Improved Turnaround Time for Identification of Blood Culture Isolates Using MALDI-TOF MS to Assay "Scum", or Brief Outgrowths of Blood Culture Broths

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Despite advances in medical care, the mortality rate for sepsis is ~17%, with rates of sepsis increasing in both the hospital and the outpatient setting (Hall, MJ, Williams SN, DeFrances, CJ, Golosinskiy, A. 2011. Inpatient Care for Septicemia or Sepsis: A Challenge for Patients and Hospitals. NCHS Data Brief 62). Optimized antimicrobial therapy for septic patients depends on the identification of the causative microorganism(s) and their antimicrobial susceptibility profile. Traditional blood culture methods utilize automated systems that continuously monitor blood cultures. Once growth is detected by the system, positive blood culture broths are then subcultured to appropriate media, incubated to obtain visible colony growth and organism identity is determined. Traditionally, this has been performed using a variety of phenotypic and/or biochemical tests. In total, from the time the blood culture signals positive, it can take 48-72 hours to identify the causative organism and determine the antimicrobial susceptibility profile.

Matrix-associated laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS) is a rapid method to identify microorganisms, requires only a small amount of biomass, and does not rely on enzymatic activity. To more rapidly identify the microorganisms from growth positive blood cultures, MALDI-TOF MS testing was performed on the scant growth obtained on the subcultured media incubated for 4 to 6 hours, prior to observing isolated colony formation. This scant growth testing, termed "scum" MALDI, was performed when growth was observed in the second streak quadrant of the plate, with an avoidance of the first quadrant to eliminate interference with the blood culture inoculum (see Figure 1 for an example of "scum" growth that could be used for MALDI-TOF MS testing). The effect of "scum" MALDI on turnaround time of organism identity was determined in a before-and-after experimental model, by examining data prior to and after implementation of routine MALDI-TOF MS identification from positive blood cultures. Specifically, we recorded the time the initial Gram stain result was recorded, and the time that the culture identification was noted in the electronic medical records. The pre-

intervention period included 55 samples from September 2013 and the post-intervention period included 101 samples from September 2014. Results for yeast, non-fermenting Gram-negative bacteria, and members of the *Enterobactericeae* were examined, while polymicrobial infections were excluded from analysis. We found a statistically significant reduction in turnaround time for organism identification with all 3 groups of microorganisms, nearly reducing by half the time to provide organism identification (Table 1). The reduction in turnaround time from the pre-intervention and post-intervention period for yeast went from 43.8 to 28.6 hours, for non-fermenting Gram-negative bacteria from 46 to 23.4 hours, and for *Enterobactericeae* from 55.2 to 24.7 hours; all of these differences were statistically significant. These results indicate that MALDI-TOF MS based identification of "scum" growth from subcultures of positive blood culture broths is both accurate and provides a significant reduction in time for organism identification.

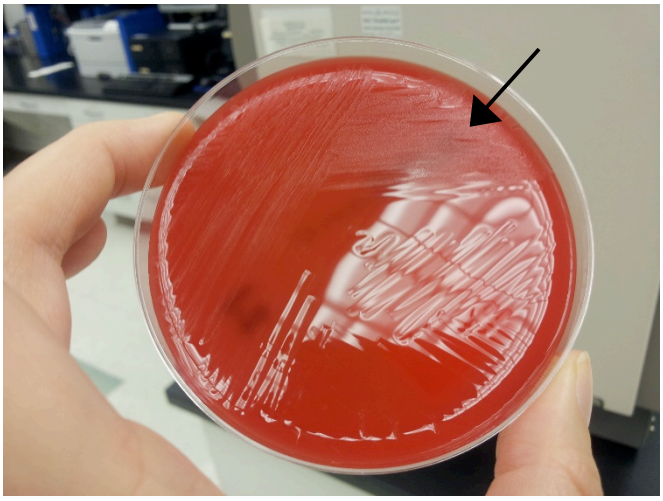

Figure 1. Example of a blood agar plate inoculated from a positive blood culture with "scum" growth that could be used for MALDI-TOF MS identification. The black arrow indicates the area in the second quadrant that would be tested.

Table 1. Summary of time to organism identification from positive blood culture broths before and after MALDI-TOF "Scum" Testing.

Organism Group	Pre-MALDI (Sept 2013)			Post-MALDI (Sept 2014)			P value
	n	Average TAT[a] (h)	IQR[b]	n	Average TAT (h)	IQR	
Yeast	11	43.8	38-55.5	22	28.6	19.1-35.8	0.0003
Non-fermenting Gram-negatives	11	46	25.5-68.8	27	23.4	16-28.3	0.0001
Enterobactericeae	33	55.2	44-60	52	24.7	14.4-29.5	<0.0001

[a] Turnaround time, TAT. TAT is calculated as the interval between reporting the Gram stain and the final organism identification in the electronic medical record.

[b] Interquartile range, IQR