


# Evaluation of antibiotic prescribing for ambulatory patients seeking primary dental care services in a public hospital in Ghana: a clinical audit study

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**Background:** One in 10 of all antibiotic prescriptions globally are for dental conditions with 80% of them being inappropriate, making it a potential driver of antimicrobial resistance.

**Objectives:** To evaluate the appropriateness of antibiotic use among ambulatory patients seeking dental care services in a public hospital in Ghana.

**Methods:** A retrospective clinical audit was conducted by extracting the medical records of all patients seeking dental care at the ambulatory care clinic of Keta Municipal Hospital (KMH) from January 2020 to December 2020 using the hospital's electronic database. Descriptive statistics, bivariate and multivariate analysis were performed on the data collected.

**Results:** Overall, 1433 patient medical records were extracted from the database within the study period. The mean age of the patients identified was 39.9 years with almost two-thirds being female. The majority (91.1%,  $n = 1306$ ) of them were attended to by a dental nurse. In total, 88.6% ( $n = 1269$ ) of the patients received antibiotics and 87.5% ( $n = 1254$ ) of antibiotics prescribed were non-compliant with Ghana Standard Treatment Guidelines. Three-quarters of the dental conditions were managed with dual antibiotics comprising amoxicillin and metronidazole. Antibiotic prescription was associated with age, gender, type of prescriber and type of dental condition diagnosed.

**Conclusions:** There is a high usage of antibiotics for dental conditions managed at the outpatient section of the hospital and most are inappropriate. Development of local guidelines supported by education of dental clinicians on empirical use of antibiotics is a suitable target for the antimicrobial stewardship team to address in KMH.

## Introduction

There has been an increase in the use of antibiotics for dental care worldwide.<sup>1,2</sup> Despite evidence suggesting that a greater proportion of dental diseases could be effectively managed by surgical and other interventions requiring no antibiotic

prescriptions, there is appreciable inappropriate prescribing of antibiotics by dentists especially in low- and middle-income countries (LMICs) with limited patient benefits.<sup>1-4</sup>

The majority of the antibiotics for dental procedures are for prophylaxis, where evidence has shown no clear benefit of antibiotic usage in preventing surgical site infection, swelling or

post-operative pain.<sup>5-7</sup> Overall, approximately 80% of the global antibiotics prescribed for dental procedures are seen as inappropriate.<sup>8-11</sup> The use of prophylactic antibiotics prior to dental procedures to prevent infective endocarditis is however recommended for patients with specific cardiac conditions such as those with prosthetic cardiac valves, history of infective endocarditis, specific congenital heart defects and cardiac transplant patients.<sup>12</sup> Limited guidance from professional societies and other stakeholders regarding how to manage specific dental infections has been a contributory factor to inappropriate antibiotic prescribing across countries, which needs to be addressed.<sup>11</sup> However, a number of antimicrobial stewardship programmes (ASPs) are now being implemented particularly among high-income countries to address the situation.<sup>13-14</sup>

The inappropriate use of antibiotics is the major modifiable key driver of antimicrobial resistance (AMR).<sup>15-17</sup> AMR is a global public health problem impacting on morbidity, mortality and costs with greater concern in LMICs with limited healthcare resources.<sup>5,16,18-20</sup> Currently, more than 80% of human consumption of antibiotics occurs in ambulatory care with up to 30% of these antibiotic prescriptions being unnecessary especially for upper respiratory tract infections.<sup>12,20,21</sup> One in 10 of all antibiotic prescriptions globally are for dental conditions making it a potential source of AMR given, as mentioned, findings from published studies that approximately 80% of antibiotics prescribed as part of dental procedures are unnecessary.<sup>8-11,22</sup>

Globally, antibiotics from the penicillin group account for a majority of the prescriptions made in dental primary care settings, with amoxicillin being the most commonly prescribed antibiotic.<sup>23-25</sup> Whilst the penicillins are currently included in the WHO Access group of the Access, Watch, Restrict (AWaRe) classification of antibiotics, which are the preferred antibiotics to reduce resistance potential, their overuse for dental conditions is a concern.<sup>26-29</sup> The AWARe framework recommends the use of antibiotics in the Access group for most common infectious diseases, with the WHO Global Programme of Work proposing that a target of at least 60% of total antibiotic utilization should be in the Access group by 2023 (4b Programmatic Target).<sup>28-30</sup> Alongside this, the Ghana Standard Treatment Guidelines (STG) currently recommend no antibiotics for dental caries. However, oral amoxicillin can be prescribed as first-line empirical management of mild odontogenic infections, or as prophylaxis in patients with cardiac-related disorders at risk of bacterial endocarditis in the course of dental manipulations while oral co-amoxiclav is reserved for severe odontogenic infections in dental ambulatory clinics.<sup>31</sup>

We are aware that there have been concerns with the prescribing of antibiotics in Keta Municipal Hospital (KMH), a public hospital in Ghana.<sup>20,32-33</sup> Consequently, there was a need to undertake an audit of antibiotic prescribing practices among patients attending as dental outpatients in the hospital as part of the hospital's ASP strategies to reduce unnecessary or inappropriate use of antibiotics. There are also scarce data on antibiotic use from audits of dental conditions at primary care settings especially in poor healthcare resource settings such as Ghana.

In view of this, the study was designed to determine, first, the proportion of antibiotic use for dental conditions in patients presenting at the outpatient setting at KMH and the potential predictors of their use among dental clinicians. Alongside this we will determine the appropriateness of the choice of antibiotics

prescribed according to the Ghana STG and assess the proportion of antibiotic prescription per the WHO AWARe classification for the range of dental conditions managed in the hospital. The study findings can be used to provide feedback to the dental team regarding future quality improvement programmes including future ASPs to reduce unnecessary prescribing of antibiotics while adding to knowledge on current measures for AMR control in resource-limited settings. Inappropriate use of antibiotics has a cost implication not only for patients but also a potential threat of resistance development.

## Methods

### Study design and setting

A retrospective cross-sectional survey was conducted by extracting the medical records of all patients seeking dental primary care at the ambulatory care clinic of KMH from January 2020 to December 2020 using the hospital's electronic database.

We started with KMH as this is a leading public primary care hospital located in the Keta Municipality that lies at the southern part of the Volta Region of Ghana with a population of just over 2.1 million people (8.6% of the total population of Ghana).<sup>34,35</sup> KMH is a government-owned primary healthcare facility with a 110-bed capacity providing general outpatient services, dental service, eye care services, mental health services and pharmaceutical care services to an average of 200 ambulatory patients on daily basis as well as inpatient services.<sup>32,34,35</sup> The dental unit is staffed with one dentist, one dental physician assistant (trained to assist the dentist in the diagnosis and management of dental conditions including surgical interventions) and a dental trained nurse. The clinic attends to an average of 90 ambulatory patients per month with a range of dental conditions.

### Data collection

An audit tool adapted from a previous study was developed to capture information routinely collected from patients attending the dental ambulatory clinic using the hospital electronic database called the Patient Clinical and Health Information System (PHIS).<sup>25</sup> The PHIS software was instigated in the hospital in 2018 to ensure data security and accessibility of information on prescribed and dispensed drugs and to aid drug and non-drug inventory. The type of information collected for this study was based on the medical records routinely collected in the PHIS for patients attending the dental clinic. This included sociodemographic information incorporating age, gender and payment type, i.e. national health insurance scheme (NHIS) or 100% co-payment via cash payments. Clinical information comprising the primary dental diagnosis, other diagnosis (categorized as infectious disease diagnosis, non-infectious disease diagnosis and no additional diagnosis), name(s) of antibiotic prescribed, class of antibiotic(s) according to the WHO Anatomical Therapeutic Chemical (ATC) classification, number of antibiotic(s) prescribed per patient episode, and WHO AWARe category of antibiotic(s) prescribed.<sup>28,29</sup> The classification of diagnoses into infectious and non-infectious disease was based on disease classification in the Ghana STG.<sup>31</sup> However, details of other medicines prescribed for comorbid disorders were not collected as this information could not be readily retrieved from the PHIS in a format that allowed for analysis. The common comorbid diagnoses made included anaemia, hypertension, respiratory tract infections and arthritis.

Two clinical pharmacists (I.A.S. and D.O.E.) retrieved the data using the audit tool, with both having previous expertise in retrieving data from this PHIS software.<sup>20</sup> Following the data entry, a detailed data audit process was conducted by the team of pharmacists to check for accuracy and consistency. Any areas of concern were identified, checked and refined if needed. All the medical records of the patients who visited the

dental ambulatory clinic and underwent either medical examination, medical treatment or surgical procedures for their reported dental problems within the study period were included in the study. We excluded all patient medical records where the patient was managed for their dental conditions on admission.

Antibiotics prescribed were then categorized by the audit team based on their ATC class, number prescribed for each patient episode and their WHO AWaRe category.

### Data analysis

All data collected were entered on Microsoft Excel version 2013 and imported into STATA version 14 (StataCorp, TX, USA) for analysis. The primary study outcome measure was the proportion of antibiotic prescribed for the reported dental problem at the ambulatory clinic of KMH. In addition, compliance with the Ghana STG with respect to whether antibiotics were needed for the dental condition diagnosed were assessed. The guidelines currently recommend that no antibiotic should be prescribed for dental caries managed with or without surgery. However, oral amoxicillin is recommended as first-line empirical management for mild odontogenic infections which manifest as spreading dental infections with signs and symptoms of jaw swelling with persistent gnawing pain, fever, chills and tenderness of tooth to percussion and for patients with cardiac-related disorders at risk of bacterial endocarditis in the course of dental manipulations while oral co-amoxiclav is reserved for severe odontogenic infections in dental ambulatory clinics.<sup>31</sup> Thus, all prescriptions of antibiotics that were made for the diagnosed dental disorders especially dental caries with or without surgery, except those prescribed for orofacial abscess, impacted tooth and periodontitis, which usually presented with signs and symptoms of odontogenic infections as defined above, were classified as non-compliant.

The analysis comprised of descriptive statistics as well as Fisher's exact test to determine any association between the primary study outcome (i.e. the need for antibiotic prescription for the dental condition diagnosed) and the independent variables at a significance level of 95%.

Multivariate logistic regression analyses were subsequently conducted by including all independent variables used in the bivariate analysis. This was performed to determine possible predictors of antibiotic prescription at the dental ambulatory clinic while adjusting for possible confounders.

### Ethical clearance

No formal ethical exemption was sought as there was no direct patient contact and all data were anonymized and kept securely locked at all times accessible only to the researchers. Administrative approval was however given by the management of the hospital. This is in line with our previous studies on antimicrobial use in the hospital.<sup>20,32,33,36,37</sup>

## Results

### Descriptive analysis of patient medical records

In all, 1433 medical records of patients who attended the ambulatory dental clinic of KMH over the 12 month period were extracted from the database. The mean age of the patients was 39.9 ( $\pm$  20.1) with 27.8% ( $n=399$ ) aged between 16 and 30 years followed by 26.5% ( $n=380$ ) aged between 31 and 45 years (Table 1). In total, 62.2% ( $n=891$ ) were female and 72.9% ( $n=1044$ ) paid for dental services via out-of-pocket payment (cash payment). Overall, 91.1% ( $n=1306$ ) of the patients who attended the dental clinic within the study period were managed by a dental nurse with 6.6% ( $n=94$ ) managed by a dental physician assistant (Table 1).

The commonest dental condition reported at the clinic was dental caries managed by forceps extraction (58.2%,  $n=834$ ) followed by dental caries without any surgical procedure (38.1%,  $n=546$ ). Of patients who were diagnosed as having a dental condition, 88.6% ( $n=1269$ ) had an antibiotic prescribed as part of the management intervention. Compliance with the Ghana STG in terms of whether an antibiotic was indicated for the dental condition the patient presented with was poor, with only 12.5% ( $n=175$ ) of patients either receiving or not receiving antibiotics appropriately. In total, 73.2% ( $n=1049$ ) of patients had more than one antibiotic prescribed. While 36.2% ( $n=519$ ) of patients had a comorbid disease that was an infectious disease, the remainder had either no comorbid disease or a non-infectious comorbid disease. The commonest antibiotic prescribed for the diagnosed dental condition was amoxicillin plus metronidazole (77.9%,  $n=988$ ) followed by amoxicillin alone (12.0%,  $n=152$ ). While over 80% of antibiotics prescribed were among the penicillins, 99.6% ( $n=1264$ ) of the prescribed antibiotics belonged to the WHO AWaRe Access category (Table 1).

### Bivariate analysis of patient medical records using antibiotic prescription as the outcome measure

Prescribing of antibiotics for the management of the reported dental conditions at the ambulatory clinical was statistically associated with the age of patients ( $P<0.0001$ ), the type of dental prescriber ( $P<0.0001$ ) and the type of dental diagnosis made ( $P<0.0001$ ) (Table 2).

### Multivariate analysis of patient medical records using antibiotic prescription as the outcome measure

Antibiotic use for the management of the reported dental condition was independently predicted by the age category of the patient ( $P=0.003$ ), the patient's gender ( $P=0.019$ ), the type of dental prescriber ( $P<0.0001$ ) and the type of dental diagnosis made ( $P<0.0001$ ) (Table 3).

## Discussion

We believe this is the first comprehensive study undertaken to assess the extent of antibiotic prescribing for patients attending as dental outpatients in Ghana. However, we are aware of one study that was undertaken to assess antibiotic susceptibilities among patients undergoing dental procedures in Ghana but did not assess appropriate use as we have done in this study.<sup>38</sup>

Almost 90% of patients who reported to the dental clinic received antibiotics and three-quarters of these were managed with more than one antibiotic comprising amoxicillin and metronidazole for dental conditions, which were mostly caries and therefore failed to comply with the STG. This is in line with previous publications, which suggest that the majority of antibiotic prescriptions for dental conditions are inappropriate.<sup>8-11,13,17</sup> The commonest single antibiotic prescribed for ambulatory dental condition was amoxicillin followed by co-amoxiclav (Table 1), making penicillin the most used oral antibiotic for primary dental care in KMH. This is similar to the findings in other countries.<sup>23-25,39,40</sup>

Dental caries with or without surgical procedures (tooth extraction, temporary filling, etc.) were the main dental problem

**Table 1.** Characteristics of patient records assessed

Variables	Frequency n (%)
Age, years, mean (SD)	39.9 (±20.1)
Age category (n=1433)	
0–15 years	126 (8.8)
16–30 years	399 (27.8)
31–45 years	380 (26.5)
46–60 years	268 (18.7)
Above 60 years	260 (18.1)
Gender (n=1433)	
Male	542 (37.8)
Female	891 (62.2)
Payment status (n=1433)	
Cash	1044 (72.9)
NHIS	389 (27.1)
Comorbid diagnosis made (n=1433) <sup>a</sup>	
No additional diagnosis	549 (38.3)
Infectious comorbid disease	519 (36.2)
Non-infectious comorbid disease	365 (25.5)
Number of antibiotics prescribed (n=1433)	
0	164 (11.4)
1	220 (15.4)
2	1049 (73.2)
Antibiotic use (n=1433)	
No antibiotic prescribed	164 (11.4)
Antibiotic prescribed	1269 (88.6)
Antibiotic prescription compliance with Ghana STG (n=1433)	
Compliance	179 (12.5)
Non-compliance	1254 (87.5)
Type of prescriber (n=1433)	
Dentist	33 (2.3)
Dental physician assistant	94 (6.6)
Dental nurse prescriber	1306 (91.1)
Dental diagnosis (n=1433)	
Cervical abrasion requiring composite filling	3 (0.2)
Dental caries requiring amalgam filling	5 (0.4)
Dental caries requiring forceps extraction	834 (58.2)
Dental caries requiring temporary filling	4 (0.3)
Dental caries without procedure	546 (38.1)
Impacted tooth managed surgically	5 (0.4)
Periodontitis managed by scaling and polishing	19 (1.3)
Orofacial abscess managed by drainage	2 (0.1)
Tongue tie	15 (1.1)
Type of antibiotic prescribed (n=1269)	
Amoxicillin (J01CA04) only	152 (12.0)
Co-amoxiclav (J01CR02) only	51 (4.0)
Metronidazole (J01XD01) only	15 (1.2)
Cefuroxime (J01DC02) only	2 (0.2)
Amoxicillin (J01CA04) + metronidazole (J01XD01)	988 (77.9)
Co-amoxiclav (J01CR02) + doxycycline (J01AA02)	1 (0.1)
Co-amoxiclav (J01CR02) + metronidazole (J01XD01)	57 (4.5)
Cefuroxime (J01DC02) + metronidazole (J01XD01)	3 (0.2)
WHO AwaRe category of antibiotic prescribed (n=1269)	
Access	1264 (99.6)
Watch	5 (0.4)

Continued

**Table 1.** Continued

Variables	Frequency n (%)
Reserve	0 (0.0)
Antibiotics according to ATC classification (n=1269)	
Penicillins only (J01C)	203 (16.0)
Penicillins (J01C) + imidazole derivatives (J01XD)	1045 (82.4)
Cephalosporins (J01D) only	2 (0.2)
Cephalosporin (J01D) + imidazole derivatives (J01XD)	3 (0.2)
Imidazole derivatives (J01XD) only	15 (1.2)
Other antibiotics (J01)	1 (0.1)

<sup>a</sup>The common comorbid diagnoses made included anaemia, hypertension, respiratory tract infections and arthritis.

reported by patients in this ambulatory clinic (Table 1). This suggests that majority of the antibiotics prescribed were meant to treat dental caries or to be used as prophylaxis against surgical site infection. This resulted in the observation of 87.5% of antibiotic prescriptions that were non-compliant with the Ghana STG (Table 1). The current guidelines recommend the use of analgesics to relieve pain in dental caries without the need for antibiotics.<sup>31</sup> Also, the guideline does not comment on the use of prophylactic antibiotics either before or after dental surgery except for patients with cardiac disorder at risk of bacterial endocarditis such those with previous history of heart valve disease, bacterial endocarditis and heart valve replacement undergoing dental manipulation. This needs to be addressed going forward. None of these exceptions though was currently documented for any of the patients who underwent dental surgical procedure such as tooth extraction and temporary or amalgam filling. This is a concern as this gap may be the reason for the use of antibiotics for most cases of dental procedures.

Alongside this, the prescribing of more than one antibiotic as adjunct treatment to dental procedures is said to be unnecessary and also lacks evidence of benefit in preventing surgical site infection, swelling or post-operative pain.<sup>2,6,7</sup> This again needs to be carefully looked at since unnecessary prescribing of antibiotics is a major driver of AMR.<sup>15–17</sup> It is however welcoming to note that 100% of the antibiotics prescribed at the ambulatory clinic were in the WHO Access category with none in the reserve category, even though their use in this case was mostly inappropriate and therefore a potential threat to AMR development. Generally, Access antibiotics are known to have a narrow spectrum of activity, lower cost, a good safety profile and generally low resistance potential and are therefore recommended as empirical first treatment options for common infections.<sup>28–30</sup>

Antibiotic prescribing for the patients in our study was independently predicted by their age category ( $P=0.003$ ), gender ( $P=0.019$ ), type of prescriber ( $P<0.000$ ) and the type of dental condition diagnosed ( $P<0.000$ ). Patients older than 30 years were approximately twice as likely to be prescribed antibiotics for their reported dental condition than their younger counterparts (less than 15 years). A 5 year cohort study in the USA observed the reverse.<sup>8</sup> However, our findings may be due to the high disproportionate number of adults who utilize the dental

**Table 2.** Bivariate analysis of selected patient records against antibiotic use for dental conditions

Variables	Antibiotic use				P value
	Antibiotic prescribed, n=1269 (88.56%)		No antibiotic prescribed, n=164 (11.44%)		
	n	%	n	%	
Age category (n=1433)					0.000
0-15 years	91	72.22	35	27.78	
16-30 years	348	87.22	51	12.78	
31-45 years	348	91.58	32	8.42	
46-60 years	244	91.04	24	8.96	
Above 60 years	238	91.54	22	8.46	
Gender (n=1433)					0.199
Male	488	90.04	54	9.96	
Female	781	87.65	110	12.35	
Type of prescriber					0.000
Dentist	20	60.61	13	39.39	
Physician assistant	55	58.51	39	41.49	
Dental nurse prescriber	1194	91.42	112	8.58	
Payment status (n=1433)					0.780
Cash	926	88.70	118	11.30	
NHIS	343	88.17	46	11.83	
Dental diagnosis (n=1433)					0.000
Cervical abrasion requiring composite filling	3	100.00	0	0.00	
Dental caries requiring a procedure	768	91.10	75	8.90	
Dental caries without procedure	483	88.46	63	11.54	
Impacted tooth managed surgically	3	60.00	2	40.00	
Periodontitis managed by scaling and polishing	11	57.89	8	42.11	
Orofacial abscess managed by drainage	1	50.00	1	50.00	
Tongue tie	0	0.00	15	100.00	
Other diagnosis made (n=1433)					0.259
No additional diagnosis	481	87.61	68	12.39	
Infectious disease diagnosis	469	90.37	50	9.63	
Non-infectious disease diagnosis	319	87.40	46	12.60	

clinic compared with children in this setting. Male patients were approximately one-and-a-half [adjusted OR (aOR) = 1.586, 95% CI 1.070-2.349] times more likely to be prescribed antibiotics than females even though more females (62.2%) were found to have visited the clinic than the males in the study. However other studies have found a higher rate of antibiotic prescriptions written for females<sup>8,41</sup> while others observed no difference.<sup>42</sup> Prescribers who were either dentists (aOR=0.204, 95% CI 0.088-0.475) or dental physician assistants (aOR=0.182, 95% CI 0.106-0.311) were appreciably less likely to prescribe antibiotics for patients who reported to the dental ambulatory clinic. This may reflect the fact that over 90% of attending patients had their dental condition managed by a dental nurse. We will

**Table 3.** Multivariate analysis of patient records against antibiotic use for dental conditions

Variables	aOR	95% CI	P value
Age category (n=1433)			0.003
0-15 years	1 (reference)		
16-30 years	1.503	0.811-2.783	
31-45 years	2.213	1.154-4.242	
46-60 years	2.291	1.144-4.587	
Above 60 years	2.262	1.119-4.569	
Gender (n=1433)			0.019
Male	1.586	1.070-2.349	
Female	1 (reference)		
Type of prescriber			0.000
Dentist	0.204	0.088-0.475	
Dental physician assistant	0.182	0.106-0.311	
Dental nurse prescriber	1 (reference)		
Payment status (n=1433)			0.306
Cash (reference)	1 (reference)		
NHIS	0.783	0.520-1.178	
Dental diagnosis (n=1433)			0.000
Cervical abrasion requiring composite filling (reference)	1 (reference)		
Dental caries requiring a procedure	2.132	0.122-37.337	
Dental caries without procedure	1.249	0.071-21.959	
Impacted tooth managed surgically	0.232	0.008-6.967	
Periodontitis managed by scaling and polishing	0.175	0.008-3.583	
Orofacial abscess managed by drainage	1		
Tongue tie	1		
Other diagnosis made (n=1433)			0.764
No additional diagnosis	1 (reference)		
Infectious disease diagnosis	1.495	0.926-2.414	
Non-infectious disease diagnosis	1.003	0.629-1.597	

be following up these findings with a qualitative study to explore further the views and behaviours of dental teams with respect to antibiotic use as well as our other findings regarding the key drivers for the prescribing of antibiotics. The combined findings will be helpful in developing a local guideline especially for conditions that are not captured by the national guideline such as prescription of prophylactic antibiotics for dental procedures. There is the need to instigate ASPs, including training on empirical antibiotic selection for ambulatory management of dental conditions especially among the nurses to promote guidelines compliance.

Over 70% of the studied patients paid cash for their dental treatment rather than using a pre-paid NHIS option. This is a concern with an appreciable number of the population living below the minimum wage.<sup>43</sup> Consequently, it is vital that any medicines prescribed be justified.

## Conclusions

This study has confirmed high usage of antibiotics for dental conditions among patients who presented at the ambulatory dental clinic of a public hospital in Ghana, which were mostly non-compliant with Ghana STG. Prescription of antibiotics was associated with the age category of patients, the type of prescriber and the type of dental condition diagnosed of which dental caries were the commonest diagnosed dental condition. The development of local guidelines for antibiotic use for dental conditions that are not explicitly captured in the national STG supported by education for dental clinicians, especially dental nurses on empirical selection of antibiotics for common dental conditions, is a suitable target for the antimicrobial stewardship team to address in KMH. A qualitative study has been instigated to explore further the views and behaviours of dental and pharmacy teams with respect to antibiotic use in dental conditions. The combined findings will help inform our approach to the provision of appropriate ASP strategies and engagement with key prescribers to improve subsequent prescribing practices.

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This study was undertaken as part of our routine work.

## Transparency declarations

None to declare.

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