An Introductory Study into the Advantages of the Sigma-Transwab® Open Cell Polyurethane Foam Swabs in Microbiological Transport Systems with Improved Cellular Flow Dynamics and Reduced Sample Entrapment in Microorganism Detection

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Poster 156
100th NVvM & Scientific Spring Meeting 2011. Papendal, NL

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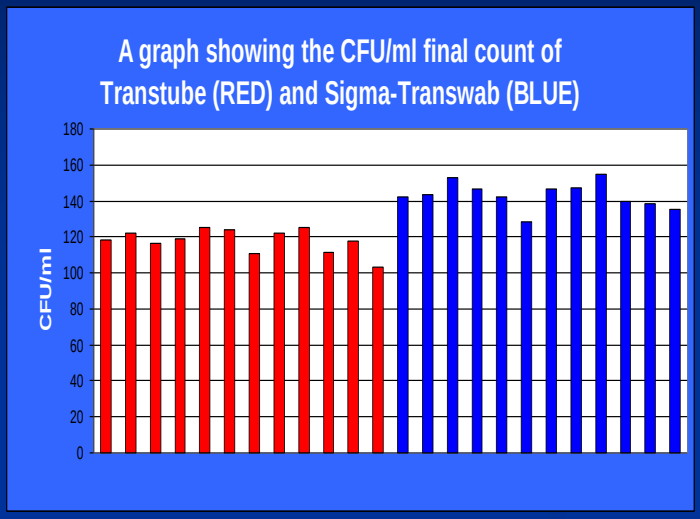
Abstract

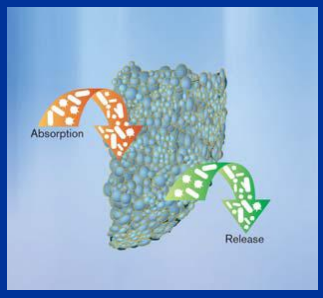
Bacterial entrapment within microbiological transport systems pre-inoculation phase decreases sensitivity. Device manufacturers aim to improve cellular flow dynamics; to which one such advent is the use of polyurethane foam (as used in the Medical Wire Σ-Transwab®). Molecular and automated advances in microbiological diagnostics are fast becoming the gold standard for detection of microorganisms. Polymerase Chain Reaction (PCR), Matrix Assisted Laser Desorption Ionisation Time of Flight (MALDI-TOF), and automated inoculation techniques pose the need for greater sensitivity in microbiological transport systems. Polyurethane foam provides greater penetration of detection reagents used in molecular detection, creating advantage with improved cellular flow dynamics. Such transport devices are designed to be compatible with automated inoculation systems (automated screw top removal and 100µl direct liquid extraction onto media). The reduction of bacterial entrapment with the use of polyurethane greatly increases the sensitivity of detection of pathological bacteria (especially infection control concerns, such as MRSA), even in high level mixed bacterial species environments. The retention of microorganisms in the liquid phase allows greater sensitivity with solid culture media detection, molecular-based techniques, and automated inoculation techniques compared to conventional diagnostic methodology. Sample entrapment in swab based microbiological transport systems refers to the trapping of microbial cells within a hydrophilic centre created by the wrapping of material applied to conventional swab designs. Sigma-Transwab® is a pre-analytical transport device developed by Medical Wire® that uses polyurethane foam aimed at enhancing the cellular flow dynamics of microbial cells into the liquid phase. Liquid based transport systems allow complete flow through of microbial cells and their retention within the liquid media. Reduced sample entrapment in transport systems increases the sensitivity of organism detection in mixed bacterial species environments.



Methods

The study uses the elution method for swab validation. An initial inoculum was obtained by spectrophotomeric analysis and verified by plating to non-selective media. The inoculum (0.5 McFarland standard diluted to approximate concentration of 1.5×10*7)(1) was diluted in serial dilution according to adjustment based on absorption capacities of the two swab types (1:5 for polyurethane based and 1:10 for fibre based(1)). The absorption volume was then used to inoculate the swab type in question. The transport swab was manipulated according to the manufacturer's instructions and kept in the device for a specified time period (Zero-time). The swab was then removed from the device and used to inoculate non-selective media using Miles and Misra type methodology to obtain an acceptable colony forming unit (CFU) count. The organism used for comparison of sample entrapment was *Staphylococcus. aureus* NTCC 25923. 12 swabs from each material design were tested for comparison.

This diagram demonstrates the desired principle of cellular flow dynamics. This study compares the level of sample entrapment between a currently used open weave fibre based swab and the polyurethane foam swab both launched by Medical Wire.



References

1.CLSI document M40-A-Quality Control of Microbiological Transport Systems; Approved Standard

Results

Data Table – An average of 3 plates was calculated to obtain a final CFU/ml count

Device	CFU/ml FIN	Device	CFU/ml FIN
Transtube 1	119×10^5	Sigma 1	142×10^5
Transtube 2	122×10^5	Sigma 2	144×10^5
Transtube 3	117×10^5	Sigma 3	153×10^5
Transtube 4	119×10^5	Sigma 4	147×10^5
Transtube 5	126×10^5	Sigma 5	143×10^5
Transtube 6	124×10^5	Sigma 6	129×10^5
Transtube 7	111×10^5	Sigma 7	147×10^5
Transtube 8	122×10^5	Sigma 8	147×10^5
Transtube 9	126×10^5	Sigma 9	155×10^5
Transtube10	112×10^5	Sigma 10	140×10^5
Transtube11	118×10^5	Sigma 11	139×10^5
Transtube12	104×10^5	Sigma 12	136×10^5

Conclusion

The study showed that polyurethane foam tipped swabs have reduced sample entrapment for the inoculation stage compared with fibre based swabs. The lower sample yield of wound fibre swabs on the collected data shows that physical entrapment directly affects the availability of bacteria for subsequent testing. The data shows that polyurethane foam swabs overcome this limitation. This seems to be due to the cellular structure, which allows maintenance of microbial cells within the liquid phase, and ready release into test media. It is noted that Transtube® , also developed by Medical Wire, itself has an open weave fibre structure, and in previous studies demonstrated reduced entrapment of bacterial cells when compared with other brands of rayon fibre swabs. This highlights that the reduced entrapment of the Sigma-Transwab® demonstrated in the present study is a highly significant finding in terms of microbiological transport system research.

ADDITIONAL DATA OVERLEAF

mwe medical wire

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Additional Data

Recovery after 24 hours holding at refrigerated or room temperatures.

Holding Time	0h		24h		24h		0h		24h		24h	
Holding Temperature			4-8C		20-25C				4-8C		20-25C	
	Device	**cfu/ml**	Device	**cfu/ml**	Device	**cfu/ml**	Device	**cfu/ml**	Device	**cfu/ml**	Device	**cfu/ml**
		x 10^5		**x 10^5**		**x 10^5**		**x 10^5**		**x 10^5**		**x 10^5**
	T1	**119**	T13	**125**	T25	**132**	S1	**142**	S13	**149**	S25	**137**
	T 2	**122**	T14	**131**	T26	**141**	S 2	**144**	S14	**154**	S26	**141**
	T3	**117**	T15	**121**	T27	**148**	S 3	**153**	S15	**156**	S27	**148**
	T 4	**119**	T16	**131**	T28	**152**	S 4	**147**	S16	**161**	S28	**148**
	T 5	**126**	T17	**128**	T29	**140**	S 5	**143**	S17	**152**	S29	**133**
	T 6	**124**	T18	**133**	T30	**151**	S6	**129**	S18	**138**	S30	**146**
	T 7	**111**	T19	**132**	T31	**131**	S 7	**147**	S19	**157**	S31	**152**
	T 8	**122**	T20	**135**	T32	**138**	S8	**147**	S20	**155**	S32	**142**
	T 9	**126**	T21	**136**	T33	**151**	S9	**155**	S21	**155**	S33	**161**
	T10	**112**	T22	**132**	T34	**138**	S 10	**140**	S22	**144**	S34	**139**
	T11	**118**	T23	**131**	T35	**150**	S11	**139**	S23	**155**	S35	**153**
	T12	**104**	T24	**128**	T36	**153**	S 12	**136**	S24	**164**	S36	**138**
Average count		118		**130**		**144**		**144**		**153**		**145**

Device Code: T=Transtube, S=Sigma Transwab

Both swab devices show stable numbers without significant increase,or decrease, well within the parameters of CLSI M40-A. The Transtube medium showed a slight increase at room temperature so that average counts were virtually identical. The Sigma Transwab has a reformulated medium that seemed to keep the organism numbers very stable over the holding period, which is very desirable for a transport device.