Dispensing practices for anti-malarials in the La Nkwantanang-Madina municipality, Greater Accra, Ghana: a cross-sectional study

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Abstract

Background: Despite recent strides made towards reducing the emergence of artemisinin resistance, inappropriate dispensing practices for anti-malarials in both private and public sectors affect treatment outcomes negatively. In Ghana, private retail pharmacies are the most accessible health facilities for managing diseases of common occurrence. However, there is growing concern about the number of patients harmed by dispensing errors in the management of malaria in retail pharmacies. Although considerable work has been done in this area, several questions regarding dispensing practices remain unanswered. This study, therefore, sought to investigate the predictors of appropriate dispensing practices for anti-malarials in community pharmacies in the La Nkwantanang-Madina municipality of Greater Accra, Ghana.

Methods: A cross-sectional analytic study was conducted in sixty-one randomly selected community pharmacies in the La Nkwantanang-Madina. Data from 230 clients and 106 dispensers were analysed. It was checked for internal consistency and completeness then entered and analysed using STATA I/C version 14.0. Frequencies, Chi square tests, and logistic regression analyses were conducted, accounting for clustering.

Results and discussion: Of the 106 dispensers interviewed, 71.4% were medicine counter assistants. The mean age of dispensers was 30.4 years (SD 8.8). Over 88.0% of clients were advised to complete the full course of their anti-malarials. However, the 8-h loading dose principle for artemether-lumefantrine was not explained to 88.3% of the clients. More than half of the clients (52.2%) were given appropriate dispensing information on anti-malarial use. Most clients (66.1%), were dispensed anti-malarials without malaria tests. Dispensers with more than a 10-years experience were less likely to dispense artemisinin-based combinations appropriately relative to dispensers with less than 2 years experience (AOR = 0.04, 95% CI 0.002–0.802 p-value = 0.036) while pharmacy interns were about 19 times more likely (AOR = 18.5, 95% CI 1.40–245.6 p-value = 0.03) to dispense artemisinin-based combinations appropriately compared to pharmacists.

Conclusion: Dispensing practices for anti-malarials is unsatisfactory. There is a need to enforce existing legislation with educational programmes directed towards dispensers especially those with more than 10 years experience. Specific adherence to the World Health Organization Test, Treat and Track initiative should be encouraged to ensure effective use of anti-malarials.

Keywords: Dispensing practice, Anti-malarials, Dispensers, Clients, Community pharmacies, Ghana
Background
The accurate use medicines play an important role in healthcare delivery. The provision of appropriate medicines can help alleviate symptoms, prevent recurrence of disease and restore patient's health. Nonetheless, inappropriate use of medicines remains a major public health issue globally [1, 2].

In developing and low middle income countries, there has been considerable evidence of inappropriate drug use due to poor dispensing practices, inadequate package labelling and poor instruction given to clients on usage of medicines [3, 4].

In contrast to the developed regions, private retail pharmacies and Licensed Chemical Shops play an important role in promoting access to basic health services in sub-Saharan Africa. In Ghana, for example, private retail pharmacies and Licensed Chemical Shops, who are registered suppliers of specific over-the-counter medicines are the most accessible health facilities available for managing commonly occurring diseases [5]. Empirical studies have shown that the majority of families seek treatment for mild febrile diseases in retail pharmacies as compared to public health facilities [6, 7]. Their operations are regulated by the Pharmacy Council (PC) of Ghana under the Health Professions Regulatory Bodies Act 857 [8]. Community pharmacies are typically managed by pharmacists (individuals who hold a degree in pharmacy, completed the required internship programme and passed professional qualifying examination) and other pharmaceutical support staff; Medicine Counter Assistants (MCA—support staff trained to complement the role of pharmacy technicians, owing to acute shortage of the technicians) and pharmacy technicians.

Retail pharmacies are patronized primarily because they are readily accessible, have longer opening hours and clients may spend less time to be served compared to the public health facilities [5, 9, 10]. However, they are poorly monitored and may not be operating professionally [10–12]. In a study conducted by Buabeng in 2010, an alarming 77% of patients used incorrect dosage or did not complete the course of their anti-malarials [13]. The same study showed that (54%) of the patients who purchased from community pharmacies took their anti-malarials inappropriately possibly due to poor dispensing information [13]. Other researchers have rather observed that a greater proportion of patients had informed understanding of adverse effects compared to ‘how to use’ anti-malarials [11, 14]. These point to the importance of adequate dispensing and its pivotal role in preventing medication use errors [15, 16].

The dispensing process forms an integral part of the quality use of medicines and is the core professional role of a pharmacist. It ensures the safe and effective provision of medication to the general public. Dispensing involves all activities from the receipt of the prescription to the time the medicine is issued out to the patient [15]. The role of the pharmacist has traditionally been to provide patients with appropriate pharmaceutical care, to maintain the quality of pharmaceutical products and to ensure that patients take their medicines rationally [5, 8, 10, 11, 13].

In recent times, pharmacists’ role has evolved to advising physicians and other health professionals about drug therapy, its adequacy, side effects and possible interactions. In the community pharmacy setting, however, pharmacists and other support staff may not have the opportunity to interact with physicians and therefore, treat their clients empirically [13, 17]. This may have dire effects on patients once vital information is missed and often resources involved in patient care prior to dispensing may be wasted.

The introduction of rapid diagnostic testing (RDT) in the private sector in Ghana has made it easier for dispensers in community pharmacies to diagnose malaria definitively and treat confirmed malaria cases. However, in most malaria endemic areas, oral anti-malarials purchased from retail outlets are mainly obtained through client requests without laboratory confirmation [6, 18, 19]. Therapy initiated without conclusive test outcomes may not only accelerate artemisinin resistance but lead to the possible progression and aggravation of the actual cause of disease [17, 20–23].

Evidence from a cross-sectional survey and other studies point to a possible link between poor dispensing practices and its effect on anti-malarial resistance [24–26]. There is, therefore, a need for continuous assessment of the quality of dispensing of anti-malarials as this will inform policy makers and the National Malaria Control Programme (NMCP) on areas to be targeted during the roll-out of interventions. Although considerable work has been done in this area, past studies on dispensing practices have primarily focused more on dispensing in public health facilities, understanding the role of pharmacists, assessing staff/patient knowledge, policy guidelines adherence among many others [13, 16, 23, 27–29].

However, there is limited information on dispensing practices among community pharmacies especially in the Greater-Accra region of Ghana. This study aims to address that gap by assessing factors associated with dispenser’s practices for anti-malarials in the La Nkwantanang-Madina municipality.

Methods
The study was conducted in La Nkwantanang-Madina located in the Greater Accra Region, one of the ten administrative regions in Ghana at the time of the study. La Nkwantanang-Madina is located on the south-eastern part of the country along the Gulf of Guinea. It is estimated to have a population of 111,926 representing 2.8% of the region’s total population [30]. Pharmaceutical
services in the district are delivered in private, public, quasi-governmental health centers and mission facilities. The provision of pharmaceutical care in the health delivery system in the municipality of La Nkwantanang-Madina is considered to be critical and is dominated by the private sector. The study population included dispensers at post in retail community pharmacies and their clients who had purchased oral anti-malarials for use and were exiting from the pharmacies. Pregnant women and individuals with cognitive disabilities who had purchased anti-malarials were excluded from the study.

This study employed an analytical cross-sectional approach among 61 selected community pharmacies in La Nkwantanang-Madina, from May to July 2017. A total of 122 retail community pharmacies and 36 wholesale outlets were obtained from Pharmacy Council, Ghana. This study employed a simple random sampling technique to select 61 community pharmacies, excluding wholesalers and licensed chemical shops. Data were gathered from three sources: dispensers, clients, and pharmacies.

Questionnaires were administered for data collection. The client and dispensers’ questionnaires were adapted from the WHO modified paper on good dispensing practices, as well as Training Manual for Licensed Chemical Sellers in Ghana [16]. Data obtained from respondents were collected, reviewed for completeness and entered using EpiData (Version 3.1). Double data entry was done to minimize errors and ensure the reliability of data collected.

The clients’ questionnaire captured data on age, gender, educational level, religion, marital status, National Health Insurance (NHI) registration status, rapid diagnostic test (RDT) check, client’s occupation, purchased drugs and dispensing information. Information on the number of times Pharmacy Council had visited the pharmacy within the last 6 months, availability of reference materials on Malaria Case Management (MCM) and availability of MCM wall chart were obtained from the dispensers in their respective pharmacies.

The client and dispenser data were merged and checked for internal consistency and completeness using simple summary statistics of the selected variables. Age of respondents (both dispensers and clients) were measured as completed years. Frequencies were used to describe the sociodemographic characteristics of dispensers and clients. Where there was evidence of skewness in the data, means were estimated for continuous variables after log transformation.

The dependent variable, dispensing practice was measured as a binary ordinal categorical variable (appropriate and inappropriate dispensing practices) (Table 1). This was assessed based on 13 key indicators for measuring dispensing practices (Table 4) [20, 27].

Chi square tests of associations were used to determine associations between the independent and independent categorical variables. Fisher’s exact tests were used when sample sizes were found to be small (< 5 per cell). Univariable and stepwise multivariable logistic regression analyses were performed to determine the predictors of dispensing practices at 95% confidence level and α-value of 0.05.

### Results

Overall, client sample size of 248 and 106 dispensers were obtained after data validation. However, there were 18 missing values in the client dataset. Therefore, 230 and 106 completed questionnaires were obtained for client and dispenser data, respectively.

Table 2 shows the characteristics of dispensers in community pharmacies at the time of the survey. Although hundred and twenty-four (124) dispensers initially consented to partake in the study, only a hundred and six (106) completed questionnaires were obtained in the 61 pharmacies visited. Females constituted 72%. The mean age of these dispensers was 30.4 (SD = 8.8) years ranging from 18 years to 70 years.

The characteristics of the study participants (clients) are presented in Table 3. More than half of the clients (60.9%) were females. The mean age was 33.70 (SD = 10.3) years and ranged from 15 years to 69 years. The majority (53.6%) were married. About thirty-nine percent (38.7%) had completed secondary school whereas primary and tertiary had nearly equal proportions of 25.0% and 25.4% respectively. Seventy-two (29.4%) clients were traders while 26.6% were artisans (Table 3).

More than half (58%) of the clients were given accurate directions on the use of their ACT’s with 88.7% being advised to complete the full course. However, most dispensers (88.3%) did not explain the 8-h loading dose principle to their clients (Table 4).

Chi square test for trends (Table 5) showed significant associations between each of the following variables: NHIS status (χ² = 5.69, p < 0.05), dispenser’s marital status (χ² = 6.55, p < 0.05), access to reference materials (χ² = 9.59, p < 0.05), type of recommender (χ² = 16.54, p < 0.05), awareness of guidelines (χ² = 5.38, p < 0.05) and dispensing practices.

A crude analysis of the association between dispensing practices and the predictor variables showed that marital status, access to reference materials, dispenser’s

### Table 1 Dispensing practice classification

| Score (n = 13) | Dispensing practice |
|---------------|---------------------|
| Less than 9   | Inappropriate       |
| At least 9    | Appropriate         |

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awareness of guidelines, National Health Insurance Scheme registration status and number of supervisory visits within the last 6 months were associated with the outcome of dispensing practices. However, adjusting for all other variables, dispenser’s age, level of education, professional category and level of experience were significant predictors of dispensing practices (Tables 5, 6).

Pharmacist interns were 18.5 times more likely to dispense anti-malarials appropriately compared to practicing pharmacists (AOR 18.50, 95% CI 1.40–245.6; \( p < 0.05 \)). Also, relative to dispensers with less than 2 years working experience, dispensers with more than 10 years’ experience were less likely to dispense Artemisinin Combination Therapy (ACT’s) appropriately (AOR 0.04, 95% CI 0.002–0.802; \( p < 0.05 \)). The most dispensed anti-malarial was artemether-lumefantrine (83.55), while atovaquone-proguanil was the least dispensed (Fig. 1).
Discussion
The over-consumption of oral anti-malarials in the private drug retail sector is a major threat to the health of the people. With concerns of overdiagnosis of malaria, poor dispensing and subsequent increase in antimicrobial resistance, key strategic options such as the distribution of rapid diagnostic test kits, peer education and training of dispensers in the private retail sector was done to scale up malaria prevention and treatment [28, 31, 32].

This study showed that dispensing practices for anti-malarials is generally unsatisfactory at the study site. With about 48% of dispensers (47.8%) dispensing anti-malarials inappropriately, a high fraction of inappropriate dispensing practices was similarly observed by Alotaibi and Abdelkarim in a survey conducted in Dawadmi, Saudi Arabia [33]. Consumers perceived that pharmacists (48%) do not give enough counselling about their medications [33]. The observation could, however, be attributed to time constraints either from the service provider or the client [34]. In connection to this, some authors
| Variables                        | Dispensing practices | χ² | p-value |
|---------------------------------|----------------------|----|---------|
|                                 |                      |    |         |
|                                 | Appropriate          |    |         |
|                                 |                      |    |         |
|                                 | Inappropriate         |    |         |
|                                 |                      |    |         |
| Age group                       |                      |    |         |
| 15–24                           | 14                   | 11.6 | 11   | 10.0 | 8.05 | 0.184  |
| 25–34                           | 59                   | 49.2 | 58   | 52.7 |        |        |
| 35–44                           | 29                   | 24.2 | 36   | 32.7 |        |        |
| 45+                             | 18                   | 15.0 | 5    | 4.6  |        |        |
| Total                           | 121                  | 100.0 | 110 | 100.0 |        |        |
| Sex                             | N = 120              | N = 110 |
| Male                            | 34                   | 28.3 | 33   | 30.0 | 0.08 | 0.802  |
| Female                          | 86                   | 71.7 | 77   | 70.0 |        |        |
| Educational level               | N = 120              | N = 110 |
| None                            | –                    | –    | –    | –    | 1.47 | 0.577  |
| Primary                         | 1                    | 0.8  | –    | –    |        |        |
| Secondary                       | 42                   | 35.0 | 36   | 32.7 |        |        |
| Tertiary                        | 76                   | 63.3 | 72   | 65.5 |        |        |
| Vocational/technical            | 1                    | 0.8  | 2    | 1.8  |        |        |
| NHIS status                     | N = 120              | N = 110 |
| Have NHIS                       | 59                   | 49.2 | 37   | 33.6 | 5.69 | 0.048* |
| Not have NHIS                   | 62                   | 51.2 | 73   | 66.4 |        |        |
| Professional category           | N = 120              | N = 110 |
| Pharmacist                      | 14                   | 11.8 | 15   | 13.6 | 6.51 | 0.239  |
| Medicine Counter Assistant      | 85                   | 71.4 | 88   | 80.0 |        |        |
| Pharmacy Technician             | 6                    | 5.0  | 2    | 1.8  |        |        |
| Pharmacy Intern                 | 11                   | 9.2  | 3    | 2.7  |        |        |
| Other                           | 3                    | 2.5  | 2    | 1.8  |        |        |
| Years of experience             | N = 119              | N = 110 |
| < 2 years                       | 28                   | 25.0 | 14   | 14.6 | 3.73 | 0.535  |
| 3–5 years                       | 41                   | 36.6 | 39   | 40.6 |        |        |
| 6–9 years                       | 31                   | 27.7 | 29   | 30.2 |        |        |
| > 10 years                      | 12                   | 10.7 | 14   | 14.6 |        |        |
| Marital status                  | N = 112              | N = 96 |
| Single                          | 82                   | 68.3 | 57   | 51.8 | 6.55 | 0.046* |
| Married                         | 38                   | 31.7 | 53   | 48.2 |        |        |
| Access to wall chart            | N = 120              | N = 110 |
| Yes                             | 13                   | 10.8 | 24   | 21.8 | 5.13 | 0.095  |
| No                              | 107                  | 89.2 | 86   | 78.2 |        |        |
| Access to reference material    | N = 120              | N = 110 |
| Yes                             | 53                   | 44.2 | 71   | 64.5 | 9.59 | 0.02*  |
| No                              | 67                   | 55.8 | 39   | 35.5 |        |        |
| Supervisory visits              | N = 120              | N = 110 |
| Once                            | 48                   | 40.0 | 58   | 52.7 | 10.71 | 0.127 |
| Twice                           | 40                   | 33.3 | 20   | 18.2 |        |        |
| Three times                     | 3                    | 2.5  | 5    | 4.6  |        |        |
| More than 3                     | 3                    | 2.5  | 0    | 0    |        |        |
| Can't remember                  | 26                   | 21.7 | 27   | 24.6 |        |        |
| Recommender                     | N = 120              | N = 110 |
have indicated interruptions during dispensing; low staff strength, inadequate knowledge, lack of training and dispen-
sers fatigue as likely causes of inappropriate dispensing prac-
tices [35]. This high rate of inappropriately dispensed
ACT medicines and poor counselling if not addressed
could impede progress in the fight against anti-malarial
resistance in Ghana.

This study could not clearly establish an association
between in-service training and dispensing practices. In
contrast, several studies have associated a positive rela-
tionship between training and dispensing practices. In
a study where, dispensing practice was measured as the
ability to identify the recommended anti-malarial, the
odds of knowing the recommended treatment was signif-
ically higher amongst participants with health training
[28].

Dispensers with more than 10 years’ experience were
less likely to dispense ACT appropriately (AOR = 0.04,
95% CI 0.002–0.802 p-value < 0.05) while pharmacy
interns were about 19 times more likely (AOR = 18.5,
95% CI 1.40–245.6 p-value < 0.05) to dispense ACT
appropriately compared to pharmacists. Hussein and
Ibrahim, in a similar study, reported that dispensers with
less than one-year work experience had a better knowl-
edge in Lahore, thus reflecting in their dispensing prac-
tices [4]. This might be linked to a greater number of
graduate pharmacists with updated knowledge on the
newer trends in managing diseases of common occur-
rence at the community level. Cordina et al. in their study
asserted that younger pharmacists identified more with
current trends in the practice of pharmacy relative to
their colleagues [36].

The role of accurate diagnosis with the newly intro-
duced rapid diagnostic test kits cannot be underes-
timated. Ansah et al., in a cluster randomized trial
conducted among LCS in the erstwhile Dangme West
District of Ghana, demonstrated that providing RDT’s
for malaria in the private drug retail sector significantly
reduced dispensing of anti-malarials to patients with-
out malaria [37]. However, some patients are not tested
prior to initiation of treatment for malaria. Findings
from this study reports that an overwhelming majority
(66%) of the patients were not tested before being dis-
pered oral anti-malarials (Fig. 2). This finding is con-
sistent with a similar study in Tanzania which reported
that about 98% of patients were treated presumptively
for malaria without performing an RDT [19]. This phe-
nomenon has been observed in the Ghanaian public
health facilities as well, as other reports suggest that
over 40% of patients were treated presumptively for
malaria [37, 38].

Brugha and colleagues have pointed out that moti-
vation for profit in the private health sector may
compromise the quality of care and numerous cross-
sectional studies have attributed this phenomenon to
inadequate training services for community pharmacy
attendants, lack of supervision by regulatory authori-
ties and the lack of confidence in the diagnostic test

| Variables                      | Dispensing practices |                |                |
|--------------------------------|----------------------|----------------|----------------|
|                                |                      | Appropriate     | Inappropriate  |
|                                | Frequency            | %              | Frequency      | %              |
| Dispenser                       | 67                   | 55.8           | 63             | 57.3           | 16.54          | 0.024*         |
| Relative                        | 16                   | 13.3           | 5              | 4.6            |                |                |
| Friend                         | 2                    | 1.7            | 0              | 0              |                |                |
| Self                           | 16                   | 13.3           | 30             | 27.3           |                |                |
| Media                          | 0                    | 0              | 2              | 1.8            |                |                |
| Unspecified                    | 19                   | 15.8           | 10             | 9.1            |                |                |
| Awareness of guidelines         |                      |                |                |                |                |                |
| Yes                            | 112                  | 93.3           | 92             | 83.6           | 5.38           | 0.019*         |
| No                             | 8                    | 6.7            | 18             | 16.4           |                |                |
| In-service training (last 12 months) |        |                |                |                |                |                |
| Yes                            | 24                   | 20.0           | 36             | 32.7           | 4.86           | 0.259          |
| No                             | 70                   | 58.3           | 53             | 48.2           |                |                |
| Can’t remember                 | 26                   | 21.7           | 21             | 19.1           |                |                |

Statistically significant associations are marked with *
Table 6 Univariate and multivariate logistic regression estimates of the socio-demographic predictors of appropriate dispensing practices of dispensers

| Characteristics                  | Crude OR (95% CI) | p-value | Adjusted OR (95% CI) | p-value |
|----------------------------------|-------------------|---------|----------------------|---------|
| **Age group**                    |                   |         |                      |         |
| 15–24 (reference)                | 1                 |         | 1                    |         |
| 25–34                            | 0.80 (0.24–2.72)  | 0.714   | 1.97 (0.31–12.61)    | 0.465   |
| 35–44                            | 0.63 (0.17–2.32)  | 0.482   | 7.76 (0.89–67.37)    | 0.063   |
| > 45                             | 2.82 (0.53–15.10) | 0.218   | 15.23 (25.91–5893.9) | 0.001*  |
| **Sex**                          |                   |         |                      |         |
| Male (reference)                 | 1                 |         | 1                    |         |
| Female                           | 1.08 (0.57–2.07)  | 0.80    | 0.95 (0.35–2.64)     | 0.927   |
| **Educational level**            |                   |         |                      |         |
| None (reference)                 | 1                 |         | 1                    |         |
| Primary                          | 1 (omitted)       | –       | 1 (omitted)          | –       |
| Secondary                        | 7.83e–7           | –       | 8.5e–7 (4.3e–8–1.7e–5) | 0.001*  |
| Tertiary                         | 7.03e–7           | –       | 9.2e–7 (5.4e–8–1.6e–5) | 0.001*  |
| Vocational/technical             | 3.36e–7           | –       | 5.8e–6 (1.22e–7–3e–4) | 0.001*  |
| **Professional category**        |                   |         |                      |         |
| Pharmacist (reference)           | 1                 |         | 1                    |         |
| MCA                              | 1.03 (0.33–3.22)  | 0.952   | 1.64 (0.43–6.25)     | 0.461   |
| Pharm. Technician                | 3.21 (0.42–24.71) | 0.255   | 1.90 (0.39–9.33)     | 0.421   |
| Pharm. Intern                    | 3.93 (0.53–29.08) | 0.176   | 18.5 (1.40–245.6)    | 0.03*    |
| Other                            | 1.61 (0.54–4.75)  | 0.383   | 4.91 (0.40–60.40)    | 0.208   |
| **Marital status**               |                   |         |                      |         |
| Single                           | 1                 | –       | 1                    |         |
| Married                          | 0.49 (0.25–0.99)  | 0.047*  | 0.20 (0.040–1.01)    | 0.051   |
| **NHIS status**                  |                   |         |                      |         |
| Have NHIS (reference)            | 1                 |         | 1                    |         |
| Don't have NHIS                  | 0.52 (0.27–0.99)  | 0.050*  | 0.41 (0.12–1.07)     | 0.067   |
| **Access to wall chart**         |                   |         |                      |         |
| Yes                              | 1                 | –       | 1                    | –       |
| No                               | 2.30 (0.85–6.23)  | 0.10    | 3.32 (0.85–13.00)    | 0.082   |
| **Experience**                   |                   |         |                      |         |
| < 2 years (reference)            | 1                 | –       |                      |         |
| 3–5 years                        | 0.53 (0.19–1.49)  | 0.219   | 0.47 (0.09–2.36)     | 0.348   |
| 6–9 years                        | 0.53 (0.15–1.92)  | 0.328   | 0.25 (0.026–2.50)    | 0.209   |
| > 10 years                       | 0.43 (0.10–1.75)  | 0.231   | 0.04 (0.002–0.802)   | 0.036*   |
| **Awareness of guidelines**      |                   |         |                      |         |
| Aware (reference)                | 1                 |         | 1                    |         |
| Unaware                          | 0.37 (0.15–0.86)  | 0.022*  | 0.45 (0.16–1.24)     | 0.122   |
| **Access to reference material** |                   |         |                      |         |
| Yes                              | 1                 | –       | 1                    |         |
| No                               | 2.30 (1.14–4.63)  | 0.020*  | 2.10 (0.61–7.20)     | 0.240   |
| **Supervisory visits**           |                   |         |                      |         |
| Once                             | 1                 | –       | 1                    |         |
| Twice                            | 2.42 (1.15–5.06)  | 0.020*  | 1.35 (0.38–4.84)     | 0.636   |
| Three times                      | 0.73 (0.25–2.08)  | 0.543   | 0.51 (0.12–2.14)     | 0.345   |
| > Three                          | 1 (omitted)       | –       | 1 (omitted)          | –       |
| Can't remember                   | 1.16 (0.55–2.50)  | 0.688   | 1 (omitted)          | –       |
| **Recommender**                  |                   |         |                      |         |
| Dispenser                        | 1                 | –       | 1                    | –       |
This finding illustrates the potential risk of malaria misdiagnosis which may accelerate the burden of anti-malarial resistance as has been recorded in South Eastern Asia [24, 26, 40]. Further research is, therefore, required to get the views and perception of dispensers. Monitoring and evaluation of training interventions may provide useful insights on dispensing practices. In so doing, pharmacists can introduce methods and strategies to expand their contribution in the dispensing process.

Study limitations
The study had some few limitations. Firstly, responses to dispensing practices and the last attendance to an in-service training may have been influenced by recall biases. Also, the cross-sectional nature of the study may limit the ability to infer causality.

The findings of this research may represent the reality in municipalities with comparable characteristics as the study site.

Conclusion
Community pharmacy dispensing practices were found to be unsatisfactory. Almost half of the clients (47.8%) were given inappropriate dispensing information on the use of their anti-malarials. Dispensers with more than 10 years working experience were less likely to dispense ACT medicines appropriately, while pharmacy interns were more likely to dispense ACTs appropriately. In view of this, strategies to educate and update the knowledge base of all dispensers focusing on those with more than 10 years working experience may be helpful. Education should be channeled on adherence and compliance to World Health Organization’s Test, Treat and Track initiative, as well to promote the appropriate use of anti-malarials.

Abbreviations
ACT: artemisinin-based combination therapy; AL: artemether–lumefantrine; CI: confidence interval; NMCP: National Malaria Control Programme; RDT: rapid diagnostic test; LCS: Licensed Chemical Sellers; PC: Pharmacy Council; NHI:

Table 6 (continued)

| Characteristics | Crude OR (95% CI) | p-value | Adjusted OR (95% CI) | p-value |
|-----------------|-------------------|---------|----------------------|---------|
| Relative        | 3.00 (1.18–7.68)  | 0.022*  | 7.40 (1.03–53.41)    | 0.047*  |
| Friend          | 1 (omitted)       | –       | 1 (omitted)          | –       |
| Self            | 0.50 (0.25–0.99)  | 0.046*  | 0.20 (0.07–0.53)     | 0.002*  |
| Media           | 1 (omitted)       | –       | 1 (omitted)          | –       |
| Unspecified     | 1.79 (0.66–4.85)  | 0.248   | 3.22 (0.78–13.35)    | 0.104   |

Statistically significant associations are marked with *
OR: odds ratio
National Health Insurance; MCM: Malaria Case Management; MCA: Medicine Counter Assistants; AOR: adjusted odds ratio; WHO: World Health Organization.

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Authors' contributions

CEA was the principal investigator for this project. He played active roles in the conceptualization, design, data collection, data analysis and drafting of the manuscript. HB was actively involved in the design of the project, its analysis and contributed immensely to the reviewing manuscript. KA contributed to the analysis and reviewing of the manuscript. PAN was the project supervisor and contributed to the drafting and reviewing of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets obtained and/or analysed during the current study are not available publicly, however, it will be made available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval for the study was granted by the Ghana Health Service—Ethics Review Committee (Approval Number: GHS-ERC 83/02/17). Additional approval by way of informed consent (written consent) was obtained from dispensers, clients and the owners of retail facilities prior to data collection.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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