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Targeted Pharmaceutical Analysis of Antibiotic Use by Risk Criteria in Patients Hospitalized in the Infectious and Tropical Diseases Department at Treichville Teaching Hospital (Abidjan, Côte d'Ivoire)

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Most pharmacotherapeutic problems in hospitals are caused by anti-infectives. Audit of prescriptions by a clinical pharmacist is a control and prevention element for iatrogenic risks. The main aim of our study was to assess the use of antibiotics according to risk criteria in patients hospitalized in the infectious diseases Unit of the Treichville Teaching Hospital (Abidjan, Ivory Coast). This cross-sectional descriptive study conducted from August to December 2022 in the Infectious and Tropical Diseases department of the Treichville University Hospital aimed to analyze the use of antibiotics in patients with risk criteria. The tools for detecting pharmacotherapeutic problems allowed us to evaluate the frequency and nature of pharmaceutical interventions, highlighting the role of the pharmacist in patient management. Data were analyzed using SPSS version 20.0 software (IBM, USA). A total of 88 patients were included in the study, with a majority of singles (54.5%) and a predominance of subjects under 45 years of age (87.6%) and HIV-positive (93.2%). Antibiotics were the most frequent treatment (75.1%), followed by beta-lactams (36.7%). The main drug interactions were precautions for use (53.6%) and contraindicated associations (45.6%), especially the combination of Ofloxacin with bivalent cations or didanosine. The main pharmaceutical interventions proposed were monitoring of biological parameters in at-risk patients (68.8%) and drug substitution (14.8%). All proposed pharmaceutical interventions were accepted by prescribers. Risk criteria associated with the use of antibiotics were significantly associated with the nature of proposed pharmaceutical interventions. In conclusion, the use of antibiotics in patients with risk criteria is common in the Infectious and Tropical Diseases department of the Treichville University Hospital. The results emphasize the importance of prescription audit by a clinical pharmacist in detecting pharmacotherapeutic problems and preventing iatrogenic risks. The proposed pharmaceutical interventions were accepted by prescribers and were tailored to the risk criteria associated with the use of antibiotics.

Keywords: Anti-Infectives; Abidjan; Infectious; Pharmaceutical Interventions; Risk Criteria; Treichville; Tropical Diseases Unit.

Most medication-related problems in hospitals are caused by anti-infectives[1]. Inappropriate use of these drugs can lead to resistance and higher hospitalization costs[2-4]. Therefore, pharmacoresistance is a real public health problem, especially since pharmaceutical innovation in infectious diseases is not very active[5]. Indeed, many studies have demonstrated a significant association between irrational antibiotic use and resistance rates[5]. Pharmaceutical interventions (PI) are therefore essential to promote optimal antibiotic use[6]. However, simply following recommendations is not enough to make antibiotic prescribing adequate. The audit of prescriptions by a clinical pharmacist is an element of control and prevention of iatrogenic risks[7]. Indeed, PI reduce drug-related problems by 37.4% through control of drug effectiveness and monitoring[8], promotion of treatment efficacy[9], and improvement of desired health outcomes[10-12].

In Côte d'Ivoire, data has revealed several pharmacotherapeutic problems. Thus, the problem of "non-optimal dosing" (88.9%) was the main problem encountered in this study, followed by underdosing (3.2%) and abnormally shortened treatment duration (7.9%)[13]. Antibiotics are responsible for 24% of the increase in the incidence of adverse events, making them high-risk drugs[14]. High-risk drugs are products with a high risk of causing serious harm to patients in the event of errors during their use in the drug circuit, according to the Institute for Safe Medications Practices (ISMP)[15].

While several interventional studies have evaluated the quality of antibiotic prescribing, very few studies have critically analyzed prescriptions in high-risk patients, taking into account personal physiopathological contraindications and drug interactions. Our study aimed to assess the utilization of antibiotics in hospitalized patients at the infectious diseases department of CHU Treichville (Abidjan, Côte d'Ivoire) based on risk criteria.

METHODS

Type and setting of the study: This was a descriptive cross-sectional study conducted from August to December 2022 at the Infectious and Tropical Diseases Department of Treichville Teaching Hospital (TTH) in Abidjan.

Study population: This study included patients on antibiotics with risk criteria, either due to drug interactions (drug-related criteria) or due to altered clinical and biological status (clinicobiological criteria) not justifying the use of antibiotics.

Inclusion criteria

The study included adult patients of both sexes on antibiotics with risk criteria in terms of precautions, contraindications.

Exclusion criteria

The study excluded patients on antibiotics who did not meet the above criteria and patients with incomplete medical records.

Data collection tools

A questionnaire addressed to patients was used. It included three parts:

• A section on general patient information and their biological data;

• A section on patient clinicobiological and therapeutic data;

• A section on the risk criteria for antibiotic use.

Detailed information on pharmaceutical interventions performed, including information on patients, medications, identified problems, and proposed interventions. The study used this dashboard to assess the frequency and nature of pharmaceutical interventions in a clinical environment, thus enabling a better understanding of the pharmacist's role in the therapeutic management of patients.

Pharmaceutical intervention coding tool

In France, following the observation of the absence of standardization and therefore the difficulty of pooling data, a tool for collecting and classifying pharmaceutical interventions was developed by the The French Society of Pharmacy's working group on standardization and enhancement of clinical pharmacy practices.

Study porotocol and Design (Figure 1)

Definition and analysis of risk criteria in patients

The optimization of a targeted drug risk analysis approach[21] allowed us to describe risk criteria. These are a set of factors that could compromise therapeutic success and also alter a patient's vital functions. In the context of our study, we adapted the model of the approach to identify situations of medication-induced risk.

Detection of pharmacotherapeutic problems (PP) and pharmaceutical interventions

Avowed or potential pharmacotherapeutic problems (PP) were classified according to criteria published by French Society of clinical Pharmacy[22]: drug interactions, subtherapeutic doses, high doses, drugs used without indications, untreated indications, inappropriate drug selection, and adverse effects. Adherence and observance problems were not addressed in this study. The clinical relevance of pharmaceutical interventions was initially described by several authors[23-24].

Assessing of the pertinence of Pharmaceutical Interventions

The relevance of pharmaceutical interventions was evaluated based on the acceptance rate by physicians and the evaluation of their clinical impact. The clinical impact of the interventions was interpreted using a score based on a particular rating system[25, 26]. Each pharmaceutical intervention was scored based on the principle that the potential clinical impact of the patient problem (PP) was linked to the severity of clinical consequences that could be avoided by the

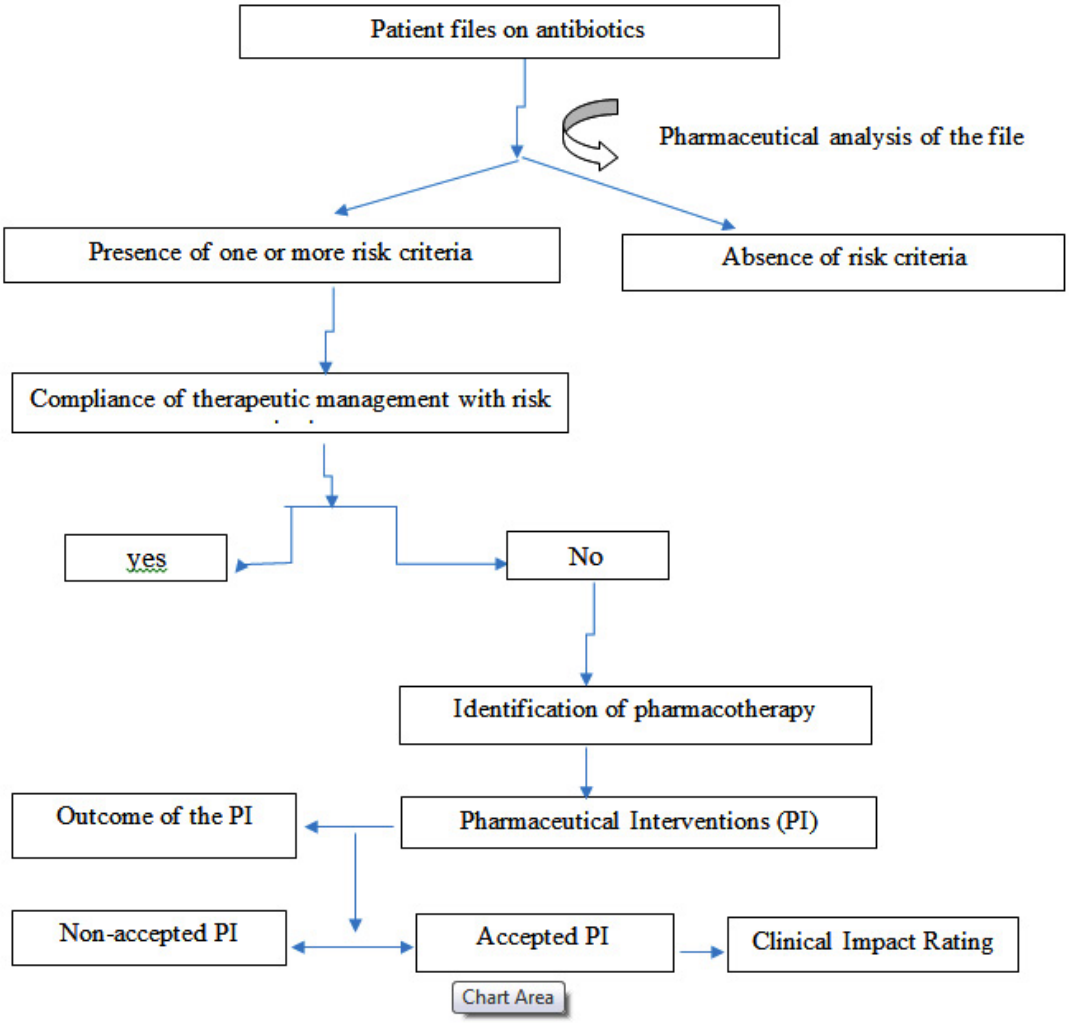

Figure 1 : Description of the study protocol

Fig. 1. Description of the study protocol

intervention. The table below (Table 1) provides a description of the rating scale that was utilized.

Statistical analysis of the data

The SPSS version 20.0 software (IBM, USA) was used to analyzed the data. Mean values were considered for quantitative variables, percentages and frequencies for qualitative variables. The significance threshold for tests was 5%.

RESULTS AND DISCUSSION

There was an overall involvement of 88 patients. The sex ratio (M/F) was 0.78. Singles accounted for 54.5% of the sample. Subjects aged d"45 years were the most common at 87.6%. 93.2% were HIV-positive. (Table 2)

The most common reason for hospitalization was fever (26%), followed by general deterioration of health (21.3%). Sepsis was the main infectious location (32.6%), followed by digestive location with 20.2%., Anti-infectives (75.1%) were the most prescribed medications. Antibiotics (56.5%) were the most commonly prescribed type of anti-infectives. Prescription analysis showed that rifampicin (9.14%) was the most commonly prescribed drug in combination with antibiotics, followed by Tenofovir disoproxil fumarate (4.43%). (Table 3a and 3b))

Beta-lactams (36.7%) were the most commonly prescribed class of antibiotics. Ceftriaxone (23.0%), gentamicin (8.8%), and cotrimoxazole (6.9%) were the most frequently administered molecules (Table 4)

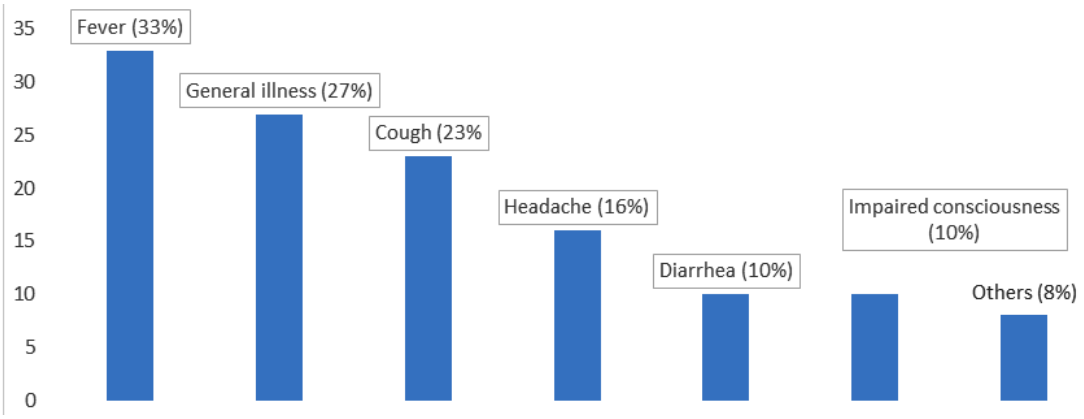

Fig. 2. Distribution of patients by reason for consultation (Others : nausea,vomiting …)

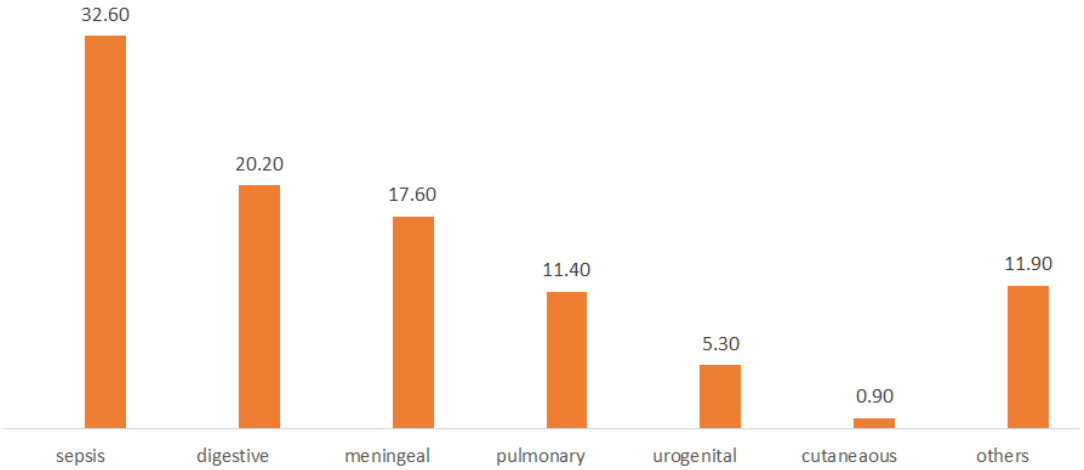

Fig. 3. Location of the infectious focus
Others : Oropharyngial, Eyes infectious

The analysis of the main risk criteria showed that 61.9% of these criteria were related to drug interactions and 38.1% related to the patients' clinico-biological data. Precautions for use (53.6%) represented the bulk of drug interactions, followed by inadvisable combinations (45.6%). The precautions for use were essentially the association of Ofloxacin and bivalent cations or didanosine (Antiretroviral). The inadvisable associations were essentially combinations of two nephrotoxic drugs (Lamivudine and Pyrimethamine) (Table 5)

Regarding the criteria related to clinico-biological data, the absence of information on renal clearance represented 36, 4% of cases followed by anemia with a Hb level <7.5g/dl (18.2%) (Table 6).

The pharmacotherapeutic problems were mainly drug interactions (61.9%), followed by the monitoring to be followed (19.3%). The proposal to monitor biological parameters of patients at risk (68.8%), was the main pharmaceutical intervention, followed by the proposal (21.3%) and among them, the proposal of substitution was the most important (14.8%) (Table 7).

All proposed pharmaceutical interventions were accepted by prescribers. IP1-rated pharmaceutical interventions (64.5%) were the most important, followed by PI_2 (31,8%) (Table 8).

The nature of pharmaceutical interventions differed significantly according to the risk criteria associated with the use of antibiotics (p=0.001). Proposals for monitoring biological parameters were mainly related to clinical and biological data (Table IX).

DISCUSSION

General characteristics of patients

Out of 239 patient records analyzed, 88 (36.82%) presented risk criteria related to the use of antibiotics. In Zahar et al.'s study, out of 105 prescriptions, 35% were inadequate according to the criteria used[27]. Asseray et al. found an inadequacy rate of 37% by not including reassessment criteria[28]. Gennai et al. calculated a compliance rate of 34% taking into account the choice of molecule and the mode of administration[29]. Therefore, it appears that regardless of the evaluation criteria chosen, there are still non-conformities in the prescription of antibiotics in healthcare services.

Sepsis (32.6%) were the most encountered in our study. They are vastly different from the infectious locations of other studies. Indeed, Gennai et al.[29] found 25.6% of urinary infections, while other studies revealed a predominance of infections in their urinary and pulmonary locations[30-33]. Sepsis indicates that infectious management is delayed in our contexts. HIV infections and their corollaries of opportunistic infections may explain the high

Table 1. Rating Scale for Interventions Derived from Hatoum

Rating	Clinical significance
PI_0	IP without direct clinical impactIntervention either for financial or informational purposes, or proposed after the event.
IP_1	IP with significant clinical impact Intervention that increases the effectiveness and/or safety and/or quality of life of the patient.
PI_2	IP with very significant clinical impactIntervention that prevents organic dysfunction, avoids intense medical surveillance, or irreversible sequelae.
PI_3	IP with vital clinical impactIntervention that prevents a potentially fatal accident

Table 2. General characteristics of patients (n=88)

Characteristics		N(%)
Sexe	Female	49(56.2)
	Male	39(43.8)
Age (years)	≤ 45	76(87.6)
	>45	12(10.4)
	Mean [SD]	40.42 [12.4]
Jobs	Yes	45(51.1)
	No	43(48.9)
Marital status.	Umarried	48(54.6)
	Married	39(45.3)
	Widowed	1(1.1)
HIV serological status	Négative	6(6.8)
	Positve	82(93.2)
	Total	88(100)

Table 3a. ATC Classification of Prescribed Medications

Classification	Level 1 / International Nonproprietary Name	N(%)
A: Digestive System and Metabolism	Attapulgite	2(0.55)
	Allopurinol	1(0.28)
	Esomeprazole	1(0.28)
	Multivitamin complexes	1(0.28)
	Levosulpiride	3(0.83)
	Omeprazole	2(0.55)
	Aluminum phosphate	5(1.39)
	Sucralfate	2(0.55)
	Tolbutamide	2(0.55)
	Sous-Total	19(5.3)
B : Blood/Hematopoietic Organs	Acenocoumarol	7(1.94)
	Iron salt	2(0.55)
	Fluindione	2(0.55)
	Sub-Total	11(3.0)
C : Cardiovascular SystemAmiodarone	Amiodarone	1(0.28)
	Acetylsalicylic acid	6(1.66)
	Amlodipine	1(0.28)
	Furosemide	8(2.22)
	Hydrochlorothiazide	1(0.28)
	Périndopril	3(0.83)
	Rosuvastatin	1(0.28)
	Sub-Total	21(5.8)

Table 3b. ATC Classification of Prescribed Medications

Classification	Level 1 / International Nonproprietary Name	N(%)
J: Anti-infectives	Antibiotics	204(56.5)
	Artesunate+Lumefantrine	1(0.3)
	Didanosine	1(0.3)
	Fluconazole	11(3.0)
	Itraconazole	2(0.5)
	Lamivudine	4(1.1)
	Miconazole	8(2.2)
	Flucystosine	1(0.3)
	Rifampicine	33(9.1)
	Tenofovir	16(4.4)
	Valganciclovir	5(1.4)
	Sub -total	286(75.1)
N : System nerveux	Acide valproïc	3(0.8)
	Bromocriptine	1(0,3)
	Lopéramide	6(1,6)
	Phenytoïn	3(0.8)
	Ergotamine	1(0.3)
	Tramadol	3(0.8)
	Sub-total	17(4.7)
H : Systemic Hormones	Prednisone	7(1.9)
	Sous-total	7(1.9)
	Total	361(100)

Table 4. Distribution of Prescribed Antibiotics

	International Nonproprietary Name	N(%)	
Beta-lactams	Ceftriaxone	47(23.0)	75(367)
	Amoxicilline/ Clavulanic Acid	13(6.4)	
	Imipenem	13(6.4)	
	Cefixime	1(0.50)	
	Penicillin G	1(0.50)	
Sulfonamides and antifolates	Sulfadiazine	10(4.9)	41(20.1)
	Cotrimoxazole	14(6.9)	
	Pyriméthamine	7(3.4)	
Aminosides	Gentamicin	18(8.8)	22(10.8)
	Netromycin	2(1.0)	
	Amikacin	2(1.0)	
Macrolides and related	Clarithromycin	3(1.5)	22(10,8)
	Spiramycin	1(0.50)	
	Erythromycin	2(1.0)	
	Clindamycin	6(2.9)	
	Rovamycin	12(5.9)	
Quinolones	Ofloxacin	12(5.9)	22(10.8)
	Pefloxacin	9(54.4)	
	Ciprofloxacin	1(0.5)	
Nitrofurane	Nitrofurantoin	7(3.4)	11(5.4)
	Nifuroxazide	4(2.0)	
Glycopeptides	Vancomycin	8(3.9)	8(3.9)
Imidazolés	Metronidazole	3(1.5)	3(1.5)
	Total	204(100)	

prevalence of sepsis. However, in Abrogoua et al.'s study, pleuropulmonary pathologies and meningitis were the most frequent in a Pediatrics service[13]. Their results are closer to the results of Gennai et al.[29] by the quality of the described elements.

The most prescribed pharmacotherapeutic class in combination with antibiotics is the class of anti-infectives (75.1%). This is due to the high prevalence of infectious diseases other than HIV (Tuberculosis, toxoplasmosis, etc.), but also due to the medical specification of this service, which only receives patients with infectious diseases. Indeed, studies on the distribution of drugs in several services other than infectious diseases showed mostly prescriptions of drugs from the cardiovascular, central nervous, and digestive systems[34,35].

The most prescribed families of antibiotics were beta-lactams (36.7%), sulfonamides (20.1%), quinolones (10.8%), and macrolides (10.8%). Besides their efficacy on sensitive germs, beta-lactams are certainly the most prescribed because of their affordable cost and, above all, their relatively good tolerance. Integrating a pharmacist into a clinical unit could also reduce the cost of antibiotic therapy[36].

The most frequently found pharmacotherapeutic classes corresponded to those identified in the literature as being the most involved in drug iatrogenesis[37-38]. In several studies on the evaluation of antibiotic prescription, penicillins, associated or not with a beta-lactamase inhibitor, were the most prescribed, followed by fluoroquinolones and third-generation cephalosporins[38-42]. The high frequency of the use of C3G, particularly ceftriaxone, is due to its therapeutic malleability and synergy with other antibiotics (aminoglycosides)[43].

Ceftriaxone is frequently used as an antibiotic because of its potent antimicrobial activity, broad range of effectiveness, and minimal risk of toxicity. It is prescribed to manage various bacterial infections such as pneumonia, bone infections, and abdominal infections. The

Table 5. Risk criteria

	Risk criteria	Description	N(%)	
Drugs Interactions	Contraindication	Ergotamine derivatives (Ergotamine and Erythromycin) The combination of macrolides with ergotamine leads to a risk of ergotism with necrosis of the extremities	1(0.8)	125(61,9)
	Taken into Account	Bromocriptine/Rovamycin; increases serum bromocriptine levels resulting in increased antiparkinsonian activity Drug interaction Fluconazole and ofloxacin decreases plasma levels of ofloxacin	34(27,2)	
	Discouraged association	Combination of two nephrotoxic drugs (Lamivudine and Pyrimethamine), Combination of two nephrotoxic drugs valganciclovir and imipenem, Rifampcin and ofloxacin without biological monitoring (Hydrochlorothiazide/Gentamicin)	23(18,4)	
	Employment precaution	Association Ofloxacine et cations divalents (Ca2+ Zn2+ Fe2+) diminution de l'efficacité de la ciprofloxacine par précipitation Association Ciprofloxacine et didanosine, diminution de l'efficacité de la ciprofloxacine par précipitation	67(53,6)	
Biological data	Clr not requested	Patients on nephrotoxic antibiotics (gentamicin, Vancomycin, Imipenem) without renal function monitoring	28(36,4)	77(38,1)
	Cl <30 ml/min	Contraindication renal insufficiency and administration of Ceftazidime associated with gentamycin.	12(8,4)	
	Clr [30-60] ml/mn	Contraindication renal insufficiency and administration of Imipenem, Vancomycin.	3(3,9)	
	Hb < 7,5 g/dl	Contraindication: in a patient with anemia taking sulfonamides (cotrimoxazole, sulfadiazine...)	14(18,2)	
	INR not requested	Patients on oral anticoagulants (acenocoumarol, Fluindione) and taking ceftriaxone without monitoring for hemostasis disorders	8(10,4)	
	ALT> 160 IU	Contraindication hepatic insufficiency and administration Metronidazole, rifampicin, nitrofurantoin,	8(10,4)	
	PPN<750 cells/mm^3	Contraindication neutropenia with sulfonamides (sulfadiazine, Cotrimoxazole)	2(2,6)	
	Allergy to sulphonamides	Patients with a history of allergy to sulphonamides with sulphonamides intake	1(1.,3)	
	Allergy to penicillins	Patients with a history of drug-induced toxidermia when taking penicillins	1(1,3)	
	Total			202(100,0%)

Legends: Hb: Hemoglobin level: g/dL; Clr: Renal clearance; INR: International Normalization Ratio; ALAT: Alanine aminotransferase; PNN: Polynuclear neutrophil; IU: International Units.

Table 6. Identified drug therapy problems and pharmaceutical interventions

Pharmacotherapeutic problems		N(%)	
Drug interactions		125(61.9)	
Monitoring to be followed		39(19.3)	
Non-compliance with recommendations		22(10.9)	
Overdose		9(4.5)	
indication without treatment		7(3.5)	
Total		202 (100)	
Pharmaceutical Interventions			N(%)
Dosage adjustment			7(3.5)
Suggested therapeutic choice	Addition	11(5.4)	56(27.9)
	stop	2(0.9)	
	Substitution	30(14.8)	
Optimization of administration			13(6.4)
Proposed monitoring of biological			139(68.8)
Total			202(100)

Table 7. Acceptance rate and rating of pharmaceutical interventions

		N(%)
Acceptance rate		202(100)
Rating of pharmaceutical interventions (PI)	PI_0	8(3.7)
	PI_1	130(64.5)
	PI_2	62(31.8)
Total		202(100)

PI_0: No direct clinical impact; PI_1: Significant impact; PI_2: Very significant impact.

Table 8. Risk criteria and nature of pharmaceutical intervention

Natures of interventions	Risk criteria		Total	p
	Drugs interactions	Clinicobiological data		
Dosage adjustements	0(0.0)	7(9 .1)	7(3.5)	
Proposal of therapeutic choices N(%)	28(22.4)	15(18.2)	43(21.3)	
Optimization of adminsitration modalities N(%)	13(10.)	0(0)	13(6.4)	0. 001*
Proposal of monitoring of biological parameters (N%)	84(67.2)	55(71.4)	139(68.8)	
Total	125(100%)	77(100%)	202(100%)	

results are similar to those of Abrogoua et al., who showed that the most prescribed antibiotics were ceftriaxone (49%) and gentamicin (38%) in children aged zero to two years in a Pediatrics service in Côte d'Ivoire[13].

The compliance of these prescriptions with national recommendations reflects the efforts of SMIT clinicians in the appropriate use of antibiotics. Lemtiri-Florek et al also reported a change in antibiotic prescribing habits in favor of narrow-spectrum antibiotics after pharmaceutical interventions[36].

Data on risk criteria and pharmacotherapeutic problems

Regarding clinical-biological criteria, the most common lack of information encountered

was on renal function, with 36.4% of patients affected. Most of the patient-related risk criteria observed in our study were related to the absence of glomerular function control elements in medical records of patients taking potentially nephrotoxic drugs. Indeed, certain antibiotics (aminoglycosides and glycopeptides) are nephrotoxic, and monitoring of renal function is essential to avoid glomerular filtration rate impairment. According to Ryback et al, in a study showing the correlation between the use of nephrotoxic antibiotics and the occurrence of renal impairment, the risks increased with concurrent administration of either aminoglycosides or other nephrotoxic drugs, as well as in elderly subjects[44]. Significant links were observed between vancomycin concentration levels and the occurrence of adverse events. Therefore, pharmacological therapeutic monitoring (PTM) of vancomycin and gentamicin is necessary to reduce this risk[45]. In our context, PTM is not routinely performed, which is why renal function monitoring must be closely followed in at-risk patients and used as an alternative for better patient management.

The interpretation of all risk criteria allowed us to establish a correlation with pharmacotherapeutic problems. Drug interactions can be pharmacokinetic or pharmacodynamic, in addition to physicochemical interactions, and are responsible for the majority of drug-related adverse effects. Mechanisms take into account enzymatic metabolic activities and transporters enzymes[46-47].

Changes in drug concentration in bodily fluids and tissues are linked to pharmacokinetic drug interactions. Antacids, proton pump inhibitors, and histamine H2 antagonists can impact the absorption of drugs that dissolve based on pH levels, including certain oral cephalosporins. Moreover, in the gastrointestinal tract, antacids (such as calcium carbonate or magnesium oxide) can form complexes with antibacterial agents like tetracyclines or fluoroquinolones, obstructing their absorption[48-51]. Optimization of administration modalities such as spacing of doses is necessary.

The bioavailability of certain oral cephalosporin prodrugs, such as cefpodoxime proxetil, cefuroxime axetil, and ceftidorone pivoxil, is decreased. when co-administered with H2 blockers[48-51]. It has also been shown that concomitant use of antacids reduces exposure to cefaclor, cefdinir, cefpodoxime, and cefditoren by 20% to 40%[48-51] To avoid this interaction, it is advisable to separate the administration of these oral cephalosporins by at least 2 hours if it is not possible to avoid their simultaneous use with antacids or H2 blockers.

Macrolide interactions involve the CYP 450 enzyme complex. Their administration (erythromycin) with motility inhibitors can cause pseudomembranous colitis. The oral bioavailability of fluoroquinolones can be significantly reduced by cations[48-51]. Aminoglycoside treatment is commonly linked to significant adverse effects such as nephrotoxicity, ototoxicity, and neuromuscular blockade. Due to these toxicities, drug interactions involving these agents typically pose an additive or synergistic risk.

Several studies have reported an increased risk of nephrotoxicity in patients when aminoglycosides are co-administered with amphotericin B, cisplatin, cyclosporine, vancomycin, or indomethacin (in newborns with persistent ductus arteriosus)[52]. The mechanism behind this is believed to be direct or additive injury to the renal tubule. To avoid such adverse effects, patients undergoing aminoglycoside treatment should have their renal function closely monitored, and the dosage should be adjusted based on body weight, estimated creatinine clearance, or serum drug concentrations. Furthermore, caution must be exercised when combining aminoglycosides with known nephrotoxic drugs or avoided altogether[53-57].

Vancomycin is classified as a glycopeptide antibacterial agent. A significant drug interaction associated with vancomycin is the increased risk of nephrotoxicity when administered concomitantly with aminoglycoside antibiotics[56].

The liver is primarily responsible for the metabolism of sulfamethoxazole. Interactions between sulfamethoxazole and trimethoprim are due to various mechanisms such as inhibition of hepatic metabolism, reduction of renal tubular secretion, displacement of protein-binding sites, and additive pharmacodynamic activity[53-56].

Pharmacotherapeutic problems (PP) were mostly drug interactions (61.9%). The frequency of drug interactions varies from study to study. Thus, Poudel et al[58] found that 4.7% of hospitalized patients had a clinically significant interaction. The high prevalence of drug interactions in our

study is due to polymedication resulting from polymorbidity in the service or a high prevalence of HIV infection[59].

Type of pharmaceutical interventions

Surveillance of biological parameters (68.8%) was the main proposed pharmaceutical intervention, followed by therapeutic choices (21.3%), particularly substitutions (14.8%). Lemtiri-Florek et al found that substitutions were more important in an internal medicine service[36]. Gaillard et al reported that 50% of IPs concerned substitutions, 24% optimization of administration modalities, 11% dosage adaptation, and 4% therapeutic monitoring[60]. Pharmaceutical interventions vary from study to study and from service to service[60]. They depend on the clinicobiological profile of patients and the specificity of clinical services[60].

Acceptance rate and rating of pharmaceutical interventions (PI)

In our case, the acceptance rate of IPs was 100%. In the literature, acceptance rates vary from 50% to 98%[61]. Other authors found lower acceptance rates (40.9%) when suggestions for treatment optimization were written[60]. In scientific literature, isolated suggestions that were not accepted by doctors were related to a different evaluation of the clinical situation by the doctor or a lack of willingness to modify treatments for chronic diseases[60, 61].

Interventions were rated primarily PI1 in 64.5% of cases. PI2s were found in order of 31.8%. These results have a similar profile to those found in the study by Jenn et al, which showed that 63.3% of interventions had a significant impact (PI1) and 22.8% had a very significant impact (PI2)[62].

We have thus provided relevant pharmaceutical contributions to doctors. This once again shows that the association of pharmaceutical and medical skills is necessary for the proper care of patients. Thus, the presence of a pharmacist in the care unit increases the number of PIs as well as their acceptance rate[36].

Analysis of different pharmaceutical interventions based on risk criteria

The analysis between risk criteria and pharmaceutical interventions shows a significant difference (p=0.001). According to Lemtiri-Florek[36], the presence of a pharmacist in an infectious disease team, communication between a pharmacist and an infectiologist, and increased time dedicated to pharmaceutical validation of antibiotic prescriptions lead to more comprehensive monitoring of anti-infectives.

CONCLUSION

This study allowed us to evaluate the risk criteria and prescription of antibiotics within an infectious and tropical disease department. The analysis of the main risk criteria showed that 61.9% of these criteria were related to drug interactions and 38.1% to patients' clinical and biological data. Precautions for use (53.6%) represented the majority of drug interactions, followed by discouraged combinations (45.6%).

Pharmaceutical interventions on antibiotic prescriptions based on risk criteria will certainly contribute to improving patient care. In conclusion, collaboration between clinical pharmacists and infectiologists leads to multidisciplinary discussions and improved relevance of pharmaceutical interventions around priority areas in order to promote appropriate use of antibiotics.

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Conflict of Interest

The authors declare no conflict of interest

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