T2 Biosystems®

Earlier Targeted Effective Antibiotic Therapy through Culture Independent Diagnostics

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Thomas J. Lowery, PhD

T2 Biosystems

T2 Biosystems is a commercial stage company in Lexington, Massachusetts dedicated to providing the best diagnostic solutions to save lives and improve healthcare by empowering clinicians to effectively treat patients faster than ever before.

T2 Biosystems' proprietary detection method, T2 Magnetic Resonance (T2MR®) technology, is protected by over 60 patents and has been featured in over 200 publications, including the *New England Journal of Medicine*, *Science Translational Medicine*, *Nature Biotechnology*, *Clinical Infectious Diseases*, and *Blood*.

First-in-class FDA-cleared products: T2Dx® Instrument, T2Candida® and T2Bacteria® Panels.

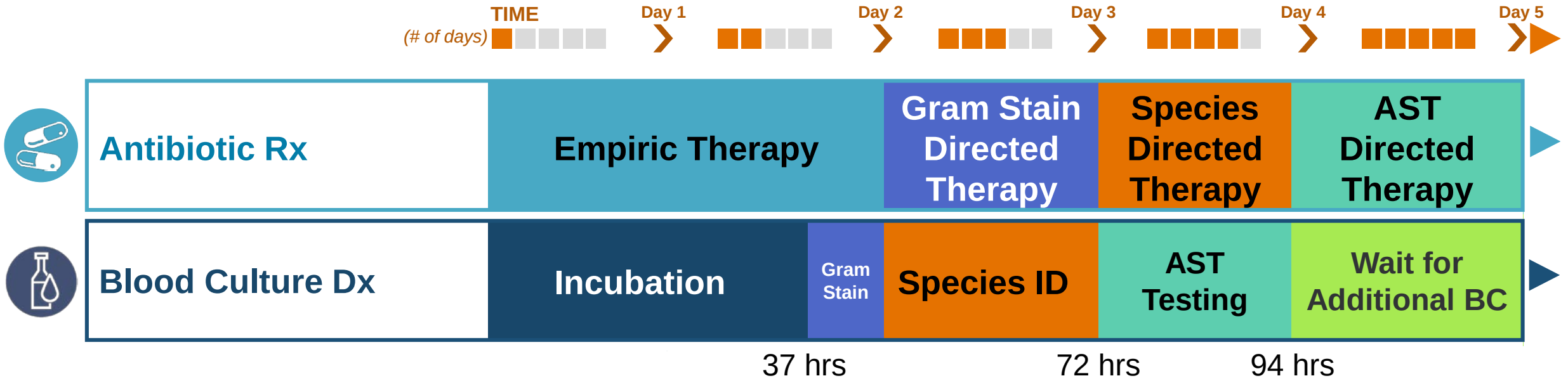
Founded in 2006 by innovators at MIT & Massachusetts General Hospital.

Recipient of the prestigious Prix Galien USA Best Medical Technology award in 2015.

Ranked #2 Fastest Growing Public Company in Massachusetts by the *Boston Business Journal* in 2017.

All Product Development, Operations, and Manufacturing based in Massachusetts.

Blood Culture Time to Result Influences Therapy

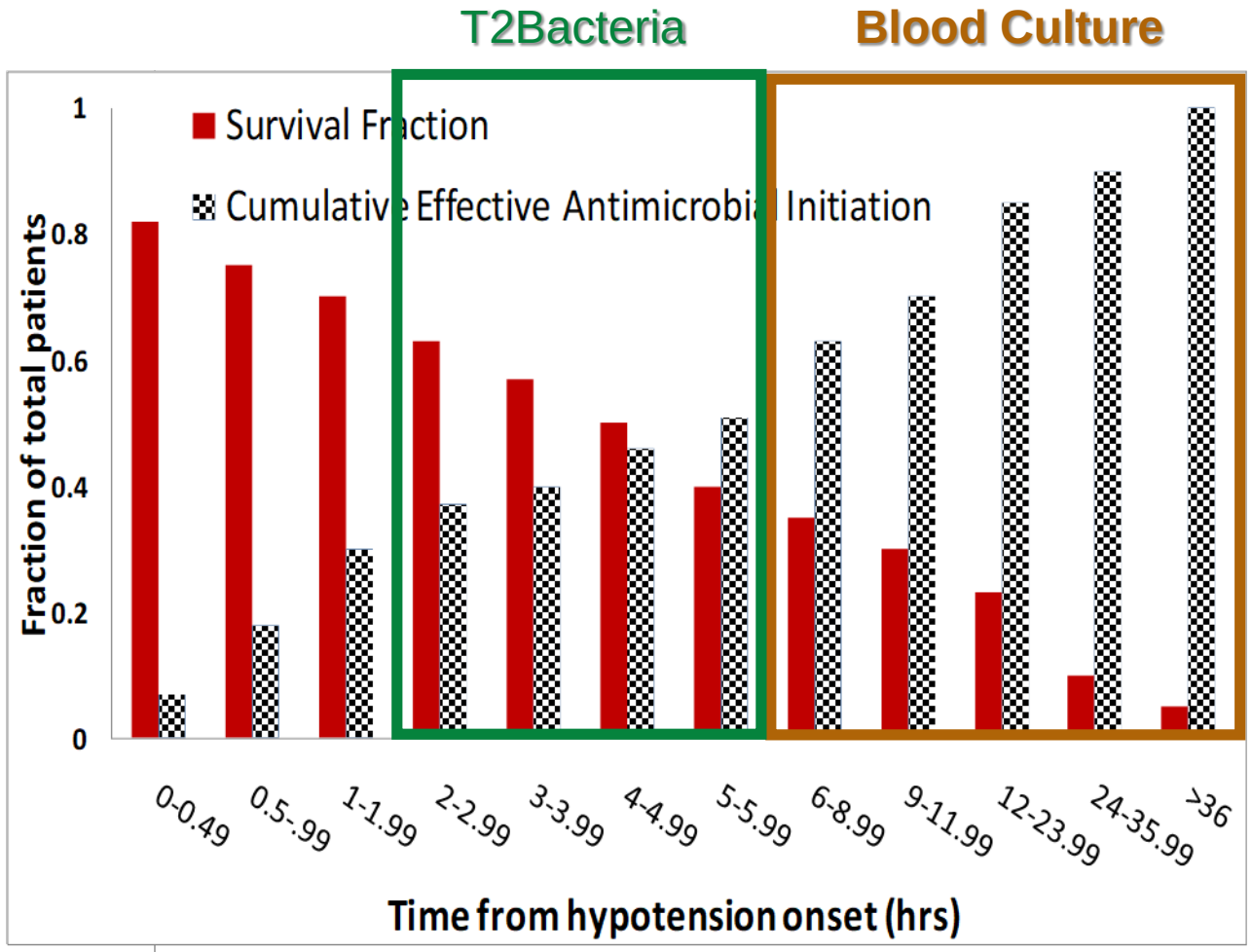


- Antibiotic administration rates range from 50% to 70% for patients with a blood culture draw. (1-3)
- Meta-analysis of 70 studies found empiric antibiotic therapy was inappropriate in 46.5% of patients.[4]
- The proportion of patients on effective therapy after organism species ID has been shown to be >90%, demonstrating effectiveness of antibiogram-directed therapy based on species ID.[5]

(1) Suberviola et al. J Clin Care 2016. (2) Karlsson et al. Int Care Med 2007; (3) Castellanos-Ortega et al. Crit Care Med 2010; (4) Paul et al. Antimicrob Agents Chemother 2010; (5) Doern et al. *J Clin Micro* 1994. Average turn around times from: 1 Huang et al. CID 2013; 2 Nguyen et al. In review 2018.

Time to Appropriate Therapy Impacts Survival

- Key predictor of survival and length of stay (LoS) for patients with bacteremia is time to effective therapy.
- For every hour delay in time to appropriate therapy:
  - Survival decreases by 7.6% during septic shock.[1]
  - Relative odds of death increase by 4.0% during bacteremia.[2]
- Reducing time to effective therapy has resulted in significant reductions in LoS, up to 8 days.[3-5]
- Appropriate and rapid delivery of targeted antibiotics is critical for surviving sepsis.[6]

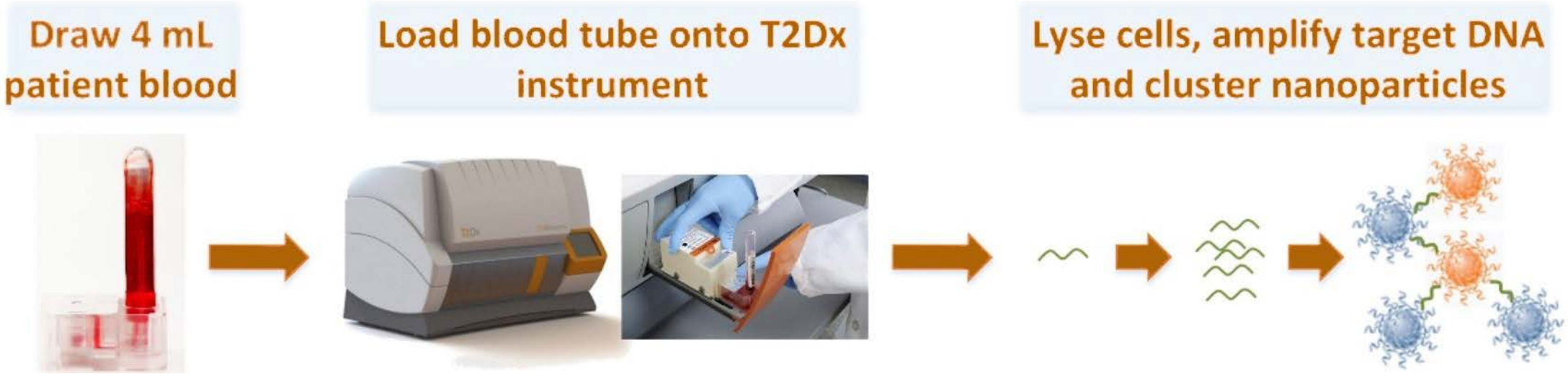


Kumar A. et al., Crit Care Med 2006, 34:1286, N=2731

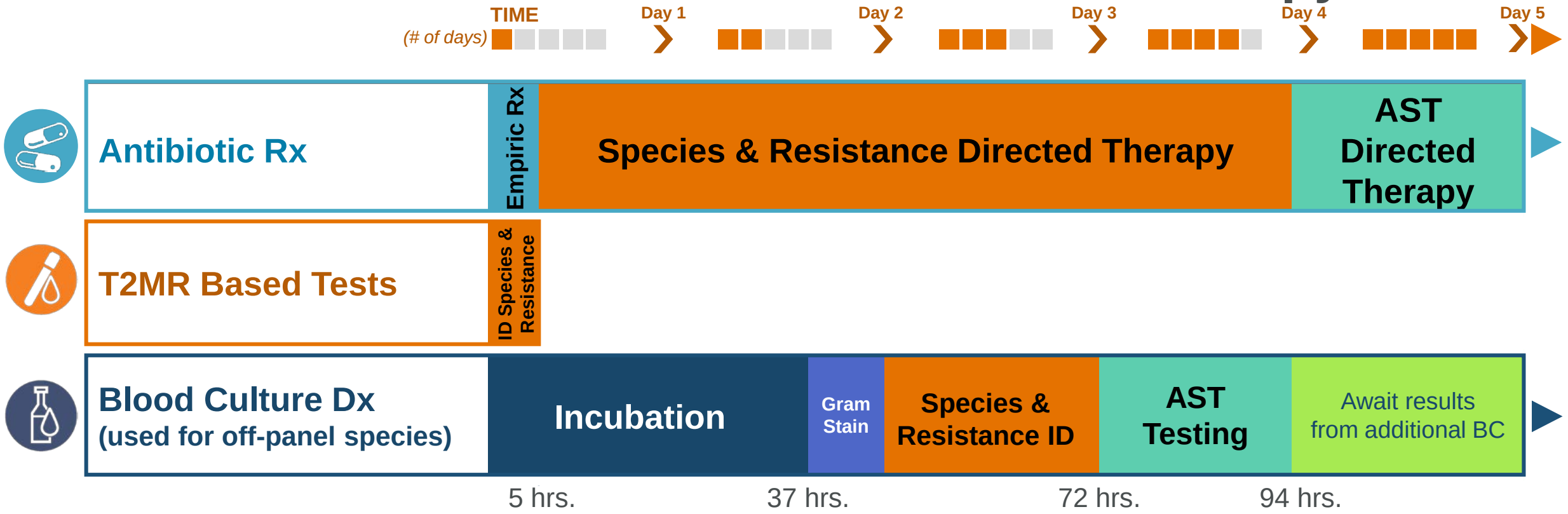
(1) Kumar et al. Crit Care Med 2006. (2) Seymour et al. NEJM 2017. (3) Huang et al. Clin Infect Dis 2013. (4) Perez et al. Arch Pathol Lab Med 2013. (5) Perez et al. J Infect 2014. (6) Rhodes et al CCM 2017.

The Only FDA-Cleared Direct-from-Blood Test for Bloodstream Infections

- The T2Bacteria & T2Candida Panels are the only FDA-cleared assays available to U.S. healthcare providers today for detection without the need for blood culture.
- CLIA moderately complex assays approved to be used in routine clinical laboratory.
- T2Dx instrument fully automates the T2MR detection process in a sample-to-answer fashion.
- Blood Culture Independent Species Identification in 3-5 hours.



T2MR & Blood Culture Results Influence Therapy



- T2MR Based tests enable more rapid targeted therapy based on species ID.
- The proportion of patients on effective therapy after organism species ID has been shown to be >90%, demonstrating effectiveness of antibiogram-directed therapy based on species ID.[1]
- Studies indicate that this will reduce both LoS and mortality for infected patients.

(1) Doern et al. *J Clin Micro* 1994. Average turn around times from Nguyen et al. in review 2018.

T2Direct Diagnostics™

Rapid Identification of Sepsis-Causing Pathogens & Resistance Genes

FDA-Cleared and CE Marked Products Plus Deep Pipeline of New Targets

Powered by CARB-X

T2Bacteria®	T2Candida®	T2 *C. Auris*	T2Carba Resistance +	T2ARx
FDA Cleared & CE Marked	FDA Cleared & CE Marked	RUO	In Development RUO 2019	In Development
E. faecium *S. aureus* *K. pneumoniae* *A. baumannii** *P. aeruginosa* *E. coli*	*C. albicans* *C. tropicalis* *C. parapsilosis* *C. krusei* *C. glabrata*	*C. auris* *C. duobushaemulonii* *C. haemulonii*	*Enterobacter* *Klebsiella* spp KPC NDM OXA-48 VIM IMP AmpC (CMY/DHA)	Additional resistance markers and species including ESBL & gram-positive resistance
Commercially & Clinically available in US & Europe as IVD.	Commercially & Clinically available in US & Europe as IVD.	Available for RUO. Validated by CDC for patient swabs demonstrated in blood; 5 CFU/mL sensitivity.	Fully automated on T2Dx Instrument. Pilot clinical studies pending. ≤10 CFU/mL sensitivity.	Multiplex developed. T2Dx automation pending ≤10 CFU/mL sensitivity.

**A. baumannii* currently available only in Europe

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T2Direct Diagnostics: Proven Performance

- Proven time-to-result days faster than blood culture based methods (5 hrs vs 72 hrs).[1]
- Proven to enable 8-fold reduction in time to appropriate therapy (5 hrs vs 44 hrs).[2]
- Meets desired ~5 hour time-to-result from n= 166 ID practitioners in independent survey.[3]
- Proven clinical sensitivity of 90%-100% for 10 bacterial and fungal pathogens across more than 5 independent studies and covering more than 300 confirmed infections.[1]
- Proven clinical specificity of 98.5% from many independent studies covering over 3,000 patients in more than 15 institutions.[1]
- Publications have estimated an NPV of > 99% and a PPV of 33%-92%, for targeted pathogens depending on prevalence in specific patient populations.[1]
- Implementation of T2Candida:
  - Study demonstrated $2.3M in annual hospital savings.[4]
  - Two independent studies show 7 day LoS reduction ICU patients.[5]
  - Pharmacy savings of $195 to $280 per tested patient cross multiple studies.[5]

(1) Mylonakis et al CID 2015; Pfaller et al Future Microbiology 2015; De Angelis Podium Presentation ECCMID 2017; Clancy, C.J. Podium Presentation IDWeek 2017; Kateon, H. et al. Poster Presentation IDWeek 2016; Turner et al. Poster Presentation IDWeek 2017; T2Bacteria pivotal study data presented by Leber Podium Presentation IDWeek 2017.
(2) Wilson, N.M. et al, JAMS 2017; Turner et al. Poster Presentation IDWeek 2017. (3) She et al. *PLOS ONE* 2015. (4) Wilson et al. Poster Presentation IDWeek 2016. (5) Wilson et al. Poster Presentation IDWeek 2016; Estrada et al. ASM Podium Presentation 2016; Kateon et al. Poster Presentation IDWeek 2016; Patel et al. Poster Presentation IDWeek 2016.

Impact on Antibiotic Therapy and Patient Outcomes

- Evaluation of potential therapy impact of T2Bacteria using pivotal study data:
  - 70% of T2Bacteria positives could have a favorable influence on therapy.
  - Studies have shown 2.7 hrs reduction in Length of Stay (LoS) for 1 hour more rapid therapy; [1-3] based on this, the more rapid time to therapy based on T2Bacteria represents a potential reduction in LoS of >50%.
  - Every hour of delayed appropriate antibiotic therapy increased relative odds of death by 4.0%;[4] accordingly, based on pivotal study results, the T2Bacteria panel has potential to reduce relative odds of death by 53%.
- Using the T2Bacteria Panel can help de-escalate and focus therapy in <4 hours to provide these benefits:
  - Reduce toxicity, side effects, and risk of death from antibiotics.[5-6]
  - Reduce societal burden from development of antibiotic resistance.[7]
- T2Bacteria Panel data show potential de-escalation opportunities:
  - 35% of T2Bacteria positive patients were already on effective therapy and could have dropped unnecessary therapy.
  - These patients were on an average of 3.6 ± 1.1 (mean ± SD) unnecessary antibiotics.
  - An independent study demonstrated de-escalation opportunities of 1.6 antibiotics per patient tested with T2Bacteria for de-escalating coverage for *P. aeruginosa* and *S. aureus*.[8]

(1) Huang et al. Clin Infect Dis 2013. (2) Perez et al. Arch Pathol Lab Med 2013. (3) Perez et al. J Infect 2014. (4) Seymour et al. NEJM 2017. (5) Bhattacharyya et al. Neurology 2016. (6) Koch-Weser et al. Ann Intern Med 1970. (7) Boucher et al. Clin Infect Dis 2009. (8) Weisz et al MAD ID 2018.

Conclusions

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- In patients with bacteremia, a major predictor of patient outcome is time to effective therapy.
- Currently, patients are treated empirically exposing many patients to incorrect or unnecessary antibiotic therapy.
- Direct-from-blood, culture independent diagnostics provide information days earlier than blood culture based diagnostics and allow for earlier, more informed therapy decisions.
- Available direct-from-blood test menu currently consists of pathogen ID results that covers 50%-70% of bloodstream infections, with pipeline for resistance gene ID and additional species to expand coverage.
- Studies have shown significant cost and LoS savings from implementation of T2Candida.
- Studies have shown that the T2Bacteria assay can enable physicians to treat >50% of infected patients with an effective therapy days faster than current standard of care, potentially favorably impacting antibiotic stewardship, length of stay and mortality.

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