

Clinicopathologic Profile of Gastric Endoscopic Biopsies in Port Harcourt, Nigeria

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Abstract

Background: Histological diagnoses of endoscopic biopsies are keys to improved outcomes of patient management; hence endoscopy and histological evaluation of the associated specimens are agelong practices globally, but this practice is just evolving in Port Harcourt. **Aim:** To characterize the clinico-pathologic features of gastric endoscopic biopsies seen in Port Harcourt. **Methodology:** This is a retrospective study of gastric endoscopic biopsies seen in a private pathology referral practice in Port Harcourt between 1st January 2014 and 31st December 2018. The relevant clinical and demographic information were obtained from patients' laboratory request forms. The gastric biopsies were fixed in 10

Index terms— gastric biopsy, gastritis, helicobacter pylori, chronic atrophic gastritis (CAG), dyspepsia.

I. introduction ommon gastric lesions are gastritis and its complications (gastric ulcers, mucosal atrophy (MA), intestinal metaplasia (IM) and dysplasia), and gastric polyps and tumors 1 . Gastritis (which could be active or chronic) is a mucosal inflammatory process, which could be asymptomatic or symptomatic. Common symptoms of gastritis include: / variable degrees of epigastric pain, nausea, vomiting, hematemesis, melena stool, and rarely massive blood loss. 1 Based on pathogenesis; there are two broad types of gastritis -gastritis associated with *Helicobacter pylori* (H pylori) infection and gastritis without H pylori infection. In the latter group are autoimmune gastritis, granulomatous gastritis, chemically induced reactive gastritis, ex-H pylori gastritis, Crohns gastritis, eosinophilic gastritis, lymphocytic gastritis, collagenous gastritis and *Helicobacter heilmanni* gastritis. 2 Most of the non-H pylori-associated gastritis are of unknown etiology or due to infection with opportunistic organisms, the use of non steroidal anti-inflammatory drugs (NSAIDs) or auto immunereactions. 2,3 H pylori have been identified globally as the main cause of chronic gastritis (CG). [2][3][4][5] H pylori infection is usually acquired during childhood and is mostly associated with poor socioeconomic living conditions. [4][5][6] The global prevalence of H. pylori infection in humans is estimated to be 50%, with a prevalence of about 70-90% in developing countries and 20-30% in developed countries. Developing countries especially in Sub Saharan Africa, and some parts of Asia have the highest prevalence, and it is said to be endemic in such countries. 5,[7][8][9] The sequelae of H pylori CG may include: (MA, IM, dysplasia and adenocarcinoma) is well documented, but fortunately, in SSA the incidence rate of gastric adenocarcinoma is reportedly low, despite the high prevalence rate which has led to the use of the terminology "African Enigma". 7 Due to the wide prevalence in SSA, at times H pylori is seen in persons with normal gastric endoscopic pictures. 10 Diagnostic endoscopy, though an invasive procedure has been proven to be a simple, safe, and well-tolerated procedure. 11 Histologic evaluation of the biopsies obtained at gastric endoscopies is the gold standard for the investigation of patients with complaints of dyspepsia. The histopathology results obtained give the definitive diagnosis that determines the treatment options and prognosis. 12 This study shows the histologic pattern of gastric endoscopic biopsies seen in a private referral pathology diagnostic center in Port Harcourt.

II. Materials and Methods

This is a retrospective case-controlled study of gastric endoscopic biopsies evaluated by the authors in a Port Harcourt based referral pathology diagnostic center -Cedar Pathology and Forensic Services Ltd.

Port Harcourt is the capital of Rivers state of Nigeria and the epicenter of the oil-rich Niger Delta region, noted for the widely acclaimed environmental oil pollution that resulted from the poorly regulated activities of oil and gas companies operating in the area. Gastric endoscopy biopsy specimens are received from different private and general gastroenterology practitioners in Port Harcourt. Endoscopic biopsies processed in the center within a five years-1 st January 2014 to 31 st December 2018 were selected for the study. For each case, the relevant clinical information and demographic data were obtained from the laboratory request forms of the patients. Following endoscopy, biopsy specimens were fixed in 10% neutral buffered formalin and processed with automated tissue processor and embedded in paraffin wax with special caution taken to orient the tissue appropriately. The obtained paraffin-embedded tissue blocks were serially sectioned into 2-4?m thick ribbons that were subsequently floated onto clean, transparent glass slides. The mounted sections were then stained with hematoxylin and eosin, for general light microscopic evaluation, while modified Giemsa-stained sections were used to check for the presence of *Helicobacter pylori*. The latter appears as light blue to grayish colored short rods in the luminal mucin or epithelial crypts. The slides were read by the authors using the Updated Sydney classification system 2 . Due consideration to adequacy of the tissue section based on the presence of components of the surface epithelium and muscularis mucosa was given in the biopsy reporting. For each case, the surface and glandular epithelial cells were assessed for mucin depletion, nuclear pseudo stratification with or without pencillate appearance and hyperchromasia, increased mitotic figures as well as a loss of polarity. These features, when present, depicted dysplasia. Gastric glandular atrophy was evaluated for, based on the adequacy of glands in terms of number, distribution, and architecture, while neutrophilic activity was assessed on the presence of intraepithelial neutrophils. The presence of intestinal epithelium with mucin-producing goblet cells was also sought to ascertain intestinal metaplasia. The data were analyzed using the statistical package for social sciences (SPSS) version 20.

Three cases without stated age and sex were excluded, while 10 cases without stated ages only and 2 cases without stated sexes only were included.

2 III. Results

A total of 227 cases were seen. The youngest patient was a seven-year-old female, and the oldest a99-year-old male, mean age was 48.46 ± 16.10 . The male to female ratio was 1.1:1. Table 1, shows the age and sex distribution of cases, with age group 40-49 years accounting for most cases (25.6%) and age group 0-9 years accounting for the least. In 10 patients, the ages were not stated, while in 2 patients, their sexes were not stated, however in all 227 cases, the diagnoses were mentioned.

Table 2 shows the main symptom at presentation. Epigastric pain was the commonest indication for endoscopy (40.5%), distantly followed by the feeling of indigestion (8.4%).

Chronic gastritis (62.6%) and chronic active gastritis (22.5%) were the main histological diagnoses, as shown in table 3.

Table 4 shows the different complications of gastritis seen in the series, and the frequency of detection of *H pylori* in the cases seen. *H pylori* were seen in 26.9% of cases. A comparison of the index study with some similar studies from Nigeria, other African countries, Asia and there public of Georgia is shown in Table 5. IM = Intestinal Metaplasia IV.

This study is timely considering the paucity of gastric biopsy-based studies in Port Harcourt. A decade ago, endoscopic biopsies were not carried out in Port Harcourt largely because of a lack of technical expertise. Besides, generally across the globe, gastritis was at a time considered a more or less useful histological finding but not a disease and therefore the need for biopsy-based diagnostic workup of patients was questioned until the discovery of *Helicobacter pylori* by Warren and Marshall in 1983 13 . This erstwhile relegation of biopsy-based diagnosis of gastritis may have contributed to the very slow progress in the training and development of endoscopy skills by physicians in our environment. This, in turn, may explain the slow pace of endoscopy practice and the virtual absence of histological evaluation of endoscopic specimens in our environment. This study portends hope and a bright future for the practice of gastroenterology in Port Harcourt as endoscopies have come to stay.

The updated Sydney system of classification of gastritis, which was worked out at the *H pylori* congress of 1994 stipulated that two biopsies each from the corpus and antrum, and another from incisura angularis be taken during endoscopy, to minimize sampling errors.

However, the compliance by our gastroenterology physicians to the tenets of the updated Sydney classification is lacking in the area of strict topography based biopsy. Biopsy specimens received in our Pathology laboratory often come as one or two tiny piece(s) of tissues, lacking in topographic labeling. This practice needs to be improved upon considering the importance of topographic information in the classification of gastritis. Similarly, most of the studies available to us and cited in this work used the updated Sydney classification in their methodology, but a critical review shows that they did not comply strictly with the set standards especially in the area of taking multiple biopsies and topographically identifying them. Most of the studies were based on specimens taken from the gastric antrum only 10,12,15,17,19,21 . Gastroenterologists should strive to obtain specimens from the various topographic sites recommended by the updated Sydney classification scheme.

The mean age of 48.46 years noted in this study is within the mean age range of 35.3 and 49.1 years observed in similar previous African and Asian studies but less than 62 years observed in the Republic of Georgia. Symptomatic manifestation of CG usually arises in later decades of life, despite being acquired in childhood,

and tend to arise in subjects with advanced stages of the lesion 22,23 . The implication of the age involvement is that patients are at the prime of their productive family, economic and social life. Thus the associated morbidity will constitute some truncation of productivity with negative socioeconomic consequences to the families and the nation at large.

We observed a slight male preponderance which is different from other Nigerian studies that observed slight female preponderance. 10,15 Studies from India and Pakistan reported significant male preponderance in their series, though no reasons were given.

Chronic gastritis was the predominant histologic diagnosis in this series, which is similar to observations in other studies except in Srinagar India, where gastric hyper plastic polyps were the commonest 10, 12-21 . There were only two cases of hyper plastic polyp in our case. The relatively low rate of chronic active gastritis may be due to antibiotic abuse, which is rife in our environment. Antibiotics, especially the broad-spectrum ones commonly abused by Nigerians, cause the disappearance of neutrophil infiltrate with the persistence of other chronic inflammatory cells like lymphocytes and plasma cells 35,36 .

H pylori positivity or presence in the index study is low compared to other studies and this may be due to recent intake of proton pump inhibitors (in an attempt to take anti-ulcer drugs which are easily purchased off the counter in Nigeria), and some level of subjectivity of evaluating pathologists in the recognition and detection of H pylori in tissue specimens. Also, inadequate sampling or sampling errors or taking of specimens only from the antrum, which has been proven to give a low yield of H pylori compared to corpus, especially after treatment, may be accountable. 12,19,24 Other factors include the size of the gastric biopsies, method of staining, and level of experience of the examining pathologist. 25 Gastric biopsies from complete IM sites are also known not to contain H pylori. 26 False positive H pylori CG can also occur when the equipment is not properly cleaned and used on another patient. 27 Other non-histologic ways to confirm the presence of H pylori are the use of Polymer Chain Reaction (PCR), rapid urease test, serological detection of an anti H pylori antibody, 13Carbon-hydrogen urea breath test, or stool antigen testing. 9,10,17,28 Unfortunately these other investigations are expensive and are not routinely available in developing countries like in the setting where the index study was conducted. 9 Antibiotic abuse is also a possible contributing factor to the reduced rate of H.pylori positivity in this work 35 .

Chronic atrophic gastritis (CAG) was seen in only 3.5% of cases. This is less than the findings in previous studies but greater than 2.4% observed in Lalitpur; Nepal, while studies in Ibadan and Ilorin Nigeria, did not mention CAG 10,[12][13][14][15][16][17][18][19][20] . CAG is usually a sequelae of a life-long and aggressive inflammation resulting in destruction of gastric mucosa with time. 4 With the passage of time, CAG leads to dysfunction of stomach mucosa, which ultimately manifests as acidfree stomach. Severe CAG and acid-free stomach are the highest known risk factors for gastric cancer. 4 The chances of gastric cancer developing due to CGrises exponentially with the progression of H. pylori gastritis from a non-atrophic gastritis form to CAG form 29 .

IM occurs as a result of the replacement of the lost gastric mucosal glands due to atrophy. IM comprises of immature small or large intestinal type of epithelium 4 . Although patients with IM run a risk of gastric cancer, it is low compared to adenocarcinoma arising in patients with Barrett esophagus 30 . IM in this series is only greater than the rate seen in Nepal but less than rates observed in Jos, North Central Nigeria, Kenya, Mozambique, Pakistan, and Georgia. 14,[16][17][18][19]21 Low-grade dysplasia was seen in 7.1% of cases and in association with IM. The other studies available to us did not make mention of dysplasia in their findings 10,[13][14][15][16][17][18][19][20][21] . Looking out for dysplastic features in endoscopy biopsy is fundamental as its diagnosis may portend adjustment inpatients' treatment protocol, including undertaking surgical resection in high-grade dysplasia. 31 Gastric IM is linked to gastric dysplasia and research has shown that in up to 20% of individuals with IM, concurrent dysplasia is present ??2. Gastric epithelial dysplasia is associated with some risk of gastric cancer development. Since IM and dysplasia are individual risk factors for carcinoma development, the coexistence of both will most likely have a multiplier effect in carcinogenesis 33 . Thus our patients would have been followed up, which unfortunately did not happen. Surgeons and pathologists need closer synergy for optimization of patient treatment outcomes, including instituting patient follow up where necessary as in this case.

Compared to previous Nigerian and African studies, this study, unfortunately, observed a relatively high rate of gastric malignant lesions. The reason/s for this cannot be readily explained. Cancer is the most serious disease linked to H pylori gastritis 34 . There will be the need for a population based study in Port Harcourt to know if the so called 'African Enigma" (high rate of H pylori infection and low rate of gastric cancer in Africans) does not apply in this environment and to know factors responsible for a higher rate of gastric cancers.

The major limitations of this study include: the relatively small sample size (in respect to the long duration of study) and non-availability or use of other ancillary tests that could help in determining the presence of H pylori organisms. Also, the standard five specimen's collection from different parts of the stomach was not routinely done.

3 V. Conclusion

The histologic patterns of gastric endoscopic biopsies seen in Port Harcourt is different from findings in other parts of Nigeria, especially concerning the low prevalence of H. pylori in tissue specimens and the relatively high

3 V. CONCLUSION

rate of gastric carcinomas observed. The current efforts at performing endoscopic biopsies and histologically examining them needs not only to be sustained but improved upon, for better patient treatment outcomes.

1

Age group	Male	Female	Total	Percentage (%)
0-9	-	1	1	0.5
10-19	3	-	3	1.3
20-29	8	9	17	7.9
30-39	29	15	44	20.5
40-49	31	27	58	27
50-59	16	19	35	16.3
60-69	11	22	33	15.3
70-79	11	6	17	7.9
80-89	4	2	6	2.8
? 90	1	-	1	0.5
Total	114	101	215	100

Figure 1: Table 1 :

2

Symptom	Frequency	Percentage (%)
Epigastric pain	92	40.5
Feeling of indigestion	19	8.4
Massive rectal bleeding with upper abdominal pain	10	4.4
Dysphagia	7	3.1
Epigastric pain with anaemia and weight loss	5	2.5
Hematemesis	5	2.2
Persistent vomiting	5	2.2
Melena stool	4	1.8
Heart burn	4	1.8
Abdominal pain with weight loss	4	1.8
Others	33	14.5
Not stated	44	19.4

[Note: Others include 3 cases each of the following: Easy satiety, abdominal discomfort, abdominal mass, a combination of epigastric pain and retrosternal pain, epigastric pain with anemia and weight loss, dyspepsia with weight loss.]

Figure 2: Table 2 :

3

Figure 3: Table 3 :

4

Histologic features	Chronic gas- tritis	Chronic-active gastritis	Total (%)
H Pylori	39	22	61 (26.9)
Atrophy	7	1	8 (3.5)
IM	9	-	9(4)
IM with dysplasia	12	2	14(6.2)

Figure 4: Table 4 :

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Clinicopathologic Profile of Gastric Endoscopic Biopsies in Port Harcourt, Nigeria

Diagnosis

Chronic gastritis

Chronic active gastritis

Hyperplastic polyp

Chemical gastritis Adenocarcinoma Squamous cell carcinoma Carcinoid tumor

Maltoma

To-

tal

Para Meters Dura-	Index study	227	1.1:1	48.46	39.6	Jos	Nig	13	100	1:1	62.6	95	26.9	79	66	7	Ibadan	Ilorin
tion of study No																	Nig	Nig
of cases M:F ratio																	10	14
Mean age yrs CG																	86	125
(%) H pylori Pres-																	1:1.2	1:1.6
ence (%) (months)																	49.19	35.3
																	64	-6
																	52.35	
																	11	
Activity (%)		22.5															-	-
Atrophy (%)		3.5															-	-
IM (%)		4															-	-
IM with dysplasia		6.2															-	-
Cancer (%)		13.5															3.5	-
Nig = Nigeria																		

Figure 5: Table 5 :

- [Pasricha et al. ()] , Pj -Gastrointestinal Endoscopy. Lee Pasricha , J Goldman , Clande Bennett . *Cecil Textbook of Medicine W B Saunders* 2000. 21 p. .
- [Sipponen et al. ()] , P Sipponen , H I Maaroos , Chronic . *Scandinavian Journal of Gastroenterology* 2015. 50 p. .
- [El-Zimaity and Hm ()] ‘Accurate diagnosis of Helicobacter pylori with biopsy’. El-Zimaity , Hm . *Gastroenterol Clin North Am* 2000. 29 (4) p. .
- [Dixon et al. ()] ‘Correa P and the Participants in the International Workshop on the Histopathology of Gastritis, Classification and Grading of Gastritis. The updated Sydney System’. M F Dixon , R M Genta , J H Yardley . *Am J Surg Pathol* 1996. 20 p. .
- [Arkkila et al. ()] ‘Eradication of Helicobacter pylori improves the healing rate and reduces the relapse rate of nonbleeding ulcers in patients with bleeding peptic ulcer’. P E Arkkila , K Seppälä , T U Kosunen , R Haapiainen , E Kivilaakso , P Sipponen . *Am J Gastroenterol* 2003. 98 p. .
- [Sipponen et al. ()] ‘Gastric cancer risk in chronic atrophic gastritis: statistical calculations of cross-sectional data’. P Sipponen , M Kekki , J Haapakoski , T Ihämäki , M Siurala . *Int J Cancer* 1985. 35 p. .
- [Tanko et al. ()] ‘Gastric histopathological findings in mucosal biopsies of symptomatic patients in Jos Central Nigeria’. M N Tanko , G O Echejoh , B M Mandong , A N Manasseh , A Malu . *Nig J Med* 2007. 16 (2) p. .
- [Fennerty ()] ‘Gastric intestinal metaplasia on routine endoscopic biopsy’. M B Fennerty . *Gastroenterology* 2003. 125 p. .
- [Maaroos et al. ()] ‘Helicobacter pylori and gastritis in children with abdominal complaints’. H I Maaroos , T Rågo , P Sipponen , M Siurala . *Scand J Gastroenterol* 1991. 26 p. .
- [Sipponen ()] ‘Helicobacter pylori gastritis epidemiology’. P Sipponen . *J Gastroenterol* 1997. 32 p. .
- [Olokoba et al. ()] ‘Helicobacter Pylori infection in Nigerians with dyspepsia’. A B Olokoba , W Gashau , S Bwala , A Adamu , F Salawu . *Ghana Med J* 2013. 47 (2) p. .
- [Tarkhashvili et al. ()] ‘Helicobacter pylori Infection in patients undergoing upper endoscopy, Republic of Georgia’. N Tarkhashvili , R Beriashvili , N Chakvetadze , M Moistsrapishvili , M Chokheli , M Sikharulidze , Etal . *Emerging Infectious Diseases* 2009. 15 (3) p. .
- [Burkitt et al. ()] ‘Helicobacter pylori-induced gastric pathology: insights from in vivo and ex vivo models’. M D Burkitt , C A Duckworth , J W Williams , D Pritchard . *Disease Models & Mechanisms* 2017. 10 p. .
- [Duggan and Legan ()] ‘Helicobacter Pylori: Diagnosis and management’. A E Duggan , Rph Legan . *Practical Gastroenterol* 2002. p. .
- [Holcombe ()] ‘Helicobacter pylori: the African enigma’. C Holcombe . *Gut* 1992. 33 p. .
- [Kalebi et al. ()] ‘Histopathological profile of gastritis in adult patients seen at a referral hospital in Kenya’. A Kalebi , F Rana , W Mwanda , G Lule , M Hale . *World J Gastroenterol* 2007. 13 (30) p. .
- [Sheikh et al. ()] ‘Histopathological spectrum of lesions of upper gastrointestinal tract -A study of endoscopic biopsies’. B A Sheikh , S M Hamdani , R Malik . *Global J Medi Public Health* 2015. 4 (4) p. .
- [Thapa et al. ()] ‘Histopathological Study of Endoscopic Biopsies’. R Thapa , Lakhey , P K Yadav , P Kandel , C Aryal , K Subba . *J Nepal Med Assoc* 2013. 52 (190) p. .
- [Hunt ()] ‘Hp and pH: implications for the eradication of Helicobacter pylori’. R H Hunt . *Scand J Gastroenterol Suppl* 1993. 196 p. .
- [Afzal et al. ()] ‘Morphological spectrum of gastric lesions -endoscopic biopsy findings’. S Afzal , M Ahmad , A Mubarak , F Saeed , S Rafi , N Saleem . *Pak Armed Forces Med J* 2006. 56 (2) p. .
- [Marshall et al. ()] ‘Original isolation of Campylobacter pyloridis from human gastric mucosa’. B J Marshall , H Royce , D I Annear . *FEMS Microbiol Lett* 1994. 25 p. .
- [Correa et al. ()] ‘Pathology of Gastric Intestinal Metaplasia: Clinical Implications’. P Correa , M Piazuelo , B Wilson , K . *Am J Gastroenterol* 2010. 105 (3) p. .
- [Saad and Chey ()] ‘Persistent Helicobacter pylori infection after a course of antimicrobial therapy-what’s next?’. R J Saad , W D Chey . *Clin Gastroenterol Hepatol* 2008. 6 p. .
- [Bello et al. ()] ‘Prevalence and risk factors for Helicobacter pylori infection in gastroduodenal diseases in Kano, Nigeria’. A K Bello , A B Umar , M M Borodo . *Afr J Med Health Sci* 2018. 17 p. .
- [Jemilohun et al. ()] ‘Prevalence of helicobacter pylori among Nigerian patients with dyspepsia in Ibadan’. A C Jemilohun , J A Otegbay , O S Ola , O A Oluwasola , A Akere . *Pan African Medical Journal* 2011. 6 p. .
- [Raj et al. ()] ‘Prevalence of Helicobacter pylori among patients with dyspepsia and correlation between endoscopic and histological diagnosis’. K C S Raj , A Lakhey , K Koirala , G L Amatya . *Journal of Pathology of Nepal* 2016. 6 p. .

3 V. CONCLUSION

- 224 [Carrilhoc et al. ()] ‘Prevalence of Helicobacter pylori infection, chronic gastritis, and intestinal metaplasia in
225 Mozambican dyspeptic patients’. Modcoicarp Carrilhoc , L Cunha , M Ismail , Lorenzonic Guissevea .
226 *Virchows Archiv* 2009.
- 227 [Turner (ed.) ()] *Robbins and Cotran Pathologic Basis of Disease*, J Turner . Kumar V, Abbas A K, Aster J C
228 (ed.) 2015. Saunders Elsevier. 9 p. . (The gastrointestinal tract)
- 229 [Morson et al. ()] ‘Serck-Hanssen A. Precancerous conditions and epithelial dysplasia in the stomach’. B C
230 Morson , L H Sobin , E Grundmann , A Johanson , T Nagayo . *J ClinPathol* 1980. 33 p. .
- 231 [Bravo and Correa ()] ‘Sulphomucins favour adhesion of Helicobacter pylori to metaplastic gastric mucosa’. J C
232 Bravo , P Correa . *J ClinPathol* 1999. 52 p. .
- 233 [Lee et al. ()] ‘The Diagnostic Accuracy of Endoscopic Biopsy for Gastric Dysplasia’. S B Lee , H Y Kang , K I
234 Kim , D Ahn . *J Gastric Cancer* 2010. 10 (4) p. .
- 235 [Correa and Piazuelo ()] ‘The gastric precancerous cascade’. P Correa , M B Piazuelo . *J Dig Dis* 2012. 13 p. .
- 236 [Hoed et al. ()] ‘The prevalence of premalignant gastric lesions in asymptomatic patients: predicting the future
237 incidence of gastric cancer’. Den Hoed , C M Van Eijck , B C Capelle , L G Van Dekken , H Biermann , K
238 Siersema , PD . *Eur. J. Cancer* 2011. 47 p. .
- 239 [Stolte and Meining ()] ‘The updated Sydney system: Classification and grading of gastritis as the basis of
240 diagnosis and treatment’. M Stolte , A Meining . *Can J Gastroenterol* 2001. 15 (9) p. .
- 241 [Stolte and Meining ()] ‘The updated Sydney system: Classification and grading of gastritis as the basis of
242 diagnosisand treatment’. M Stolte , Meining . *Can J Gastroenterol* 2001. 15 (9) p. .
- 243 [World Health Organization, Regional Office for Africa. Federal Government, WHO and partners strategize to tackle antibiotic al
244 *World Health Organization, Regional Office for Africa. Federal Government, WHO and part-*
245 *ners strategize to tackle antibiotic abuse in Nigeria*, [http://www.afro.who.int/news/](http://www.afro.who.int/news/federal-govenment-who-and-partners-startegize-tackle-antibiotic-abuse-nigeriaon15th)
246 **federal-govenment-who-and-partners-startegize-tackle-antibiotic-abuse-nigeriaon15th**
247 January 2020.