have been a need for advancement in the field, including rapid microbiology results for quick and targeted treatment. [5,6]

The T2Bacteria Panel RUO is a molecular diagnostic allowing detection of the most common sepsis-causing organisms: gram negative *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii* and gram positive *Staphylococcus aureus* and *Enterococcus faecium* within a few hours. The purpose of our study was to determine the feasibility and efficacy of the T2Bacterial Panel RUO in an Emergency Medicine (ED) and Surgical Intensive Care Unit (SICU) setting in a Level 1 Trauma Center, Safety-Net Hospital.

Methods

An IRB-approved, prospective, observational study was implemented at a Safety-Net, Level One Trauma Center in Denver, Colorado. Patients were enrolled who received an order for a blood culture from the Emergency Department (ED) or Surgical Intensive Care Unit (SICU). Patients who had blood drawn for cultures had a concurrent draw for testing with a T2Bacteria Panel RUO.

After the blood draw, research team would then freeze the blood in either a negative 20 degree Celsius freezer or 4 degree Celsius refrigerator.
In order to decrease the burden on the clinical lab technicians in the present study, seven individual subjects' draws were loaded onto the T2Dx simultaneously.

Inclusion Criteria:

1) Patient in ED or SICU with orders for blood culture
2) Patient age 18-95 years old
3) Blood collected for research purposes at time of blood cultures collected for clinical blood culture

Exclusion Criteria:

1) Patient has other co-morbid condition(s) that could limit the subject's ability to participate in the study or impact the scientific integrity of the study.
2) Subject has had previous specimens tested by the T2Bacteria RUO Panel with valid results (either in current or previous admissions).
3) Subject is in custody, or is pregnant.

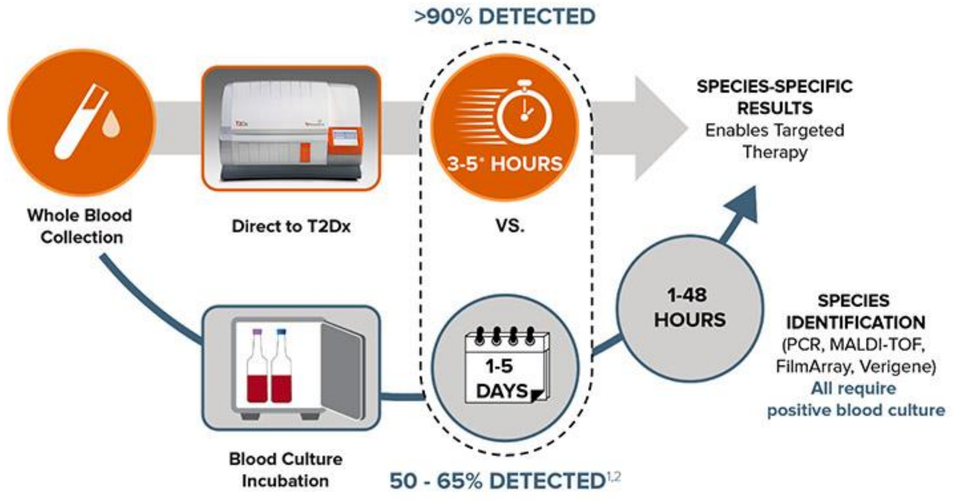
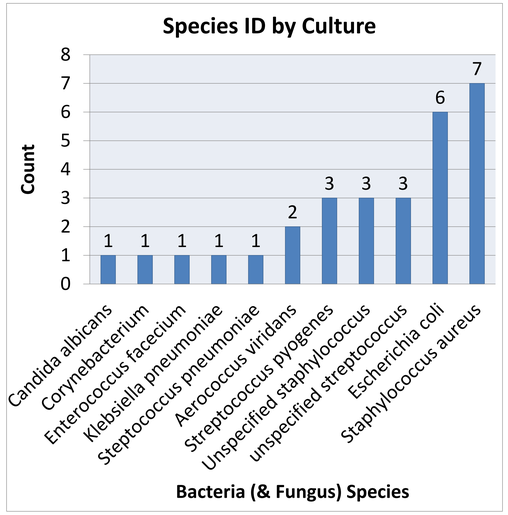
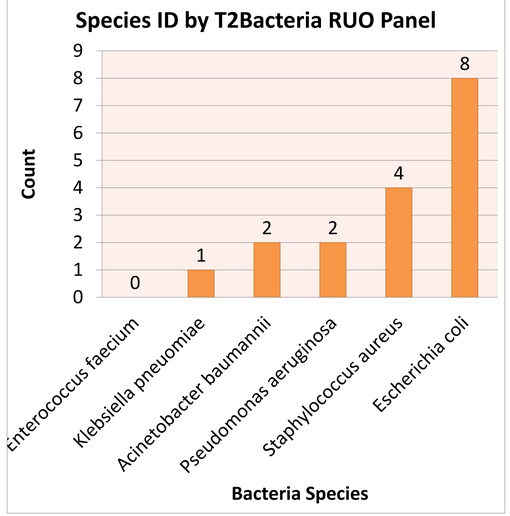


Fig. 1 Detection of Bacteria using T2Dx versus blood culture





Graphs 1 & 2 Species identified through clinical cultures and via T2 Bacteria RUO Panel

Gender & Race			Enrollment Location			Past Medical History		
Male	116	67%	ED	132	76%	Diabetes	37	21%
Female	58	33%	SICU	26	15%	CV Disease	23	13%
Caucasian	156	88%	Ward	15	9%	Hx Cancer	20	11%
Hispanic	47	30%	Other	1	1%	HIV/AIDs	10	6%

Table 1 Summary of Demographic Statistics

Results

Demographics:
174 patients were enrolled into the present study. Mean patient age was **51** years old (19-84), **33**% were female, **66%** were male. **88**% Caucasian (**30**% Hispanic/Latino).

74% of patients were enrolled upon presentation to the ED, **14**% from the SICU, and **11**% from the wards. In this patient population **21**% had diabetes (23% Type 1, 76% Type II), **13**% had cardiovascular disease, **11**% had a previous cancer diagnosis and **6**% were HIV/AIDs positive. **94**% of blood sampling (culture and T2Bacteria) was done from peripheral stick while **6**% were from the initial stick of a peripheral IV and **3**% obtained from an indwelling catheter such as a central line.

T2 & Culture Results:
77% of blood cultures were negative. Of the **134** patients with negative blood culture, **126** had concordant negative T2Bacteria results, providing a **specificity of 94.0**% in the study population. **29** patients (**17**%) had positive blood cultures, **10** of which were potentially false-positive (defined by two cultures drawn, one showing growth after 5 days, the other showing no growth after 5 days).
Of the **29** patients roughly half (**11** patients-**6%** of total population) were positive for T2Bacteria Panel RUO targets. While the other half were clinically positive for bacteria that the T2Bacteria RUO Panel does not test for (*Aerococcus viridans*, *Candida albicans*, *Corynebacterium*, *Streptococcus pneumoniae, Streptococcus pyogenes*, and unspecified *Streptococcus* species). Interestingly, only four of the patients who were clinically positive for T2Bacteria RUO targets had concordant positive T2Bacteria testing (**36%**) in defining a positive as at growth in at least one clinical culture. However, we identified several limitations in study design that might have influenced these results.
However, if defining clinical positive by culture growth from both blood draws, (clinical definition of bacteremia) then T2Dx correctly identified **91%**.

Conclusion

In the present study, T2Bacteria Panel RUO provides feasible rapid diagnostics for ED and surgical ICU settings with a high specificity and much shorter time to result when compared to gold standard blood cultures.

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