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Antibiotic prophylaxis practice in gastrointestinal surgery in five hospitals in southern Benin

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Background: Benin's healthcare system is characterized by a lack of local guidelines for surgical antibiotic prophylaxis (SAP), which is essential to prevent surgical site infection.
Aim: To audit compliance for SAP practices in gastrointestinal surgery.
Methods: Data were prospectively collected from gastrointestinal surgery departments in five hospitals. Over a four month period, SAP was assessed using five conventional criteria (indication, choice of antibiotic, dosage, timing, and duration of administration) among patients admitted for Altemeier class 1 or 2 procedures. Three guidelines were used as reference: World Health Organization (WHO), American Society of Health-System Pharmacists (ASHP)and French Society of Anaesthesia and Intensive Care Medicine (SFAR).
Findings: Of 68 surgical interventions, overall compliance with WHO, ASHP, and SFAR was observed in zero (0.0%), one case (1.5%) and two cases (2.9%), respectively. Compliance with indication varied according to the guidelines: 65 (95.6%) were compliant with WHO and ASHP and 47 cases (69.11%) with SFAR. Among compliant cases, the antibiotics

Abbreviations: ABP, Antibiotic prophylaxis; ASHP, American Society of Health-System Pharmacists; C2G, Second-generation cephalosporin; C3G, Third-generation cephalosporin; FSS, Faculté des sciences de la santé; HAI, healthcare-associated infection; HAIs, healthcare-associated infections; IDSA, Infectious Diseases Society of America; IPC, Infection Prevention and Control; MUST-PIC, MUltidisciplary STrategy for Prevention and Infection Control in Benin; NICCs, Nosocomial Infection Control Committees; SAP, Surgical Antibiotic Prophylaxis; SFAR, French Society of Anaesthesia and Intensive Care Medicine; SHEA, Society for Healthcare Epidemiology of America; SIS, Surgical Infection Society; SPSS, Statistical Package for the Social Sciences; SSI, Surgical site infection; SSIs, Surgical site infections; WHO, World Health Organization

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administered were rarely selected according to guidelines: WHO, 2 (2.9%) and ASHP, 2 (2.9%), and SFAR, 3 (4.4%). Drug dosage compliance varied from 20 (29.4%) (SFAR) to 49 (72.0%) (ASHP). Timings were respected in 47 (69.1%; WHO), 45 (66.2%; ASHP) and 9 cases (13.2%; SFAR). The number of cases compliant with antibiotic prophylaxis duration were 13 (19.1%; WHO), 17 (25.0%; ASHP) and 16 (23.5%; SFAR).

Conclusion: The SAP compliance rate in gastrointestinal surgery based on the five conventional criteria was very low. SAP guidelines must be implemented appropriately for local bacteriological epidemiology.

Introduction

The World Health Organization (WHO) estimates that hundreds of millions of patients worldwide are affected each year by healthcare-associated infections (HAIs) [1]. HAIs are infections acquired by the patient while receiving healthcare [2]. These infections occur after at least 48 hours of hospitalization and within 30 days [3] in the case of surgery, and one year in the case of implant placement. Surgical site infections (SSIs), a specific type of HAI, not only increase postoperative morbidity and mortality but also have an economic impact [3,4]. This is particularly true in developing countries where not everyone has health insurance [5]. A rare study conducted in Benin in 2012 estimated the prevalence of SSIs to be 19.2%[6]. Surgical antibiotic prophylaxis (SAP) is recommended to prevent surgical site infection (SSI) [7]. Intra-abdominal infections are one of the most frequent gastrointestinal emergencies and one of the leading causes of septic shock. [8].

Several organizations worldwide are working to reduce SSI risk, including preoperative preparation of patients and depending on the type of procedure, through administration of SAP [6,7]. In Benin, in the absence of known, defined local guidelines, practitioners often refer to international standards. However, healthcare workers' compliance with SAP measures and recommendations is poor in obstetric surgery [9]. To our knowledge, this has never been studied in Benin, based on the five standard criteria in gastrointestinal surgery.

As antibiotic prophylaxis (ABP) is key to preventing SSI, the main objective of this study was to describe compliance with SAP guidelines in five hospitals in Benin, in gastrointestinal surgery. To determine compliance with the indication and administration modalities: (i.e: antibiotic choice, antibiotic dose, timing, and duration of ABP); three international sets of guidelines were used as reference.

Methods

Study design

A cross-sectional observational study was designed to compare compliance of ABP practices against three international guidelines. The SAP practice of healthcare professionals was observed in gastrointestinal surgery. Patients gave their written consent to have their operation observed. This study was approved by the Institutional Review Board of the *Faculté des sciences de la santé* (FSS) *d'Université d'Abomey Calavi*, Benin, under reference number 011—19/UAC/FSS/CER-SS. It was carried out as part of a project entitled MUltidisciplary STrategy for Prevention and Infection Control in Benin (MUSTPIC) funded by the Belgian Academy for Research and Higher Education (ARES). The overall objective of this research project is to evaluate the adoption (by hospitals in Benin) of a complex intervention aimed at contributing towards improvements in hospital hygiene management and the rational use of antibiotics in gastrointestinal and obstetric surgery for the prevention of HAIs and bacterial resistance.

Setting and period

This study was conducted in the gastrointestinal surgery departments of five hospitals in southern Benin: *Centre National Hospitalier et Universitaire Hubert Koutoukou Maga*, a 679-bed hospital with 41 gastrointestinal surgery beds (national level); *Centre Hospitalier et Universitaire Départemental de Ouémé-Plateau*, a 365-bed hospital with 84 gastrointestinal surgery beds (intermediate level), *Centre Hospitalier et Universitaire de zone Suru Léré*, a 101-bed hospital with 17 gastrointestinal surgery beds (peripheral level); *Centre Hospitalier et Universitaire de zone de Calavi/Sô Ava*, a 116-bed hospital with 25 gastrointestinal surgery beds (peripheral level) and *Hôpital Bethesda*, a 110-bed hospital with 16 gastrointestinal surgery beds (peripheral level). Data were collected prospectively at each hospital over a four-month period (from 4th June to 4th August 2018 and from 10th December 2018 to 10th February 2019).

Data were routinely collected daily for Altemeier class 1 or 2 procedures, covering all shifts (24/7) by the principal investigator and a team of medical and pharmacy students from the FSS *d'Université d'Abomey Calavi, Benin*. The students were trained (25th May 2018) before starting observations and were supported throughout the data collection process by the research team. Data collection included direct observations in the operating theatre and data from patients' medical and anaesthetic records (Supplementary File S1).

Eligibility criteria

ABP was observed in patients aged 18 years and older, undergoing surgical interventions that were either "clean" according to Altemeier's classification (i.e. class 1: operations on the digestive tract or, in the absence of opening of the digestive tract, on the solid digestive organs), or "clean-contaminated" (i.e. class 2: operations on the digestive tract and/or, if the tract is open, on the solid digestive organs) [10]. In patients transferred from another hospital, eligibility started only after 48 hours to make sure the patient was not previously contaminated.

Exclusion criteria included diagnosis with a bacterial infection before the intervention, presence of burns, grafts or immunodeficiency and admission for a new intervention on the same surgical site, unless more than 30 days had elapsed between the two interventions. Patients who had an infection and/or were on antibiotics for other reasons before surgery were also excluded.

To assess compliance, in the absence of a local reference in the country, we chose three international guidelines: the 2017 guidelines of the French Society of Anaesthesia and Intensive Care Medicine (SFAR) [10] (in Benin, practitioners often refer to French standards), the 2016–2017 WHO guidelines [11,12] and the 2013 American Society of Health-System Pharmacists (ASHP) guidelines (the directive produced jointly by ASHP, the Infectious Diseases Society of America (IDSA), the Surgical Infection Society (SIS) and the Society for Healthcare Epidemiology of America (SHEA) (referred to below as ASHP)) (Supplementary Table S1) [13]. For practical reasons, given that ABP only administered once, multiple surgical interventions during the same procedure were considered as a single intervention and the gastrointestinal intervention was taken into account for the analysis.

Outcomes

Main outcome

The main outcome of this study was the overall compliance of SAP with the three guidelines: WHO, ASHP and SFAR.

Secondary outcomes

Secondary outcomes were compliance with the indication and administration modalities (drug choice, drug dose, timing, and duration of ABP), overall and by hospital. First, we determined the compliance for indications for ABP. Next, for those who were compliant with the indication, we determined compliance with each modality of antibiotic administration, namely: choice of the right drug according to the procedure, the dose of the chosen drug, timing of administration and duration of the ABP. Overall compliance was derived from compliance with all the criteria (Supplementary Figure).

Independent variables

The characteristics of a surgical intervention used were Altemeier class, intervention type (urgent: intervention carried out following diagnosis without further scheduling; or elective: intervention scheduled in advance), nature of intervention (name of intervention), duration of surgery and length of hospitalization. Independent variables were sociodemographic characteristics (sex and age), patient's medical history (C-reactive protein, surgical history, diabetes, cardiovascular disease, liver disease, other past medical history). These were used to investigate factors associated with non-compliance with ABP.

Statistical analysis

The data were analysed using Statistical Package for the Social Sciences (SPSS) software version 26.0. Quantitative variables were expressed as median, 25th percentile, 75th percentile and range. Qualitative variables were expressed as raw numbers and percentages.

Results

Socio-demographic characteristics of study participants and characteristics of interventions

A total of 68 surgical interventions were observed. The median age of the patient population was 36.0 years with a range from 18 to 82 years. There were more men (n=36; 52.9%) than women (n=32; 47.1%). The distribution of patients per hospital is shown in Table I.

According to Altemeier's classification, 33 (48.5%) surgical procedures were clean, and 35 (51.5%) were clean-contaminated surgery. Appendectomy was the most common surgical procedure in this study with 32 (47.1%) procedures, followed by herniorrhaphy (abdominal hernia repair, other

Table I

Description of patient characteristics per hospital

Patient demographics	Hospital					
	1	2	3	4	5	Total
Patients included n(%)	16 (23.5)	14 (20.6)	15 (22.1)	17 (25.0)	6 (8.8)	68 (100)
Age (median years) [P_{25}; P_{75}]	35.5[26.5–48.0]	50[31.5–65.3]	30[25.0–40.0]	40[32.0–52.0]	35.5[28.3–43.0]	36.0[28.0–51.8]
Sex n(%)						
Male	6 (37.5)	10 (71.4)	6 (40)	10 (58.8)	4 (66.7)	36 (52.9)
Female	10 (62.5)	4 (28.6)	9 (60)	7 (41.2)	2 (33.3)	32 (47.1)
Medical and surgical history n(%)	1 (1.5)	8 (11.8)	7 (10.3)	3 (4.4)	2 (2.9)	21 (30.9)
Cardiovascular disease n(%)	0 (0.0)	5 (35.7)	1 (6.7)	1 (5.9)	1 (16.7)	8 (11.8)
Other medical history n(%)	1 (6.3)	7 (50.0)	6 (40.0)	2 (11.8)	1 (16.7)	17 (25)
Indication for surgery n(%)						
Appendectomy	9 (56.3)	1 (7.1)	10 (66.7)	8 (47.1)	4 (66.7)	32 (47.1)
Hernioplasty	0 (0.0)	7 (50)	0 (0.0)	0 (0.0)	0 (0.0)	7 (10.3)
Herniorrhaphy	7 (43.8)	4 (28.6)	5 (33.3)	8 (47.1)	2 (33.3)	26 (38.2)
Other procedures	0 (0.0)	2 (14.3)	0 (0.0)	1 (5.9)	0 (0.0)	3 (4.4)

Items included in other medical and surgical history: allergies, appendectomy, Caesarean section, extrauterine pregnancy, hernia, asthma, epigastric burn, ulcers, tuberculosis, cyst and sinusitis.
Other procedures include cholecystectomy.

hernia repair without prosthetic plate) with 26 (38.2%). The majority of herniorrhaphies were elective procedures and most appendectomies were urgent interventions.

Antibiotic prophylaxis: compliance with the guidelines

In the 68 procedures observed, overall (complete) compliance occurred in zero (0.0%), one case (1.5%) and two cases (2.9%) based on WHO, ASHP, and SFAR guidance, respectively. The number of compliant indications were: WHO; 65 cases (95.6%), ASHP; 65 cases (95.6%) and SFAR; 47 cases (69.11%). Compliant indications are detailed in Table II. In two cases, ABP was not indicated according to SFAR and was also not prescribed.

In the cases where there was compliance with indications for ABP, the drugs chosen were compliant in two (2.9%), two (2.9%) and three (4.4%) cases with WHO, ASHP and SFAR, respectively. We observed 10 different antibiotic regimens. The drugs most used were ceftriaxone (C3G), and amoxicillin + clavulanic acid in 21 (32.3%) cases. Other regimens are shown in Table III.

The initial dose of antibiotic given to the patients was compliant in 49 (72.0%) and 20 (29.4%) cases according to ASHP and SFAR, respectively (Table II). In 88 antibiotic administrations, there were 18 (20.45%) cases of under-dosing according to ASHP and 37 (42.0%) according to SFAR; one case was not taken into consideration because the dose was based on weight, which had not been documented in the subject. Under "Following the guidelines" recommendations for additional administration of ABP during long interventions (over two half-lives), a repeat dose of the antibiotic was required during the procedure in nine (13.2%) cases, and this was not given.

The timing of ABP was correct according to WHO: 47 (69.1%), ASHP: 45 (66.2%) and SFAR: 9 (13.2%) cases. The duration of ABP was correct for 13 (19.1%), 17 (25.0%) and 16 (23.5%) cases, according to WHO, ASHP and SFAR, respectively (Table II).

The distribution of variables according to non-compliance is presented for each guideline in "Supplementary Table S2; Table S3; Table S4".

Discussion

Overall compliance with the five conventional criteria for ABP was low, ranging from 0 to 2.9% (n=2/68) according to the guidelines used as reference. Mbuyamba *et al.* reported an overall compliance rate of 0% in their study [14]. In the study by Bunduki *et al.*, ABP was non-compliant in 90.9% of those with a SSI [15]. It is essential to prevent SSI by developing appropriate measures. Carshon-Marsh *et al.* noted in their study that improved infection prevention and control (IPC) measures probably led to a low rate of SSI (6.7%) and better compliance of ABP with WHO guidelines (70% of herniorrhaphy) [16]. Our results are contrary to those of Nguyen *et al.* who reported an overall compliance rate with ABP of 54.7% [17]. The compliance rate of indications for SAP was high: 65 (95.6%) for WHO, 65 (95.6%) for ASHP and 47 (69.11%) for SFAR. The difference between guidelines can be explained by the fact that SFAR recommends ABP for hernia repairs with a prosthesis and advises against it for repairs without a prosthesis, whilst this is not the case for WHO and ASHP. Harbi *et al.* in Tunisia, reported a compliance rate of 74% in their study conducted in general surgery, orthopaedics and urology [18]. Malavaud *et al.*, in 2008

Table II
Rate of compliance according to nature of the intervention

Criteria	Compliance n (%)																	
Guidelines	Indication			Antibiotic choice			Dosage			Timing			Duration			Overall compliance		
	WHO	ASHP	SFAR	WHO	ASHP	SFAR	WHO	ASHP	SFAR	WHO	ASHP	SFAR	WHO	ASHP	SFAR	WHO	ASHP	SFAR
Nature of intervention																		
Appendectomy (n=32)	32 (49.2)	32 (49.2)	32 (68.1)	0 (0.0)	0(0.0)	3 (100)	-	24 (49)	13 (65)	19 (40.4)	18 (40)	7 (77.8)	2 (15.4)	3 (17.6)	8 (50)	0 (0.0)	0 (0.0)	0 (0.0)
Herniorrhaphy (n=26)	23 (35.4)	23 (35.4)	5 (10.6)	0 (0.0)	0 (0.0)	0 (0.0)	-	18 (36.7)	0 (0.0)	19 (40.4)	18 (40)	1 (11.1)	8 (61.5)	10 (58.8)	2 (12.5)	0 (0.0)	0 (0.0)	2 (100)
Hernioplasty (n=7)	7 (10.8)	7 (10.8)	7 (14.9)	0 (0.0)	0 (0.0)	0 (0.0)	-	6 (12.2)	6 (30)	7 (14.9)	7 (15.6)	0 (0.0)	2 (15.4)	2 (11.8)	4 (25)	0 (0.0)	0 (0.0)	0 (0.0)
Other procedures (n=3)	3 (4.6)	3 (4.6)	3 (6.4)	2 (100)	2 (100)	0 (0.0)	-	1 (2)	1 (5)	2 (4.3)	2 (4.4)	1 (11.1)	1 (7.7)	2 (11.8)	2 (12.5)	0 (0.0)	1 (100)	0 (0.0)
Total (n=68)	65 (95.6)	65 (95.6)	47 (69.1)	2 (2.9)	2 (2.9)	3 (4.4)	-	49 (72.0)	20 (29.4)	47 (69.1)	45 (66.2)	9 (13.2)	13 (19.1)	17 (25.0)	16 (23.5)	0 (0.0)	1 (1.5)	2 (2.9)

Table III
Antibiotics used for prophylaxis (n=65)

Drug (antibiotic prophylaxis scheme) (n=65)	n (%)
Ceftriaxone	21 (32.3)
Amoxicillin + clavulanic acid	21 (32.3)
Ceftriaxone + metronidazole	9 (13.8)
Amoxicillin + clavulanic acid + metronidazole	5 (7.7)
Ceftriaxone + gentamicin	2 (3.1)
Ceftriaxone + metronidazole + ciprofloxacin	2 (3.1)
Ciprofloxacin	2 (3.1)
Ceftriaxone + ciprofloxacin	1 (1.5)
Amoxicillin + clavulanic acid + metronidazole + gentamicin	1 (1.5)
Ampicillin	1 (1.5)
Total	65 (100)

reported an 85% compliance rate with indication in gastrointestinal surgery in Franc.e [19] In Benin, in the specific case of Caesarean Section, Dohou *et al*. reported in 2016 a rate of 99.3% of compliance with indication [9]. The high rates of compliance with indication observed in this study and others might be due to the fear of infection at the operation site, which is known to result in morbidity and mortality and poorer economic outcomes.

The least respected criterion in this study was the choice of antibiotics. Our results are in line with those of Mbuyamba *et al.*, where compliance was 0.31% for the choice of antimicrobial [14]. One of the possible explanations for this is that around half of the recommended antibiotics were absent from the Beninese market, such as cefoxitin (C2G), cefazolin (C2G), cefamandole (C2G) and clindamycin. Our results are similar to those of other authors, who probably link the high use of ceftriaxone to the absence of first- and C2G [20]. This may lead practitioners to use drugs that are accessible: cefuroxime (C2G), gentamicin, metronidazole, aminopenicillin + beta-lactamase inhibitor. Cefuroxime, although recommended and available, was rarely used for ABP. Similarly to a study carried out in Italy, concerning general surgery, massive use of C3G has been reported [21]. We had 9 patients receiving ceftriaxone and metronidazole, a pragmatic combination to cover Enterobactacteriacae and anaerobes in the absence of other drugs on the market.Ceftriaxone is found at a very affordable price on the Beninese market. Indeed, the price of ceftriaxone 1g varies from 445 FCFA (0.75 USD) to 7,530 FCFA (12.67 USD). The price of amoxicillin and clavulanic acid 1g varies from 1,855 FCFA (3.12 USD) to 7,300 FCFA (12.28 USD), while cefuroxime costs 4,553 FCFA (7.66 USD). It would be hugely beneficial if all the medicines recommended on the national list of essential medicines were available. Similarly, Alemkere *et al*. reported excessive and inappropriate use of ceftriaxone for SAP in their study on ABP in gynaecology and obstetrics, general surgery and orthopaedics [22]. In a study in Ethiopia, ceftriaxone was the antibiotic most commonly used (70.50%) for ABP, followed by the combination of ceftriaxone and metronidazole (21.90%) [20]. Harbi *et al*. also reported in their study that the main non-compliances concerned the prescription of antibiotics with a broader spectrum than those recommended. This resulted in greater financial expenditure and a risk of bacterial resistance occurring [18]. Some authors hypothesise the occurrence of surgical site infection due to the inappropriate use of ABP such as ceftriaxone [20]. The initial dose of antibiotic administered complied with ASHP and SFAR recommendations in 49 (72.0%) and 20 (29.4%) cases respectively. This compliance is very low compared with the results of Fall *et al*. [23] They reported a rate of compliance of 86% in three Dakar university hospitals [23]. According to the study by Dohou *et al.*, the level of knowledge among healthcare professionals about antibiotic dosage is low [24]. Knowing that patients have to pay for their own antibiotics, our hypothesis is that their ability to purchase prescribed drugs would be a major influencing factor.

The same factor could influence the poor timing of prophylaxis administration (i.e. appropriate at best in 69.1% of the cases). In addition, the emergency context could explain the non-compliance of the timing in some cases. The rate of compliance with timing was very low (13.2%) according to SFAR compared with the results in the literature. Simon *et al*. reported 57.1% consistency for compliance with timing of the first dose of ABP within 30–90 minutes of skin incision in gastrointestinal surgery [25]. Muller *et al*. reported 34.1% antibiotic injection 30–60 minutes before incision versus 65.1% 15–30 minutes before incision in gastrointestinal surgery. In contrast, reinjection was incorrect in almost 70% of cases [26]. The variability of the guidelines may accentuate this difference.

The duration of ABP was correct in 13 (19.1%), 17 (25.0%) and 16 (23.5%) cases out of 68, based on WHO, ASHP and SFAR, respectively. Fall *et al*. also noticed a prolongation of ABP duration beyond 48 hours (58%) in Dakar hospitals [23]. Patil *et al*. noted in their study that only 14 out of 140 patients received antibiotics within 24 hours [27]. This is inconsistent with the results of the European hospital survey, which reported that more than half of the patients operated on had received antibiotics for more than 24 hours after the end of the operation [28]. Moreover, Hosoglu *et al*. found that in Turkey 80.4% of prescriptions exceed five days [29]. Furthermore, of the procedures for which ABP was compliant for both indication and duration, 10 (14.7%) according to WHO and ASHP and 11 (16.2%) according to SFAR guidelines had given postoperative antibiotic therapy to patients. The regimen was either the same or different from that used for SAP. Similarly, Patil *et al*. concluded that the fear of SSI often leads to overuse of antibiotics postoperatively, resulting in an economic burden for the patient, and contribution to selection of resistant bacterial strains [27]. Karaali *et al*. in their study, noted the doctor's fear of an infectious complication in the absence of a postoperative antibiotic was a frequent reason for maintaining ABP for more than 24 hours [30]. Some authors have reported significant use of antibiotics postoperatively despite preoperative administration (caesarean section: 69.6%; herniorrhaphy: 70.7%) [16].

Lack of ownership of guidelines in general could explain these findings. The absence of local guidelines has been highlighted previously as a likely cause of non-compliance with ABP practices [15]. Our results highlight the urgent need to establish a local protocol based on knowledge of bacterial ecology and access to antibiotics, to improve patient management. In Benin, there are local hospital Nosocomial Infection Control Committees (NICCs) that oversee the development of policy on the supply and use of antibacterials and could help to disseminate guidance, monitoring and education through training. However, with little local evidence about bacterial ecology, the NICCs struggle to establish protocols. The lack of information and training of healthcare staff could explain the above findings. The information provided by pharmaceutical companies is often used. This highlights the need for dynamic IPC, with resources to drive and support training.

A state-supported implementation programme should be implemented to improve SAP. Liu *et al.* showed the positive impact of an antibiotic stewardship programme on prevention and control of SSI during clean surgery [31]. At the end of their study, Aiken *et al.* emphasise that the implementation of a local policy on ABP for surgery is feasible in low-income countries [32] The MUST-PIC project, through its contribution to the determination of the bacteriological profile of pathogens involved in SSI, can contribute towards supporting this programme.

This prospective observational study has some limitations. First, the "Hawthorne" effect may have an impact on participants' behaviour. However, the duration of observation was long, so healthcare workers could return to their usual behaviour. In addition, there is an absence of local guidelines and thereforeas no baseline for the study. Secondly, our evaluation is a strict application of guidelines, not considering the availability of the drugs on the Beninese market. Therefore, non-compliance with the choice of antibiotic does not necessarily mean inappropriate coverage to prevent SSI but often inappropriate in terms of antimicrobial resistance development risk. Third, various factors may explain the small sample observed. Patients often seek self-care, including self-medication without adequate medical advice. As a result, there has been an evolution of pathologies whose management no longer allows them to be classified in Altemeier classes 1 and 2, but in higher classes, which are therefore excluded from the study. Classes 1 and 2 are therefore rarer than in high income countries. Acute appendicitis has been identified as one of the main aetiologies of peritonitis in the tropics (complicated evolution of acute appendicitis), while biliary and pancreatic pathologies are rare. Delayed management due to diagnostic error or the use of traditional medication for these cases of peritonitis means that patients present too late, with catastrophic consequences [33]. Furthermore, in Africa, there are three types of delays in access to care. Delay in the decisions to seek healthcare, delay in access to healthcare services and delay in the providing of quality care [34]. One strength was that information was collected prospectively and in most cases by well-trained students, which ensured data reliability. Data were collected systematically, covering all shifts (24/7).

Conclusion

The compliance rate for ABP according to standard criteria in gastrointestinal surgery departments was very low. Although the Beninese market does not offer most first-choice antibiotics mentioned in international guidelines, there are significant differences between practices and recommendations. Healthcare administrations and other authorities involved should therefore work to improve the availability of antibiotics and compliance with SAP. It will also be necessary to set up an appropriate ABP policy based on local bacterial epidemiology.

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Conflicts of interest statement

None.

Conflict of ethics

None.

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Authors' contributions

Dessièdé Ariane FIOGBE: Conceptualization, design of methodology, Formal analysis, Investigation, supervision of observation team, Data Curation, Writing - Original Draft. Angèle Modupè DOHOU: Conceptualization, design of methodology, Funding acquisition, supervision of observation team, revising the manuscript. Carine Laurence YEHOUENOU: Conceptualization, design of methodology, supervision of observation team, Revising the manuscript. Séverine HENRARD: Conceptualization, Supervision, Formal analysis, statistical analysis, Revising the manuscript. Françoise VAN BAMBEKE Conceptualization, Supervision, Project administration, Funding acquisition, Revising the manuscript. Francis Moïse Djidénou DOSSOU: Conceptualization, Supervision, Project administration, Funding acquisition, Revising the manuscript. Olivia DALLEUR: Conceptualization, design of methodology, Supervision, Project administration, Funding acquisition, Revising the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.infpip.2024.100405.

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