Infectious Outbreaks Associated with Duodenoscopes

Erin Kyle, DNP, RN, CNOR, NEA-BC
Duodenoscope Characteristics

Fig. 1  Schematic representation of the most frequent biofilm- and MDRO-harboring areas on duodenoscopes in ascending order according to their frequency: (1) channel port side of elevator; (2) recess under the elevator; (3) biopsy channel; (4) elevator channel; (5) O-ring sealing of the elevator channel; (6) air-water channel; (7) distal cap; (8) distal tip of the scope; (9) coating polymer of the flexible scope

(Balan et al, 2019)
(Rauwers et al, 2019)
(Rauwers et al, 2019)
(Rauwers et al, 2019)
(Rauwers et al, 2019)
Pseudomonas infection of the biliary system resulting from use of a contaminated endoscope

• 1984
• Review of
  • Environmental cultures
  • Instrument processing practices
• Infections traced to a single endoscope contaminated with *P. aeruginosa*
• Use of AER
• Air drying only

• 5 of 10 patients *P. aeruginosa* led to clinical infection
  • gangrenous cholecystitis
  • abscess
  • death
• Contamination ended after suctioning alcohol through lumens before air drying

(Allen et al, 1984)
Multidrug-resistant Klebsiella pneumoniae outbreak after endoscopic retrograde cholangiopancreatography

- 2008-2009
- 16 patients
- *Klebsiella pneumoniae* that produced extended-spectrum beta-lactamase type CTX-M-15
  - 8 bloodstream infections
  - 4 biliary tract infections
  - 4 cases of fecal carriage
- Environmental evaluation
- Routine surveillance cultures were negative

- Finally isolated from one duodenoscope using flushing and brushing of channels
- Practice audits
- Insufficient manual cleaning & drying
- Strict adherence to reprocessing ended the outbreak

(Aumeran et al, 2010)
New Delhi metallo-β-lactamase-producing carbapenem-resistant Escherichia coli associated with exposure to duodenoscopes

• 2013
• 39 patients
• NDM-producing CRE
• Found no lapses in duodenoscope processing

• NDM-producing *E. coli* recovered from one duodenoscope
• Hanged reprocessing procedures from AER HLD with OPA to sterilization with EO
• Sterilization with EO ended the outbreak

(Epstein et al, 2014)
Endoscopic retrograde cholangiopancreatography-associated AmpC Escherichia coli outbreak

- 2012-2013
- 7 patients
  - All had complicated biliary disease and had undergone ERCP
- AmpC-producing *E. coli*
- Genetic profiling of the organism
- Mortality for infected patients was 56%

- 2 of 8 duodenoscopes harbored AmpC *E. coli*
- No breaches in duodenoscope processing were identified.
- Endoscope reprocessing procedures exceeded manufacturer’s IFU
- Recommended reprocessing guidelines are not sufficient

(Wendorf et al, 2015)
An outbreak of carbapenem-resistant OXA-48-producing Klebsiella pneumonia associated to duodenoscopy

- 2013
- Carbapenem-resistant K. pneumoniae
- Germany
- 12 patients
  - 6 had ERCP with same duodenoscope
  - 6 others were cohorted near the ERCP patients in the hospital

Outbreak ended when the affected duodenoscope was sent to the manufacturer for repair.

(Kola et al, 2015)
Withdrawal of a novel-design duodenoscope ends outbreak of a VIM-2-producing Pseudomonas aeruginosa

- 2012
- 30 patients
  - 22 had undergone ERCP
- VIM-2-positive P. aeruginosa
- Duodenoscope had a new design
  - Fixed distal cap
  - Hampered cleaning and disinfection
  - O-ring may not seal the forceps elevator
- Outbreak ended when discontinued new duodenoscope use
A quarantine process for the resolution of duodenoscope-associated transmission of multidrug-resistant Escherichia coli

- 2012-2013
- 32 patients
  - All had undergone ERCP duodenoscopy
  - 16 patients died
  - Late-stage malignancy or medical comorbidities
- No breach in duodenoscope processing identified

- E. coli strain was identified in 4 of 8 duodenoscopes
  - No obvious malfunction or damage, however 3 needed significant repair.

- Conclusions: manufacturer’s IFU for processing were inadequate

(Ross et al, 2015)
References and Resources


- Dortet L, Naas T, Boytchev I, Fortineau N. Endoscopy-associated transmission of carbapenemase-producing Enterobacteriaceae: ret
Case Study for Improvement

Patrick Hurley
Director of Marketing, GI
Ambu
No other medical device has more issues with contamination and infection than the flexible endoscope

More nosocomial infection and pseudo-infection outbreaks have been linked to contaminated endoscopes than to any other medical device.

Between 2012 and the spring of 2015, endoscopes caused at least 250 life-threatening infections worldwide, including infections with the superbug carbapenem-resistant Enterobacteriaceae (CRE)


Contamination and inadequate cleaning of endoscopes on ECRI annual list for "Top 10 Health Technology Hazards" past 10 years
FDA has been at the forefront of pushing industry to solve issues and pushing new solutions for duodenoscopes specifically.

- **February 19, 2015**
  - Design of Endoscopic Retrograde Cholangiopancreatography (ERCP) Duodenoscopes May Impede Effective Cleaning

- **March 26, 2015**
  - Olympus Validates New Reprocessing Instructions for Model TJF-Q180V Duodenoscopes

- **August 4, 2015**
  - Supplemental Measures to Enhance Duodenoscope Reprocessing

- **March 15, 2016**
  - Olympus Validates Updated Reprocessing Instructions for Duodenoscope Models TJF-160F and TJF-160VF

- **November 13, 2015**
  - FDA Recommends Health Care Facilities Transition from Custom Ultrasonics Endoscope Washer/Disinfectors to Alternate Reprocessing Methods

- **February 19, 2016**
  - PENTAX Validates Reprocessing Instructions for ED-3490TK Video Duodenoscopes

- **August 17, 2016**
  - FDA Recommends Health Care Facilities Stop Using Custom Ultrasonics’ System 83 Plus Automated Endoscope Reprocessors (AERs) for Reprocessing Duodenoscopes; These Reprocessors Remain Available to Reprocess Other Flexible Endoscopes

- **January 13, 2017**
  - FUJIFILM Medical Systems, U.S.A., Inc. removes certain older duodenoscope models from clinical use

- **February 7, 2018**
  - Updated Status of Pentax Medical Duodenoscope Model ED-3490TK

- **April 12, 2019**
  - The FDA Continues to Remind Facilities of the Importance of Following Duodenoscope Reprocessing Instructions

- **December 10, 2018**
  - The FDA Provides Interim Results of Duodenoscope Reprocessing Studies Conducted in Real-World Settings

- **April 12, 2019**
  - The FDA is Recommending Transition to Duodenoscopes with Innovative Designs to Enhance Safety

- **August 29, 2019**
  - The FDA is Recommending Transition to Duodenoscopes with Innovative Designs to Enhance Safety
Duodenoscope outbreaks has been found to be a multifactorial issue that is not easily solved.

**Microbial Factors**

- Detection issues
  - Normal GI flora
  - Carrier state
  - Culture +/-

- MDROs just as susceptible to HLD as other pathogens

- Resistant to eradication through “biofilm” formation

**Reprocessing limitations**

- Inherent issues
  - Low margin of safety

- AER related defects
  - Cycle issues, settings, water quality

**Human Error**

- Failure to follow IFU
- Delay in reprocessing
- Inadequate leak testing
- Inadequate or absent mechanical cleaning before disinfection
- Disinfection issues
- Failure to dry scope and channels before storage

**Design Issues**

- Design Issues
  - Heat labile
  - Structural complexity
  - Hard to reach crevices
  - Springs and valves
  - Elevator mechanism and channel

- Iatrogenic
  - Damaged elevator mechanisms and channels may impede microbial exposure to HLD
  - Scratches, divots, tears in sealant created by repeated use, accessories

Source: Lichtenstein Presentations from ASGE Infection Control Summit, December 2nd, 2019
FDA found higher than expected contamination rate even with no breaches in reprocessing protocols

522 Post Market Surveillance Final Results

1.8% + 5.0% = 6.8%

Low to moderate concern  High concern (e.g., E. coli)  Total contamination rate

Duodenoscope Contamination Rates

Sources:
https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMA/pss.cfm?t_id=353&c_id=3691
Design of the reusable duodenoscope makes cleaning and reprocessing difficult to do effectively and reliably

Complex distal end of an ERCP endoscope

Contamination issues are not isolated to the elevator mechanism

Outbreak features and contributors to underreporting

- No routine endoscope surveillance cultures in U.S.
- Organisms often normal gut flora (MDR)
- Clinical infections often distant from site of colonization (e.g., UTI, PNA, sepsis)
- Long lag time (months from time of exposure)
- Silent carriage common
- Duodenoscope often culture negative after outbreak

Sources: Lichtenstein, Ofstead: Presentations from ASGE Infection Control Summit, December 2nd, 2019
Switching to innovative designs for duodenoscopes are recommended for health systems

“The FDA believes the best solution to reducing the risk of disease transmission by duodenoscopes is through innovative device designs that make reprocessing easier, more effective, or unnecessary”

Single-use endoscopy is an innovation shift with faster development and much shorter Product Life Cycle (PLC)

**Reusable Innovation Cycle**

- Long development and PLC 5-7 years
- Slower adoption of new technologies
- Expensive capital needs to be depreciated before replaced
- Technology and design constraints as design needs to withstand HLD or sterilization

**Single-use Innovation Cycle**

- Short development and PLC 2-3 years
- No or very limited capital depreciation
- Rapid adoption of new technologies and design improvements
- Limited design constraints
Thank you
Regulatory Involvement in Endoscope Processing

Erin Kyle, DNP, RN, CNOR, NEA-BC
FDA Mission

FDA is responsible for **advancing the public health** by helping to speed innovations that make medical products more effective, safer, and more affordable and by helping the public get the accurate, science-based information they need to use medical products and foods to maintain and improve their health.
**FDA Clearance**

- Endoscopes are regulated under 21 CFR 876.1500
- Flexible endoscopes are Class II medical devices that require FDA clearance to be marketed in US.
- 510(k) submission including reprocessing validation data is required
- Breakthrough device
Action in response to infectious outbreaks

- **September 2013** – CDC alerted FDA of association of a multi-drug resistant organism infections and duodenoscopes
- **February 2015** – FDA Safety Communication
- **2015 Advisory Committee Meeting** – focused on actions to improve duodenoscope processing and minimize infection risk
  - Revised reprocessing instructions
  - Clearance and recall of duodenoscopes
  - Developed webpage for Infections Associated with Reprocessed Endoscopes
- **2019 Advisory Committee meeting** – revising duodenoscope processing
Updated Design

- FDA cleared duodenoscopes with design modifications to the elevator channel sealing mechanism
- Labeling was revised to recommend annual inspection to identify wear
- New duodenoscope device designs
Supplemental measures for clinical users

• August 2015 – FDA released a summary of supplemental measures to enhance duodenoscope reprocessing that emerged from the Advisory Committee Meeting

• FDA worked with CDC to develop a protocol for sampling and culturing duodenoscopes (February 2018)
Regulatory Actions

• FDA conducted inspections and issued Warning Letters to duodenoscope manufacturers in 2015
• October 2015 – FDA ordered duodenoscope manufacturers to conduct post-market surveillance studies
  • Human factors studies
  • Sampling/culturing studies
  • More warning letters in March 2018 for failing to comply with post-market surveillance studies
Reports to FDA associated with infection, exposure, or duodenoscope contamination

(n=1115)

* Note that the year is when the report was submitted to FDA, not necessarily the date of event
** Each MDR may report events associated with one or more patients
† Reports received as of July 1, 2019
Deaths reported to FDA associated with infection, exposure, or duodenoscope contamination

* Note that the year is when the report was submitted to FDA, not necessarily the date of event
** Each MDR may report events associated with one or more patients
† Reports received as of July 1, 2019
Transition to duodenoscopes with innovative design

The FDA is Recommending Transition to Duodenoscopes with Innovative Designs to Enhance Safety: FDA Safety Communication

The FDA believes the best solution to reducing the risk of disease transmission by duodenoscopes is through innovative device designs that make reprocessing easier, more effective, or unnecessary.

Update as of April 10, 2020: The FDA continues to recommend that hospitals and endoscopy facilities transition to innovative duodenoscope designs to help improve cleaning and reduce contamination between patients, including designs with disposable caps or distal ends. When using these innovative duodenoscopes, remember to follow the manufacturer’s instructions for the assembly of the caps and distal ends. The FDA is not aware of any patient injuries related to these innovative duodenoscope designs. However, the manufacturers, Fujifilm, Pentax and Olympus have in total submitted 10 reports of device malfunctions, such as removable caps or ends falling off during endoscopic retrograde cholangiopancreatography (ERCP). Of these device malfunctions, only three occurred with models that are marketed in the United States.
The availability of a fully disposable duodenoscope represents another major step forward for improving the safety of these devices, which are used in more than 500,000 procedures in the U.S. each year. Unlike duodenoscopes that are used on multiple patients, a fully disposable duodenoscope doesn’t need to be reprocessed, eliminating the risk of potential infection due to ineffective reprocessing,” said Jeff Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health.
MedWatch: The FDA Safety Information and Adverse Event Reporting Program

*MedWatch*, the FDA’s medical product safety reporting program for health professionals, patients and consumers.

*MedWatch* receives reports from the public and when appropriate, publishes safety alerts for FDA-regulated products such as:

- **Prescription and over-the-counter medicines**
- **Biologics** such as blood components, blood/plasma derivatives and gene therapies.
- **Medical devices** such as hearing aids breast pumps, and pacemakers.
MedWatch Online Voluntary Reporting Form

Welcome

Health professionals, consumers and patients can voluntarily report observed or suspected adverse events for human medical products to FDA. Voluntary reporting can help FDA identify unknown risks for approved medical products. Reporting can be done through our online reporting portal or by downloading, completing and then submitting FDA Form 3500 (Health Professional) or 3506B (Consumer/Patient) to MedWatch. The FDA Safety Information and Adverse Event Reporting Program.

Begin Online Report

Health Professional (FDA Form 3500)
Consumer/Patient (FDA Form 3500B)

En español para el consumidor/paciente (formulario 3500B de la FDA)

Continue an incomplete report

Click here to continue filling out an incomplete report. You will need Report ID and Import Date. You will have 3 days to complete this report from the start date.

MedWatch Voluntary Report

About Patient

Patient Identifier:

Please do NOT enter the Patient's Name or Social Security Number

Age or Date of Birth:

Age (specify unit of time for age) ____________ Unit ________ OR mm/dd/yyyy

Gender:

- Female
- Male
- Intersex
- Transgender
- Prefer not to disclose
References and Resources

- Devices for which a 510(k) should contain validation data (Reprocessing Final Guidance Appendix E.) | FDA
- Duodenoscope Surveillance Sampling & Culturing Reducing the risks of Infection | HAI | CDC
- Infections Associated with Reprocessed Duodenoscopes | FDA
- 510(k) Clearances | FDA
- MedWatch: The FDA Safety Information and Adverse Event Reporting Program | FDA
The Business Case for Single-Use

Russ Montgomery, PhD
Director, Health Economics and Market Access
Ambu
Need for a Business Case: Comparing Costs and Benefits

Value of Single-Use

- **Cost-effective** – lower cost than reusables for many facilities
- **Reduced financial risk** – predictable, transparent, variable costs
- **Elimination of infection risk** from endoscope reprocessing and reuse
- **Reduced exposure related to infection risk** – addresses liability and reputational risks
- **Improved productivity** – no procedure delays, potential for improved patient throughput
- **Streamlined operations** – eliminate burdens associated with reprocessing

Cost of Reusables Often Underestimated

Costs spread across multiple budgets

- Capital
- Clinical Dept.
- Repair Contracts
- Central Sterile Dept.

Lack of cost transparency
Reusable Endoscope Cost Drivers

**Capital Equipment**
- Endoscopes
- Towers, monitors, video processors
- AERs and sterilizers
- Other reprocessing equipment

**Reprocessing**
- Labor costs, from bedside precleaning to drying stage
- Consumable supplies, including PPE, detergents, brushes, etc.

**Repairs**
- Repair and maintenance contracts
- Ad-hoc repairs as needed

**Cross Contamination**
- Cost to treat infections resulting from use of contaminated endoscopes
- Most common conditions are ventilator-associated pneumonia and sepsis
Comparing the Costs: Reusables vs. Single-Use

### Duodenoscopes

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<thead>
<tr>
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<th>Reusable Cost Per Use</th>
<th>Single-Use Price</th>
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### Bronchoscopes

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### Sources:
### Comparing the Costs: Reusables vs. Single-Use

#### Cystoscopes

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#### Rhinolaryngoscopes

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<tr>
<td><strong>Total Cost</strong></td>
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<td><strong>$27</strong></td>
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**Sources:**
Additional Reprocessing Costs

- Availability issues leading to delayed or canceled procedures
- Compliance program, tracking changing requirements
- Training and education (initial and continuing ed)
- Transportation to/from central reprocessing
- Overtime for late night/weekend labor
Customized Budget Impact Analysis

Request a customized analysis comparing the cost of reusables and single-use in your facility

Send an email to us-healthcon@ambu.com

or

Use our online calculators at www.singleuseendoscopy.com/calculators
Thank you!

Questions?