comprised 22% of pediatric cases and 25% of adult cases. The remaining 24% of pediatric cases were impetigo cases.

The SmartSet was used in 58 (12.4%) of 469 postintervention cases. The median duration of antibiotics for pediatrics was 7 days both before and after the intervention, but prescriptions with ≤5-day durations increased from 18.3% to 39.7%. An ITS analysis showed that following the release of guidelines and education to pediatric clinicians, the proportion of pediatric antibiotic prescriptions of inappropriate duration decreased by 1.6% per quarter ($P < .01$) from a high of 35% in quarter 4 of 2019. After SmartSet implementation, the proportion of prescriptions of inappropriate duration immediately decreased by 10.3% ($P < .01$), a relative decrease of 40% from the modeled percentage just prior to the intervention (Fig. 1a). After the intervention, the proportion of prescriptions of inappropriate duration remained stable at ≤15%.

For adult patients, the median antibiotic duration was 7 days, and 25.7% of prescriptions had durations of ≤5 days. The proportion of antibiotic prescriptions of inappropriate duration averaged 22.9% and did not change over the study period ($P = .88$) (Fig. 1b).

Discussion

Implementation of an EMR-embedded CDS tool was associated with an immediate relative decrease of 40% in inappropriate antibiotic duration for outpatient pediatric SSTI. Prior to SmartSet implementation, guidelines and clinician education resulted in only a modest decline in inappropriate antibiotic duration. Subsequent passive feedback via dissemination of a Tableau dashboard sharing inappropriate prescribing rates by clinician or clinic did not result in a further reduction in inappropriate prescribing. The improvement was sustained over 12 months. SmartSet use was low, though concordant with the degree of improvement. We hypothesize that increasing SmartSet use may result in further improvement.

In contrast to the improved prescribing in pediatrics, the proportion of prescriptions of inappropriate duration for adult patients within the same health system remained unchanged over the study period. Adult providers received comparable SSTI guidelines and generalized education on treatment of common infections including SSTI but no CDS tool. These findings suggest that timely EMR nudges are associated with improved outpatient antibiotic prescribing for duration for SSTI over guidelines and education alone.

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Implementation of multidrug-resistant bacterial testing to prioritize duodenoscope sterilization: Experience from a high-volume health system

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Reusable duodenoscopes are used to perform >650,000 endoscopic retrograde cholangiopancreatography (ERCP) procedures annually in the United States.[1] These devices contain small working parts, which makes cleaning and disinfection challenging compared to other devices. Multiple outbreaks have been reported over

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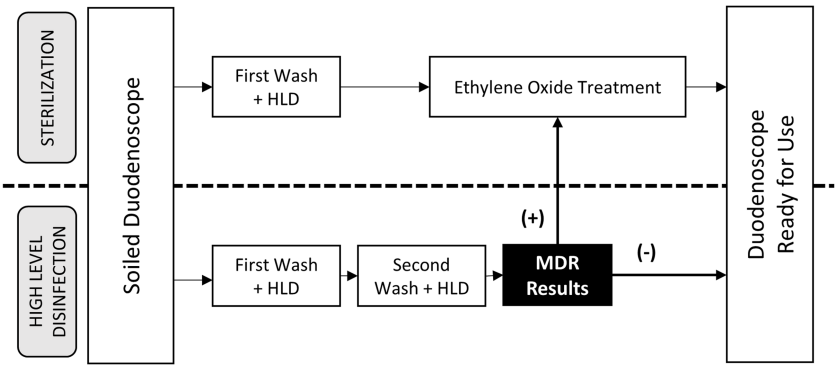

Figure 1. Schematic outlining MDR testing paradigm to prioritize duodenoscopes for sterilization with ethylene oxide.

the past decade, most commonly from multidrug-resistant organisms (MDROs), prompting numerous safety communications and mandates for instrument redesign.[2,3] Device sterilization, often performed with ethylene oxide gas (ETO), is the highest level of disinfection available. Data are limited regarding the incremental benefit of sterilization, but it remains the gold standard for disinfection.[4,5] However, due to cost, environmental impact, need for specialized facilities, and supply shortages, ETO is not used routinely for reprocessing. In this report, we describe the feasibility, implementation, and impact of a systematic testing protocol among patients undergoing ERCP to detect MDROs in duodenoscope reprocessing.

We performed a retrospective review of all patients who underwent screening for MDROs via polymerase chain reaction (PCR) testing of rectal swabs at the time of ERCP (TJF-Q180V duodenoscope, Olympus, Tokyo, Japan) between January 2018 and May 2022 at a single healthcare system, including a tertiary-care center and community practices. Beginning in 2018, PCR testing of rectal swabs was routinely performed at 2 community practices and at the tertiary-care center when daily sterilization capacity was exceeded during a national shortage of ETO in 2022. PCR targets included oxacillin-hydrolyzing β-lactamase (Oxa-48), *Klebsiella pneumoniae* carbapenemase (KPC), New Delhi metallo-β-lactamase (NDM), and Verona metallo-β-lactamase (VIM). All duodenoscopes underwent double high-level disinfection [ie, wash plus high-level disinfection (HLD), followed by wash plus HLD], with subsequent diversion to ETO sterilization if point-of-care testing returned positive (Fig. 1). HLD was performed on an automated processor with a peracetic acid–based disinfectant (Rapicide PA, Steris, Mentor, OH). Patients were monitored via retrospective chart review and hospital-wide surveillance and reporting systems for MDRO infections.

In total, 557 patients underwent testing, and only 1 (0.2%) result was positive. However, 2 (0.4%) tests were processed incorrectly, prompting precautionary sterilization. All duodenoscopes used in patients with negative PCR tests were reprocessed with double washing and high-level disinfection. No patients developed a healthcare-associated infection or an MDR-related disease.

The implementation of this protocol maintained procedural throughput while minimizing MDRO transmission risk. We utilized established mechanisms and infrastructure for PCR testing at our institution, which generally yielded results in 12 hours at the tertiary-care center and within 24–48 hours for all sites. Point-of-care testing for similar applications has been used to provide rapid detection of MDROs within 1 hour, allowing for even more rapid triage of high-risk devices. This technology was described in a series of 201 patients, among whom carbapenemase resistance was detected in 0.5% of patients.[6] Another study reported a positive or indeterminate rectal swab in 0.6% of patients.[7] Alternative approaches, including routine duodenoscope cultures, are more costly and have significant turnaround times. A financial analysis determined that a culture-based approach would only be cost-effective if the probability of MDRO infection rose to >24%.[8] The rate of colonization reported here is consistent with previous surveillance data reporting CRE rates <1.1%.[9] The low colonization rate would challenge the cost efficacy of any universal screening program. However, this same approach could be targeted to high-risk populations such as inpatients, prolonged hospitalizations, antibiotic exposure, nursing home residents, and outbreak scenarios.

MDR pathogens are not the only microorganisms transmitted through reusable endoscopes, and they are likely overrepresented given established hospital surveillance programs. However, outbreaks of MDROs have been closely associated with duodenoscopes despite following disinfection protocols and carry significant clinical implications. This characteristic has made them particularly concerning to regulatory agencies, manufacturers, and professional organizations. There has been significant advancement in the development of single-use duodenoscopes, which are now available from several manufacturers, and in reuseable duodenoscopes with single-use components, which are the only reusable versions available for purchase in the United States. Data assessing the impact of these innovations are very limited. One study evaluated contamination in duodenoscopes reprocessed with or without a removeable cap in place and showed significantly lower ATP activity in the end cap–detached group. However, it remains unclear how this surrogate outcome translates to transmissibility.[10] Although these devices have the potential to reduce the risk of pathogen transmission, many questions remain related to safety, implementation strategy, cost, and environmental impact.[11] The sole use of these devices will make economics of building and maintaining infrastructure to perform ETO sterilization even less favorable. Utilizing the method outlined in this report may help further streamline and focus the sterilization process to cases with the greatest risk of pathogen transmission. Innovations in device cleaning and reprocessing are likely to be as important as duodenoscope design.

This study had several limitations. This study was retrospective in design, with a relatively small sample size and a low number of events. The study cohort originated from a single institution with an established processes in place to perform rapid PCR testing. Institutions without this infrastructure would face upfront costs not well described in this report.

In summary, this point-of-care testing model was efficient and feasible and may help optimize resource utilization while

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minimizing the risk of interpatient pathogen transmission. This approach to device reprocessing was successfully implemented across tertiary and regional community sites. Although additional studies are needed to evaluate the model's cost-effectiveness, environmental impact, and performance in a broader patient population, it provides a robust framework that could be implemented easily in similar healthcare systems.

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