Clinical Literature Review

Title	Endoscope reprocessing: Comparison of drying effectiveness and microbial levels with an automated drying and storage cabinet with forced filtered air and a standard storage cabinet
Authors	Ryan B. Perumpail MD, Neil B. Marya MD, Betty L. McGinty MS, HAS, BSHSA, RN, CGRN, CER, V. Raman Muthusamy MD, MAS, FACG, AGAF, FASGE
Journal	American Journal of Infection Control, March 2018
Abstract	**Background**: Automated drying may help prevent endoscopically transmitted infections. We aimed to assess the efficacy of an automated drying and storage cabinet compared to a standard storage cabinet in achieving endoscope dryness post reprocessing and in reducing the risk of microbial growth. **Methods**: Drying times of bronchoscopes, colonoscopes, and duodenoscopes using two drying platforms (an automated drying and storage cabinet vs a standard storage cabinet) were measured using cobalt chloride paper. Drying assessments occurred at: 30 minutes, 1 hour, 2 hours, 3 hours, and 24 hours. A simple linear regression analysis compared rates of microbial growth after inoculation with *Pseudomonas aeruginosa* following high-level disinfection (HLD) at: 0, 3 hours, 12 hours, 24 hours, and 48 hours. **Results**: Using the automated drying and storage cabinet, internal channels were dry at 1 hour and external surfaces at 3 hours in all endoscopes. With the standard storage cabinet, there was residual internal fluid at 24 hours, whereas external surfaces were dry at 24 hours. For bronchoscopes, colonoscopes, and duodenoscopes, the standard cabinet allowed for an average rate of colony forming unit growth of 8.1×10^6 per hour, 8.3×10^6 per hour, and 7.0×10^7 per hour, respectively; the automated cabinet resulted in colony forming unit growth at an average rate of -28.4 per hour (P = .02), -38.5 per hour (P = .01), and -200.2 per hour (P = .02), respectively. **Conclusions:** An automated cabinet is advantageous for rapid drying of endoscope surfaces and in reducing the risk of microbial growth post reprocessing.
Methods	There were two distinct efforts in the study: • Drying study • Microbiological study and effects due to storage time Endoscopes used • Three Bronchoscopes (Olympus BF-3C20) • Three Colonoscopes (Olympus CF-Q160AL) • Three Duodenoscopes (Olympus TJF-160F) Drying modalities: • Automated drying and storage cabinet: ENDODRY™ Drying and Storage Cabinet using Instrument-grade air • Standard storage cabinet: Olympus standard cabinet with no forced air In-between experiments each endoscope was run through an ADVANTAGE PLUS™ Automated Endoscope Reprocessor wash/HLD cycle

	• Drying study
	  ○ Used two of each type of endoscope
	  ○ Drying points measured: 30 minutes, 1-hour, 2 hours, 3 hours and 24 hours
	  ○ Moisture was measured with cobalt chloride test paper
	  ▪ Air was blown though the channels with the paper in front of the tip of the endoscope. Any moisture on the chloride test paper was indicative of moisture retained in the endoscope
	• Microbiological study
	  ○ *Pseudomonas Aeruginosa* through culture and inoculum as it is a common waterborne pathogen
	  ○ Microbe recovery at 0, 3, 12, 24 and 48 hours
	  ○

Results	**Drying Study**
	• Standard cabinet
	  ○ External surfaces were dry at 24 hours
	  ○ Internal lumens were still wet at 24 hours
	• Automated cabinet (ENDODRY™ Drying and Storage Cabinet)
	  ○ External surfaces were dry at 3 hours
	  ○ Internal lumens were dry at 1 hour
	Microbial Assessment/Long-term Storage
	• The standard cabinet showed **GROWTH RATES** of $8.1x10^6$, $8.3x10^6$, $7.0x10^7$ colony-forming units (CFU) per hour
	• The automated cabinet (ENDODRY Drying and Storage Cabinet) showed **NEGATIVE GROWTH RATES** of -28.4, -38.5, 200.2 CFU per hour
	• **Long-term Storage**:
	  ○ There were no microorganisms recovered from the colonoscope or bronchoscope at 31 days
	  ○ The duodenoscope showed 1 CFU at 31 days (it was originally inoculated with $4.11x10^4$ CFU)

Conclusions	• The ENDODRY Drying and Storage Cabinet, utilizing forced filtered air efficiently and efficaciously, eliminates residual endoscope moisture that can lead to microbial growth • Low bioburden at 31 days may cause facilities to extend storage times to reduce costs of reprocessing expired endoscope inventory **Strengths** • Directly examined bioburden by sampling microbial cultures • Utilized positive and negative controls • Used three types of endoscopes for worst-case scenario • Extended storage may save costs associated with reprocessing **Limitations** • Wear and tear are not taken into account as the endoscopes were in pristine condition • Dryness and culture were not blinded • *Pseudomonas Aeruginosa* growth characteristics may not be entirely generalizable to some other bacterial agents

	• Endoscopes with pre-existing biofilm formation would likely not have the same drying characteristics • Direct visualization with a borescope was not performed to inspect for dryness
Messaging	• This study shows that endoscopes placed in the ENDODRY Drying and Storage Cabinet will be dry within 3 hours externally, 1 hour internally and can be stored up to 31 days without an increase in microbial levels. • This is the first study that shows how long it takes to fully dry an endoscope • This is also the first study with microbiological evidence to show that forced air drying can reduce the risk of recolonization with waterborne pathogens. • This study looked at a worst-case scenario of "What would happen if an endoscope still contained living organisms and was not fully dry when stored?" ○ The study didn't measure what would happen if a clean endoscope that wasn't inoculated was stored in the cabinet. For the pristine endoscope storage scenario, we can assume, based on these results, that the endoscope would maintain its clean state while stored in the ENDODRY™ Drying and Storage Cabinet.