Table 1. Subjects Characteristics, Work Settings, and SARS-CoV-2 IgG Positivity

Characteristic	SARS-CoV-2 IgG+No. (%)
Female (N = 555)	24 (4.32)[a]
Male (N = 108)	10 (9.26)[a]
Total (N = 663)	34 (5.13)
Profession	
Healthcare worker (N = 547)	28 (5.12)
Physician (N = 214)	10 (4.67)
Nurse (N = 216)	13 (6.02)
Other health technicians (N = 117)	5 (4.27)
Non-healthcare worker (N = 116)[b]	6 (5.17)
Setting	
Specialist outpatient services (N = 63)	4 (6.34)
Surgery (N = 27)	6 (22.22)[c]
Pediatric (N = 80)	1 (1.25)
Pediatric emergency room (N = 55)	1 (1.82)
Neonatal intensive care (N = 47)	1 (2.13)
Pediatric intensive care (N = 42)	6 (14.29)[d]
Pre- and postnatal (N = 181)	6 (3.31)
Administration/Pharmacy/Laboratory (N = 70)	6 (8.57)
Others (N = 98)	3 (3.06)

[a]Female vs male: 4.32% vs 9.26%, $P < .05$.
[b]Biologists, pharmacists, laboratory technicians and administrative employers.
[c]Surgery vs all the others: 22.2% vs 4.4%, $P < .001$.
[d]Pediatric intensive care vs all other wards: 14.3% vs 4.5%, $P < .01$.

contact with COVID-19 patients during the very early stages of the pandemic, when the availability of PPE was still inadequate. Among HCWs who did not have contact with confirmed cases, the percentage of infection was low (3.29%), even lower (although not significantly) than among non-HCWs (5.17%). Serological analysis indicated that 25% of infected HCWs were asymptomatic with no contact with confirmed COVID-19 patients (71.4%) or had PPE-protected contact (28.6%). A limitation to this study could be the lack of information regarding staff-to-staff transmission and potential community-associated risks.

In conclusion, our data indicate that the prevalence of SARS-CoV-2 among pediatric HCWs is low and similar to community prevalence, suggesting that there is no increased risk within hospitals providing appropriate PPE.

These results are of particular relevance considering that this area was among those with the highest epidemic density worldwide and that the virus had already spread unnoticed since mid-January 2020. The hypothesis of a minor role of children in the spread and transmission of SARS-CoV-2[7] should be explored. Further retrospective serological investigations among children with respiratory symptoms that were hospitalized or had access to the emergency room before the official start of the COVID-19 outbreak in Italy will allow to date the introduction of the virus in the pediatric population.

References

1. Grasselli G, Pesenti A, Cecconi M. Critical care utilization for the COVID-19 outbreak in Lombardy, Italy: early experience and forecast during an emergency response. *JAMA* 2020 Mar 13 [Epub ahead of print]. doi: 10.1001/jama.2020.4031.
2. Villa S, Lombardi A, Mangioni D, *et al.* The COVID-19 pandemic preparedness … or lack thereof: from China to Italy. *Glob Health Med* 2020; 2:73–77.
3. Percivalle E, Cambiè G, Cassaniti I, *et al.* Prevalence of SARS-CoV-2 specific neutralising antibodies in blood donors from the Lodi Red Zone in Lombardy, Italy, as at 06 April 2020. *Euro Surveill* 2020;25(24). doi: 10.2807/1560-7917.ES.2020.25.24.2001031.
4. Sorveglianza Integrata COVID-19 in Italia. Aggiornamento 15 aprile 2020. [COVID-19 Integrated Surveillance in Italy. 15 April 2020 Update. Rome: ISS]. Epicentro, Epidemiology for public health, Istituto Superiore di Sanità (ISS) website. https://www.epicentro.iss.it/en/coronavirus/bollettino/Infografica_15aprile%20ENG.pdf. Published April 15, 2020. Accessed July 31, 2020.
5. Personal protective equipment for COVID-19. World Health Organization website. https://www.who.int/medical_devices/priority/COVID_19_PPE/en/. Published April 6, 2020. Accessed July 31, 2020.
6. Valenti L, Bergna A, Pelusi S, *et al.* SARS-CoV-2 seroprevalence trends in healthy blood donors during the COVID-19 Milan outbreak. *medRxiv* 2020. doi: 10.1101/2020.05.11.20098442.
7. Zhang J, Litvinova M, Liang Y, *et al.* Changes in contact patterns shape the dynamics of the COVID-19 outbreak in China. *Science* 29 Apr 2020 [Epub ahead of print]. doi: 10.1126/science.abb8001.

Reduction in abdominal hysterectomy surgical site infection rates after the addition of anaerobic antimicrobial prophylaxis

Takaaki Kobayashi MD, Kyle E. Jenn BSN, Noelle Bowdler MD, Rita Malloy MAN, Stephanie Holley MBA, Tatiana Izakovic MD, Mary E. Kukla BSN, Oluchi Abosi MB ChB, MPH, Angelique Dains BSN, Holly Meacham MSN, Daniel J. Diekema MD, Michael B. Edmond MD and Jorge L. Salinas MD

University of Iowa Hospitals & Clinics, Iowa City, Iowa

Author for correspondence: Takaaki Kobayashi, E-mail: Takaaki-kobayashi@uiowa.edu

Cite this article: Kobayashi T, *et al.* (2020). Reduction in abdominal hysterectomy surgical site infection rates after the addition of anaerobic antimicrobial prophylaxis. *Infection Control & Hospital Epidemiology*, 41: 1469–1471, https://doi.org/10.1017/ice.2020.386

Antimicrobial prophylaxis is one of the most effective surgical site infection (SSI) prevention measures.[1] Current guidelines recommend the use of cefazolin as prophylaxis for abdominal hysterectomy procedures.[2] However, there is growing evidence that anaerobes play a role in abdominal hysterectomy SSIs.[3] We assessed the impact of adding anaerobic coverage on abdominal hysterectomy SSI rates in our institution.

Methods

The University of Iowa Hospitals & Clinics (UIHC) is an 811-bed academic medical center that serves as a referral center for Iowa. Historically, patients undergoing abdominal hysterectomy (open, laparoscopic, and robot-assisted laparoscopic) received only cefazolin for antimicrobial prophylaxis. However, in November 2017, patients undergoing abdominal hysterectomy began receiving metronidazole in addition to cefazolin after we noted an increase in SSI rates. Also, standardized infection ratios calculated by the National Healthcare Safety Network (NHSN) were >1. Order sets within the electronic health record were modified, and education was provided to surgeons, anesthesiologists, and other team members. SSI rates were calculated for abdominal hysterectomies undertaken between January 2015 and September 2019, using NHSN definitions. We excluded cases of vaginal hysterectomy. Rates were calculated for complex infections (deep incisional and organ space), and for infections at all depths (superficial incisional, deep incisional, and organ space). SSI rates were also investigated according the approach of the procedure (open vs minimally invasive surgery). Culture results were recorded. We conducted an interrupted time-series analysis using Stata software (StataCorp, College Station, TX) to determine the impact of adding prophylactic metronidazole on complex and all-depth abdominal hysterectomy SSI rates. Other prevention activities already in place included providing surgeons with individualized SSI data on a regular basis and real-time performance feedback as needed, as well as auditing compliance with preoperative chlorhexidine bathing.

Results

From January 2015 through September 2019, 3005 abdominal hysterectomies were performed at UIHC. We observed a significant decrease in the complex SSI rate from 1.5% (24 of 1,638) before to 0.6% (8 of 1,367) after adding prophylactic metronidazole ($P = .01$) (Fig. 1). We detected a nonsignificant decrease in the all-depth SSI rate from 3.2% (52 of 1,638) before to 1.6% (22 of 1,367) after the change in prophylaxis ($P = .73$). The proportion of open hysterectomies decreased from 59% to 33%, and minimally invasive hysterectomies increased proportionately during the study period. SSI rates decreased from 3.6% to 2.3% with open surgical approaches and from 2.4% to 0.8% with minimally invasive surgery (Table 1).

Pathogens were identified for 25 patients. The most common pathogen was *Bacteroides* spp (40%), followed by *Escherichia coli* (24%). After adding metronidazole, the proportion of positive cultures with anaerobes decreased from 82% to 50% among complex SSIs and from 59% to 25% among all depth SSIs.

Discussion

We compared the incidence of SSIs before and after adding anaerobic coverage to antimicrobial prophylaxis for abdominal hysterectomy. The addition of metronidazole was associated with a decrease in the abdominal hysterectomy complex SSI rate.

Postoperative infection remains one of the most common complications of surgical procedures in gynecology. The development of SSIs results in great patient morbidity.[4] Current antimicrobial prophylaxis guidelines recommend the use of cefazolin, cefotetan, cefoxitin, or ampicillin/sulbactam as a single agent before vaginal or abdominal hysterectomy.[5] The American College of Obstetricians and Gynecologists also recommends cefazolin.[6] The widespread implementation of antibiotic prophylaxis prior to surgery, and the recognition of modifiable risk factors, has led to a reduction in SSIs in recent years. According to NHSN data for 2006 to 2008, the incidence of all-depth SSIs after abdominal hysterectomy was 2.7%.[7] A more recent study from the Michigan Surgical Quality Collaboration cohort demonstrated an all-depth SSI rate of ~2.0%.[8,9] Uppal et al[9] revealed that the SSI rate was 1.8% with prophylaxis with a β-lactam, compared to 3.1% with β-lactam alternatives and 3.7% with nonstandard prophylaxis.[9] The rate of SSI at our institution decreased from 3.2% to 1.6% after adding metronidazole to cefazolin for SSI prevention. A recent large retrospective study with 18,255 hysterectomies by Till et al[3] demonstrated that the risk of SSI was lower, at 1.4%, for patients who received cefazolin and metronidazole, compared to 1.8% with cefazolin alone, and this rate was 2.1% with a second-generation cephalosporin. Currently, no published prospective studies comparing cefazolin and metronidazole to cefazolin alone are available.

Cefazolin, a first-generation cephalosporin, is the most widely used preoperative antibiotic. However, organisms isolated from SSIs after abdominal hysterectomy include anaerobic vaginal flora, most commonly *Bacteroides* spp, *Prevotella* spp, *Peptostreptococcus* spp, and *Gardnerella* spp.[10] In our study, the most common organisms were *Bacteroides* spp. Although anaerobic coverage is recommended as prophylaxis for colorectal surgery,[11]

Table 1. Surgical Site Infection Rates and Standardized Infection Ratios Before and After the Addition of Metronidazole Stratified by Surgical Approach, University of Iowa Hospitals and Clinics, 2015–2019

	Cefazolin Only 1/1/2015 to 10/31/2017		Cefazolin + Metronidazole 11/1/2017 to 9/30/2019	
Type of Infection	Open	MIS	Open	MIS
SSI, %	3.6	2.4	2.3	0.8
SIR	1.8	2.2	1.5	0.6

Note. SSI, surgical site infection, SIR, standardized infection ratios; MIS, minimally invasive surgery.

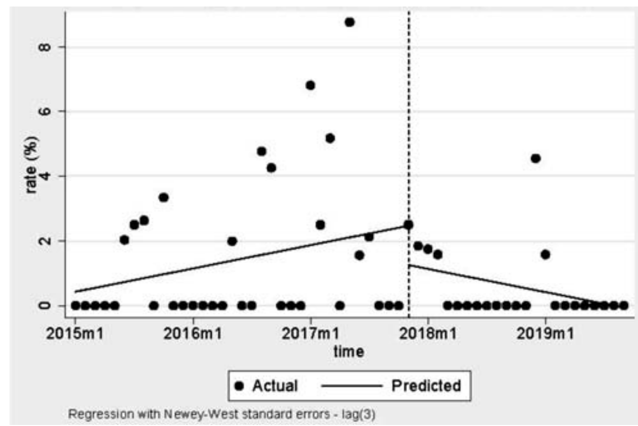

Fig. 1. Complex surgical site infections after abdominal hysterectomy, University of Iowa Hospitals and Clinics, 2015–2019.
Abbreviations: m, month.

https://doi.org/10.1017/ice.2020.386 Published online by Cambridge University Press

its role has not been proven for abdominal hysterectomy. Some institutions have shifted to using second-generation cephalosporins to improve anaerobic coverage. However, resistance of *Bacteroides* spp to second-generation cephalosporins is 15%–25%.[12] Our study showed similar results to Till et al[3] in complex SSIs. Although all-depth SSI rates trended downward compared to before the implementation of metronidazole, the difference was not statistically significant at our institution. The lack of difference in all-depth SSI after the addition of metronidazole might be because microorganisms associated with superficial infections do not typically include anaerobes. However, given that deep infections are more serious than superficial infections, the impact of adding metronidazole to cefazolin is promising and should be further investigated.

This study has several imitations. It was conducted at a single center and the results may not be generalizable to other institutions. We did not compare differences in baseline characteristics. Comorbidities such as malignancy, obesity, and diabetes mellitus might have affected the development of SSI. However, we calculated the standardized infection ratios according to the NHSN guidelines, which account for such potential confounders, and we were still able to show a decrease in SIRs (Table 1). We only investigated the association between prophylaxis and SSI rates; we did not evaluate postoperative course or mortality. The reduction could have been affected due to the change of procedure approaches over the study period. However, the SSI rates decreased for both surgical approaches. Other SSI prevention activities already ongoing might have affected the reduction. Finally, change of surgeons over the study period could have affected the SSI rate.

In conclusion, hospitals should assess the microbiology of abdominal hysterectomy SSIs and could consider adding metronidazole to their antimicrobial prophylaxis if the rate of anaerobic infections is high.

References

1. Berrios-Torres SI, Umscheid CA, Bratzler DW, *et al.* Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017. *JAMA Surg* 2017;152:784–791.
2. Van Eyk N, van Schalkwyk J, Infectious Diseases C. Antibiotic prophylaxis in gynaecologic procedures. *J Obstet Gynaecol Can* 2012;34:382–391.
3. Till SR, Morgan DM, Bazzi AA, *et al.* Reducing surgical site infections after hysterectomy: metronidazole plus cefazolin compared with cephalosporin alone. *Am J Obstet Gynecol* 2017;217:187e1–e11.
4. Lefebvre G, Allaire C, Jeffrey J, Vilos G. No. 109–Hysterectomy. *J Obstet Gynaecol Can* 2018;40:e567–e579.
5. Bratzler DW, Dellinger EP, Olsen KM, *et al.* Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Am J Health Syst Pharm* 2013;70:195–283.
6. ACOG Practice Bulletin No. 195: Prevention of infection after gynecologic procedures. *Obstet Gynecol* 2018;131:e172–e189.
7. Edwards JR, Peterson KD, Mu Y, *et al.* National Healthcare Safety Network (NHSN) report: data summary for 2006 through 2008, issued December 2009. *Am J Infect Control* 2009;37:783–805.
8. Morgan DM, Swenson CW, Streifel KM, *et al.* Surgical site infection following hysterectomy: adjusted rankings in a regional collaborative. *Am J Obstet Gynecol* 2016;214:259e1–e8.
9. Uppal S, Harris J, Al-Niaimi A, *et al.* Prophylactic antibiotic choice and risk of surgical site infection after hysterectomy. *Obstet Gynecol* 2016;127:321–329.
10. Soper DE, Bump RC, Hurt WG. Bacterial vaginosis and trichomoniasis vaginitis are risk factors for cuff cellulitis after abdominal hysterectomy. *Am J Obstet Gynecol* 1990;163:1016–1021.
11. Nelson RL, Glenny AM, Song F. Antimicrobial prophylaxis for colorectal surgery. *Cochrane Database Syst Revs* 2009;1: CD001181.
12. Aldridge KE, Sanders CV. Susceptibility trending of blood isolates of the Bacteroides fragilis group over a 12-year period to clindamycin, ampicillin-sulbactam, cefoxitin, imipenem, and metronidazole. *Anaerobe* 2002;8:301–305.