

*cepacia*) were cultured from medications in 83% (n = 10) of investigations involving manufactured medications and 75% (n = 6) of investigations involving P-CPs. Contamination of sterile pharmaceutical products occurred in 14 (70%) investigations; 11 (79%) of these involved injectables. Information regarding how contaminated pharmaceuticals were first identified was documented for 18 investigations; most cases (n = 14, 78%) started with investigation of patient infections by facilities, public health, or both, which led to laboratory testing of pharmaceuticals and confirmation of contamination. **Conclusions:** The events summarized here likely underestimate the frequency of intrinsic contamination of pharmaceutical products in the United States. These events can have devastating consequences that impact patients across the country. Waterborne pathogens appear to be the most frequently identified source of contamination in both manufactured medications and P-CPs.

Detection, investigation, control, and prevention of pharmaceutical contamination events benefit from collaboration between state and federal public health authorities; without public health intervention. Such contamination may have gone undetected and could have harmed additional patients.

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#### Presentation Type:

Distinguished Oral

#### Large Multisite Clinical Field Study Characterizing Contamination Levels in Patient Used Endoscopes After Manual Cleaning

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**Background:** Multiple outbreaks multidrug-resistant organisms (MDROs) have been associated with flexible endoscopes resulting in unacceptable patient mortality and morbidity. Evidence highlights the importance of effective cleaning to achieve effective high-level disinfection (HLD). This study presents an analysis of >700,000 measurements of adenosine-triphosphate (ATP) contamination levels found in flexible endoscopes after manual cleaning. **Method:** This 2018–2019 study consists of 702,768 measurements of ATP levels found in the suction/biopsy channel of instruments used on patients after manual cleaning: gastroscopes (267,533 measurements from 223 sites), duodenoscopes (123,697 measurements from 161 sites), colonoscopes (252,249 measurements from 229 sites), and bronchoscopes (59,289 measurements from 107 sites). Sites were located across the United States and employed protocols that included routine cleaning verification performed by the reprocessing technicians using a handheld luminometer and the associated ATP water test (3M Clean-Trace). **Results:** Figure 1 shows a boxplot analysis of the ATP levels by endoscope type. Upper gastrointestinal (GI) endoscopes (gastroscopes and duodenoscopes) show a significantly ( $P < .005$ ) greater level of ATP contamination after manual cleaning. The pairwise mean differences are all significant ( $P < .005$ ) except for colonoscopes when compared to bronchoscopes ( $P = .203$ ). Also shown on Fig. 1 is a literature supported adequate cleanliness value of 200 RLU ( $=2.3\log(\text{RLUs})$ ) (MJ Alfa et al.; *Am J Infect Control* 2013;41:245–253 and ANSI/AAMI ST91; 2015). A 95% confidence interval analysis performed against this literature value (Table 1) showed that a high number of gastroscopes (12%) and

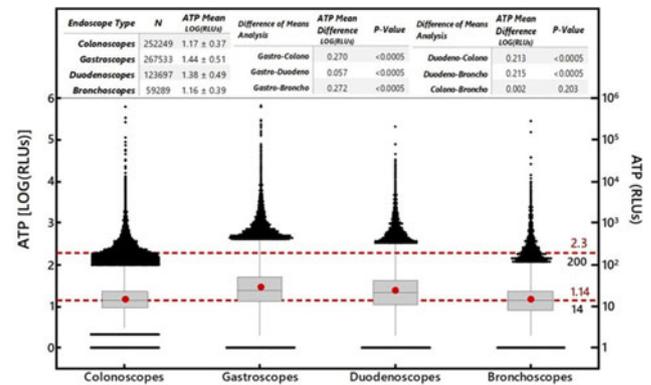


Figure 1—Boxplot analysis showing a comparison of the results by endoscope type (Q1-Q3 interquartile box range with median line and mean values shown as closed red circles, including whiskers to 1.5 times the box height and outliers shown as closed black circles. The red dotted line at 1.14LOG(RLU) or 14RLU represents the mean background value of the method)

Fig. 1.

Table 1- Results for Tolerance Interval Analysis (95% Tolerance Interval)

Endoscope Type	% Sample Population Above 200RLUs [2.3 LOG(RLU)]	Achieved Confidence (%)
Colonoscopes	2	95
Gastroscopes	12	95
Duodenoscopes	10	95.1
Bronchoscopes	3	95

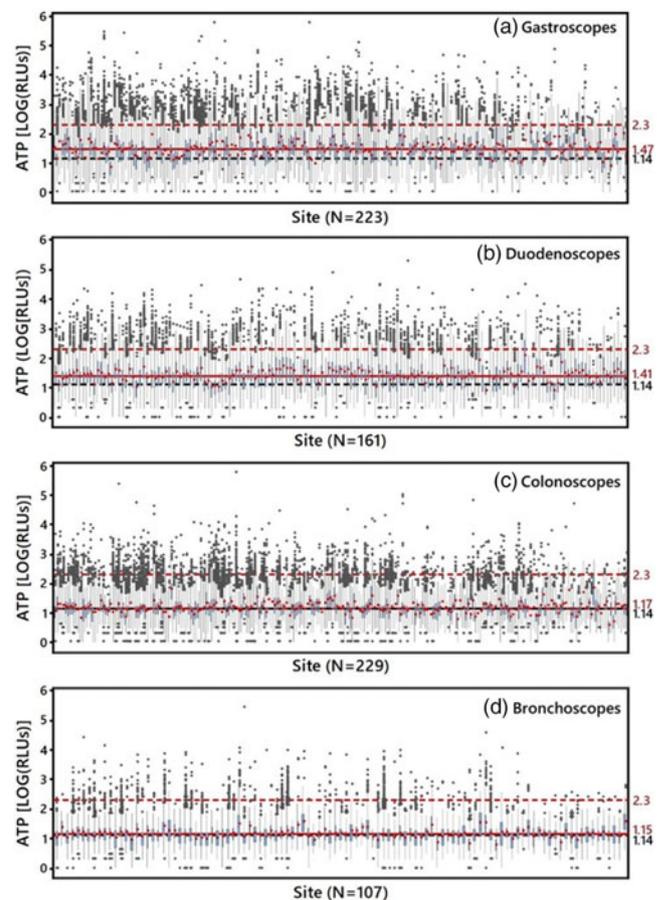


Fig. 2.

duodenoscopes (10%) are not adequately clean. Figure 2 shows a box-plot analysis of the data set by endoscope type and by site. There is significant ( $P < .005$ ) site-to-site variability for all endoscope types as demonstrated by variation in mean values, box size, and many outliers. **Conclusions:** This study highlights the importance of using a quantitative cleaning verification method to better understand process capability and to provide more robust quality assurance for manual cleaning. Significant differences were detected in the level of cleanliness between upper GI scopes and lower GI scopes and bronchoscopes. When compared to a literature-supported level for adequate cleanliness, upper GI scopes exhibited failure rates in excess of 10%. Furthermore, significant site-to-site variability occurred, and many outliers fell well beyond the normal process envelope, representing significant cleaning lapses. Root causes to these concerning findings could range from inadequate execution of the cleaning protocol, to device design, to age and existing damage that could prevent achieving adequate cleaning and possibly impair the effectiveness of HLD.

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#### Mining Camera Traces to Estimate Interactions Between Healthcare Workers and Patients

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**Background:** Simulations based on models of healthcare worker (HCW) mobility and contact patterns with patients provide a key tool for understanding spread of healthcare-acquired infections (HAIs). However, simulations suffer from lack of accurate model parameters. This research uses Microsoft Kinect cameras placed in a patient room in the medical intensive care unit (MICU) at the University of Iowa Hospitals and Clinics (UIHC) to obtain reliable distributions of HCW visit length and time spent by HCWs near a patient. These data can inform modeling efforts for understanding HAI spread. **Methods:** Three Kinect cameras (left, right, and door cameras) were placed in a patient room to track the human body (ie, left/right hands and head) at 30 frames per second. The results reported here are based on 7 randomly selected days from a total of 308 observation days. Each tracked body may have multiple raw segments over the 2 camera regions, which we “stitch” up by matching features (eg, direction, velocity, etc), to obtain complete trajectories. Due to camera noise, in a substantial fraction of the frames bodies display unnatural characteristics including frequent and rapid directional and velocity change. We use unsupervised learning techniques to identify such “ghost” frames and we remove from our analysis bodies that have 20% or more “ghost” frames. **Results:** The heat map of hand positions (Fig. 1) shows that high-frequency locations are clustered around the bed and more to the patient’s right in accordance with the general medical practice of performing patient exams from their right. HCW visit frequency per hour (mean, 6.952; SD, 2.855) has 2 peaks, 1 during morning shift and 1 during the afternoon shift, with a distinct decrease after midnight. Figure 2 shows visit length (in minutes) distribution (mean, 1.570; SD, 2.679) being dominated by “check in visits” of

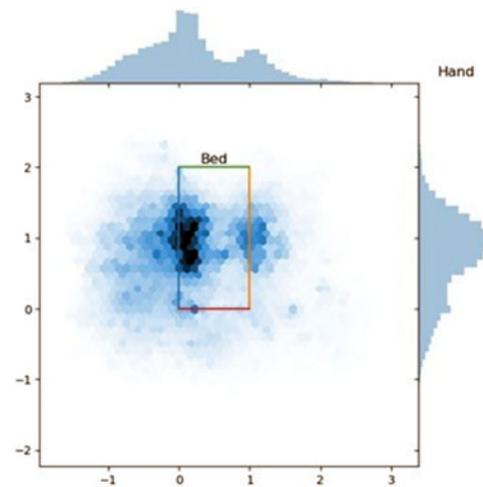


Fig. 1.

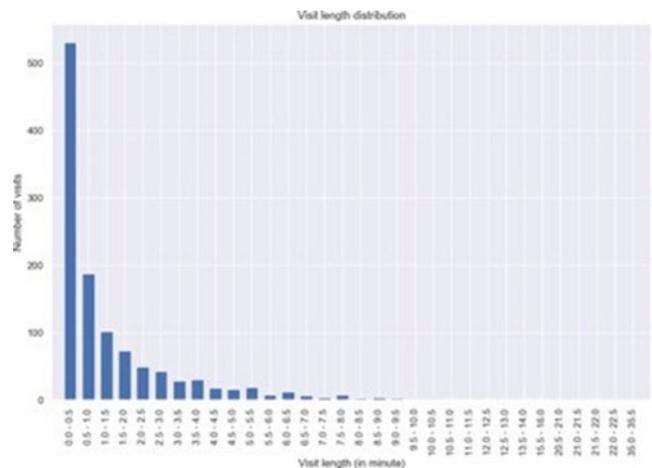


Fig. 2.

<30 seconds. HCWs do not spend much time at touching distance from patients during short-length visits, and the fraction of time spent near the patient’s bed seems to increase with visit length up to a point. **Conclusions:** Using fine-grained data, this research extracts distributions of these critical parameters of HCW–patient interactions: (1) HCW visit length, (2) HCW visit frequency as a function of time of day, and (3) time spent by HCW within touching distance of patient as a function of visit length. To the best of our knowledge, we provide the first reliable estimates of these parameters.

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#### Novel Methodology to Measure Preprocedure Antimicrobial Prophylaxis: Integrating Text Mining With Structured Data

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