# USING NAFDAC RECORDS AND CAPTURE-RECAPTURE METHODS TO TRACK THE POPULATION SIZE OF FAKE DRUG SYNDICATES IN LAGOS, NIGERIA

**Ugochukwu A. Osisiogu and Emeka E. Chinwuba**

*Department of Industrial Mathematics and Applied Statistics*

*Ebonyi State University Abakaliki, Nigeria*

*ABSTRACT*

*Most literature on fake drugs focus on the causes, sale and threat to human life, but none has examined the population size of the drug syndicates. This gap in the literature informed this study, because the syndicates are an integral part of the fake drug problem. Information on fake drugs was obtained from the National Agency for Food and Drug Administration and Control (NAFDAC), the agency responsible for checkmating illicit and counterfeit drugs in Nigeria. Four candidate estimators namely, Maximum likelihood (ML), Turing, Chao lower bound, and Zelterman, estimated the population of fake drug syndicates (FDSs) in Lagos to be 817, 1095, 1538, and 1657 respectively, while their weighted estimator was ($\widehat{N}_W$) = 1277. Since 613 syndicates were arrested from January to December 2022, while 1277 were estimated, this suggests that only about 48% of the total population size of FDSs in Lagos have been observed with 95% CI (1145; 1409), leaving about 52% still doing the illicit business. The study also shows that of all the offences observed, falsification of genuine drugs was the most rampant, followed by selling of expired drugs. In addition to establishing the population size of FDSs, the results of this study will provide information that will form the basis for resource allocation to NAFDAC zonal offices. The war against fake drugs may not succeed without investment in novel technologies that will improve NAFDAC's services. The result of this study will therefore help to advance the efforts to defeat the scourge of fake drugs.*

**Keywords:** fake drugs, fake drug syndicates, capture-recapture methods
**JEL classification:** I0

## 1. Introduction

Proliferation of fake drugs in Nigeria has resulted in the death of many Nigerians, especially children and old people. The National Agency for Food and Drug Administration and Control (NAFDAC), the agency responsible for combatting illicit and counterfeit drugs in Nigeria, reported that fake, adulterated, and substandard drugs resulted in the death of over 150 children as a result of paracetamol syrup containing diethylene glycol in 2001 alone NAFDAC (2007). Chinwendu (2008) also remarked: "the result of fake drug proliferation has led to treatment failures, organ dysfunction or damage, worsening of chronic disease conditions and the death of many Nigerians". Supporting this assertion, Akunyili (2004) noted: "the situation became so bad that even when patients were treated with genuine drugs, there was no response due to resistant[sic] caused by previous intake of fake drugs". The problem of fake drugs was so severe that neighbouring countries like Ghana and Sierra Leone, some time ago, officially banned the sale of drugs, food, and beverages made in Nigeria.

Gillian and Lawrence (2013) named the causes of fake drugs to include the neglect of good manufacturing practices (both accidental and deliberate), erratic supply and constant demand for medicine and weakness in the regulatory system, and inaccurate and inadequate tackling of the problem among health workers and the public.

Chinwendu (2008) noted that "Around 70% of drugs in Nigeria are imported, and India is a major exporter of these drugs", stating that "some Nigerian importers connived with some Indian manufacturers to produce fake and substandard drugs at a cheap rate with less active ingredients and sold them to Nigerian wholesalers at a cheap rate". This assertion was reaffirmed by a PSN (2019) report that the main sources of fake drugs in Nigeria were India, China, and Pakistan.

The problem of fake drugs assumed a dangerous dimension in the 1980s, when the granting of import licenses was eased, followed by worsened adverse effects of the Structural Adjustment Programme (SAP) introduced in the mid-

1980s. The situation progressively worsened until 2001 when NAFDAC started an aggressive war against the scourge (Osisiogu, Efor & Chinwuba, 2023). A survey conducted in 2004 in Nigeria by WHO, EU, Department for International Development (DFID) and Health Action International (HAI) showed that about 90.2% of Nigerians could not afford good quality medicine due to their income level (FMH, 2006). Many of them thus resorted to cheap medicines which, more often than not, were substandard or fake (Osisiogu, Efor & Chinwuba, 2023).

In order to check the proliferation of fake drugs, NAFDAC was established in 1994, to help create a fake-drug-free environment (NAFDAC, 2012). To ensure effective registration of good quality drugs supply, the Agency insisted that all drugs sold in Nigeria must have a NAFDAC number. In April 2001, a new NAFDAC management was inaugurated, led by Professor Dora Akunyili as Director-General. NAFDAC has since worked so hard to combat the sale of fake drugs, and to create consumer awareness that any drug without a NAFDAC number is fake.

The consistent raids by NAFDAC on pharmacy stores, vendors on the streets and in commercial buses has enabled the Agency to apprehend syndicates of these drugs. However, after some time, when things seemed to be getting better, these illegal drug sellers began again to emerge from their hideouts. Ghojazadeh & Mohammadi (2013) classified fake drugs as counterfeit, falsified, substandard, and unregistered drugs.

While the Nigerian government has been at war against fake drugs since the early 1980s, the concern about fake drugs became especially intense in 2001 when NAFDAC started a tough war against fake drugs. Seizure of fake drugs and arrest for possession was skyrocketed. Media attention to fake drugs increased and public increasingly saw it as one of the greatest problems facing the Nigerian health sector. Concern about fake drugs, however, peaked in the late 2005, when NAFDAC established many zonal offices in Nigeria, especially in the commercial cities of Lagos, Onitsha and Kano where the inflow of fake drugs were high.

Though the establishment of the zonal offices to check the spread of fake drugs was a welcome development, but to us it is only the beginning of the story and not the end of it. Those who import fake drugs, and those who distribute them to various shops in Nigeria, and those who market them on the streets, buses (we called syndicates) are also major contributors to the circulation of these drugs. The most worrisome thing about this monumental disaster is that the consumers of these drugs do not know the quality of drugs they are buying or taking.

Fake drug sellers are many and until their population size is known, all the fight to curtail the spread of fake drug circulation in Nigeria may be an exercise in futility. Unfortunately, the dealers of these drugs have no visibility of location. They migrate from one place to another, especially in the rural areas looking for a safe area to sell their products. Moreover, due to illegality and criminal nature of the business, it becomes really a big challenge to determine their population size. In other words, this hidden population requires a special technique to estimate its population size. Osisiogu & Chinwuba (2019) looked at the dangers imposed on the Nigerian health sector by fake drug sellers and proposed a technique known as capture-recapture to estimate their population size.

Lagos has 33 verified drug and pharmaceutical companies with Idumota as its drug market. The *Premium Times* August 12, 2021 edition reported that the Lagos State Ministry of Health, through its Taskforce on Counterfeit, Fake Drugs and Unwholesome Processed Foods, shut down 20 pharmacies for selling fake and expired drugs. *NAFDAC News* (2022), the official magazine of National Agency for Food and Drug Administration and Control on pages 82, 84 and 88 published the names of fake drug sellers apprehended and the offences they committed (See Table 1 below). This was the first genuine attempt by NAFDAC to take the bull by the horns. Unfortunately, this effort did not continue in the subsequent years.

### 1.1 Aims and objectives of the study

This study aims to estimate the population size of fake drug syndicates in Lagos, in southwestern Nigeria. This will provide data that would assist NADFAC in fighting the scourge of fake drugs. In that regard, the following objectives shall guide the study:

i. Use zero truncated Poisson model of capture-recapture method to estimate the population size of FDSs in Lagos, Nigeria;
ii. Construct candidate estimators of zero truncated Poisson model for estimating the population size of FDSs in Lagos, Nigeria;
iii. Construct weighted estimators to take care of differences that might arise from the candidate estimators;
iv. Use the study as appraisal of NAFDAC performance in the fight against fake drugs
v. Provide recommendations that will help NAFDAC and other stakeholders in their efforts to combat the scourge.

### 1.2 Organization of the study

The study consists of five sections. Section 1 is the introduction and provides the context, study aims and objectives, and the organization of the study. Section 2 presents the literature review on fake drugs and NAFDAC. Section 3 describes the materials and methods used in estimating the population size of FDSs in Lagos, Nigeria. While the results of candidate estimators of Poisson model used in the study are presented in section 4. Finally, section 6 gives some concluding remarks and suggestions for future research.

## 2. Literature Review

Most literatures on fake drugs and NAFDAC have focused on the causes, sale, the threat to human life, and measures to stop the spread, but none has examined the population size of the syndicates that distribute them to open drug markets. For instance, Akunyili (2004) highlighted the role medical doctors could play in eliminating fake and counterfeit medicines in Nigeria; while Joseph et al. (2015) wondered why Nigeria still had in existence open drug markets. Iweh et al. (2019) and Ufuoma et al. (2020) suggested exigent measures be taken by NAFDAC to ensure that there is strict compliance to the ban on potassium bromide as a bread additive. While Adegoke, Adegoke & Osokoya (2020) suggested ways NAFDAC could combat the sale of counterfeit and substandard medicines, while Olakunle, Olaniyi & Azeez.

(2023), and Ibrahim & Abidemi, (2015) highlighted using NAFDAC registration numbers and holograms as to check the authenticity of medicines before using them.

In each of these literatures reviewed, none researched the population size of fake drug syndicates (FDSs). NAFDAC itself chooses to publicize fake drugs more than FDSs. Its choice reflects the immediate political context and routine practices. This is what prompted us to begin this study. We therefore thought of a state-of-the-art method that could be used to estimate this hidden population.

## 3. Materials and Methods

### 3.1 Capture-recapture

Apart from being used to estimate animal abundance, capture-recapture has been proven to provide a reliable estimate of hidden populations (Martin, Owen & Karine, 2012). Since FDSs are a hidden population, we used capture-recapture methods in estimating its population size. The method relied on the pattern found in the observed part of the population to make inference on the unobserved part. From NAFDAC records, we identifies FDSs by their surnames, home and shop addresses, and phone numbers. If the identities of FDSs captured in the first, second or in other surveillances are the same or similar it is recaptured.

### 3.2 Zero-truncated model

Let $n$ denote the size of observed zero-truncated counts with $f_k$ being the frequency of observing exact counts. We used a description by Bohning & van Heijden (2019) that if arrest occurs only once, the entities are called singletons, twice are called doubletons, thrice are called tripletons, and so forth. According to the figures in Table 1, there are 430 singletons, 100 doubletons and 31 tripletons, that is number of FDSs caught by NAFDAC taskforces once, twice and thrice respectively and so on. Also indicated in Table 1 are the kinds of offences the syndicates committed.

Frequency counts of observed cases in a single or multiple registers to estimate unobserved cases give rise to zero truncated models. This method has been used to estimate the hidden populations of illicit drug users and homeless persons (Smite, Reinking, & Reijerse, 2002).

Consider a population of *N* size and count variable *Y* taking values from the set of integers {0, 1, 2, 3…}. In this study, *Y* might represent the number of times a syndicate is arrested and $f_0$, $f_1$, $f_2$, -----, the frequency with which a 0, 1, 2, ----, occurs in this population. Again, consider a list where every syndicate arrested is included except $Y = 0$, the syndicates that escaped arrest. This list reflects a count variable truncated at zero which we denote by $Y_0$. Accordingly, the list will have observed frequencies $f_1$, $f_2$, $f_3$, ---, but the frequency $f_0$ in the population is unknown. Hence, the cell $f_0$ is empty; and for us to have a reliable estimate of FDSs in Lagos this empty cell must be filled.

*NAFDAC News* and *NAFDAC Consumer Safety* are the monthly and quarterly newsmagazines of NAFDAC. The Agency uses them as its official medium of communication. They contain reports on fake drug possession and sales (see Table 1). But the question is: Is the figure in Table 1 the total number of FDSs in Lagos, Nigeria? In our considered opinion, it is not. There may be a lot of FDSs that escaped arrest by NAFDAC task forces. This number that escaped arrest must be estimated to enable us get nearer or possibly the exact population size of FDSs in Lagos.

**Table 1:** Frequency distribution (per count) of FDSs in Lagos, Southwestern Nigeria

| Kind of offence | Number of arrest cases per month | | | | | | | | | | | | n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $f_1$ | $f_2$ | $f_3$ | $f_4$ | $f_5$ | $f_6$ | $f_7$ | $f_8$ | $f_9$ | $f_{10}$ | $f_{11}$ | $f_{12}$ | |
| Falsified drugs | 234 | 70 | 13 | 10 | 6 | 4 | 0 | 0 | 1 | 1 | 0 | 1 | 340 |
| Expired drugs | 96 | 23 | 10 | 7 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 144 |
| Unregistered drugs | 57 | 6 | 7 | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 78 |
| Banned drugs | 43 | 1 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 |
| Total count of FDSs | 430 | 100 | 31 | 29 | 10 | 10 | 0 | 0 | 1 | 1 | 0 | 1 | 613 |

*Source:* Figures extracted from NAFDAC records covering January - December, 2022 by capture-recapture methods.

### 3.3 Candidate estimator

Under zero truncated Poisson model of capture-recapture, we have four candidate estimators namely, Maximum likelihood ($\widehat{N}_{MLE}$), Turing ($\widehat{N}_{T}$), Chao's lower bound ($\widehat{N}_{C}$), and Zelterman ($\widehat{N}_{Z}$).

- ***Maximum likelihood estimator***

We obtain the maximum likelihood estimator (MLE) for unknown parameter θ by maximizing the function $L$ (θ), i.e., differentiating with respect to θ and equating it to zero. MLE given by Bohning et al. (2005) is:

$$\hat{\lambda}_{MLE} = \frac{1}{n+f_0}(0f_0 + 1f_1 + 2f_2 + - - + mf_m)$$

If, for instance, we let $Y_i$ be the number of times the $i^{th}$ FDS is arrested over the surveillance period say $i$ = 1, 2, ------, $k$, under the zero-truncated Poisson model, the MLE shall be:

$$\widehat{N}_{MLE-p} = \frac{n}{1-\exp(\hat{\lambda}_{MLE})},$$ with variance given as:

$$\widehat{Var}(\widehat{N}_{MLE-P}) = \frac{\widehat{N}_{MLE-P}}{\left(exp\left(\frac{\sum kf_k}{\widehat{N}_{MLE-P}}\right) - \frac{\sum kf_k}{\widehat{N}_{MLE-P}}\right) - 1}$$

See Anan (2016) and Krisana & Yutthasak (2014).

- ***Turing estimator***

Turing estimation is formulated to estimate the number of classes, using the sum of probabilities of observed classes (Chao & Lee, 1992). Let $f_k$ be the frequency of FDSs apprehended exactly $k$ times; $k$ = 0, 1, 2, ---, $m$, where m is the largest observed case. The total number of captured FDSs can be defined as:

$$S = 1f_1 + 2f_2 + \cdots + mf_m$$

Under the zero-truncated Poisson model, the Turing estimator is given as:

$\widehat{N}_{T\_P} = \frac{n}{1-f_1/S}$, with variance derived as:

$$\widehat{var}\left(\widehat{N}_{T\_P}\right) = \frac{nf_1/S}{(1-f_1/S)^2} + \frac{n^2}{(1-f_1/S)^4}\left(\frac{f_1(1-\frac{f_1}{n})}{S^2} + \frac{f_1^2}{S^3}\right)$$

See Viwatwongkasam, Kuhnert & Satitvipawee (2008).

**• *Chao's lower bound estimator***

The estimators we have discussed so far are developed under the homogeneous Poisson model, but in practice it is rarely met. Anan (2016) stated that it is more suitable to incorporate heterogeneity. Under the Poisson zero-truncated capture-recapture method, Chao's lower bound estimator is given as:

$\widehat{N}_{C\_P} = n + \frac{f_1^2}{2f_2}$, with variance provided by as:

$\widehat{var}\left(\widehat{N}_{C\_P}\right) = \left(\frac{1}{4}\right)\frac{f_1^4}{f_2^3} + \frac{f_1^3}{f_2^2} + \left(\frac{1}{2}\right)\frac{f_1^2}{f_2}$ See Kaskasamku (2018).

**• *Zelterman estimator***

This is another candidate estimator. Because the Poisson assumption is frequently violated, Kaskasamku (2018) argued that homogeneity Poisson probability may be valid for a small range of *Y* from *k* to *k*+1. For example, singleton $f_1$and doubleton $f_2$ follow a homogeneous Poisson distribution, whereas other counts may arbitrarily be distributed (Bohning, 2008). Thus, the neighbouring frequencies $f_k$ and $f_{k+1}$ can be used to estimate a parameter $\Lambda$ by considering Poisson distributions of truncated and un-truncated with the estimator as:

$\widehat{\Lambda}_k = \frac{(k+1)f_{k+1}}{f_k}$.

If $k$ = 1, we find that $\widehat{\lambda}_1 = 2f_2/f_1$. The Zelterman estimator under the zero-truncated Poisson model therefore shall be:

$$\widehat{N}_{Z\_P} = \frac{n}{1-exp(-\lambda)} = \frac{n}{1-\exp(-\frac{2f_2}{f_1})},$$

with variance worked out by Meng (1997) as:

$$\widehat{var}\left(\widehat{N}_{Z_P}\right) = nG(\hat{\lambda})\left[1+ nG(\hat{\lambda})\hat{\lambda}^2\left(\frac{1}{f_1}+\frac{1}{f_2}\right)\right];$$

where: $nG(\hat{\lambda}) = \frac{\exp(-\hat{\lambda})}{1-\exp(-\hat{\lambda})}$ and $\hat{\lambda} = \frac{2f_2}{f_1}$. See (Rochetti, Bunge & Bohning, 2011).

## 4. Results

Having successfully reviewed the four candidate estimators, we now use them in the application. In Table 2, we notice that both the ML and the Turing estimators have small variances compared to the Zelterman and Chao estimators. In such a situation Rochetti, Bunge & Bohning (2011) suggested constructing a weighted estimator as:

$$N_W = \left(w_1\widehat{N}_{MLE} + w_2\widehat{N}_T + w_3\widehat{N}_C + w_4\widehat{N}_Z\right)/(w_1 + w_2 + w_3 + w_4),$$

where $\widehat{N}_{MLE}$, $\widehat{N}_T$, $\widehat{N}_C$ and $\widehat{N}_Z$ are the four candidate estimators of ML, Turning, Chao's lower-bound and Zelterman respectively. Since the true variances are unknown, Bohning & Heijden (2019) suggested using equal weights as follows:

$$N_W = \frac{1}{4}\left(w_1\widehat{N}_{MLE} + w_2\widehat{N}_T + w_3\widehat{N}_C + w_4\widehat{N}_Z\right)$$

**Table 2:** Result of estimate of population size of FDSs in Lagos, Nigeria

| Estimator | Obs. | Estimated | SE | 95% CI |
|---|---|---|---|---|
| MLE ($\widehat{N}_{MLE}$) | 613 | 817 | 27.50 | (764; 3257) |
| Turning ($\widehat{N}_T$) | 613 | 1095 | 47.87 | (1001;1189) |
| Chao ($\widehat{N}_C$) | 613 | 1538 | 131.99 | (1279;1797) |
| Zelterman ($\widehat{N}_Z$) | 613 | 1657 | 62.68 | (1534; 1780) |
| Weighted ( $\widehat{N}_W$) | 613 | 1277 | 67.50 | (1145; 1409) |

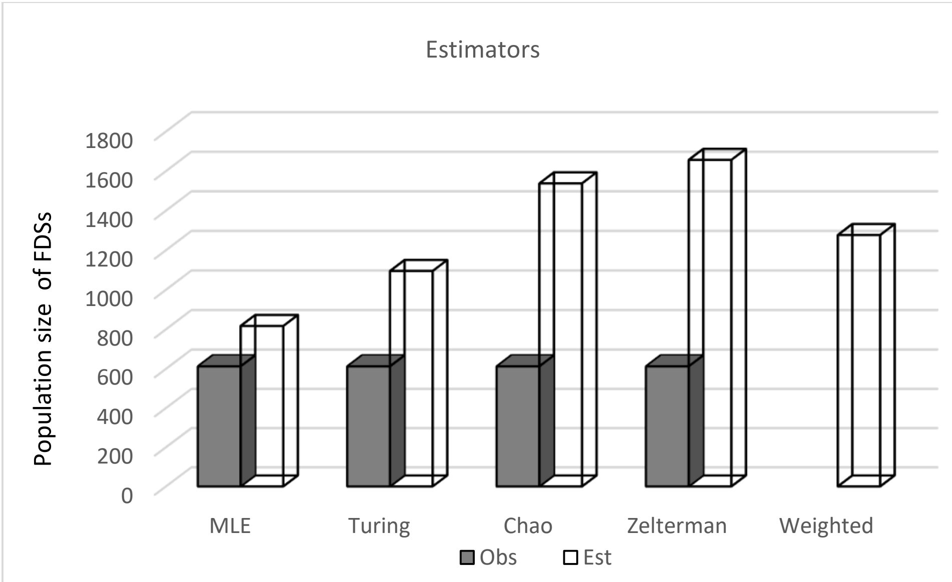


**Figure 1:** Histographs showing four candidate estimators and the weighted estimate.
*Note:* We took the weighted estimate because the four candidate estimators yielded different estimates.

In this study, we also categorize FDSs according to the offences they committed. The offences are falsification of genuine drugs, selling of expired drugs, unregistered drugs and banned drugs. Table 3 presents the results of the kind of offence committed, the observed arrest cases and the estimates using the four candidate estimators and the weighted estimator.

**Table 3:** Results of estimate of FDSs in Lagos by kind of offence committed

| Offence | Estimator | Obs. | Estimated | SE | 95% CI |
|---|---|---|---|---|---|
| Falsifying | MLE ($\hat{N}_{MLE}$) | 340 | 472 | 23.56 | (426; 518) |
| of drug | Turning ($\hat{N}_T$) | 340 | 630 | 39.80 | (552; 708) |
| | Chao ($\hat{N}_C$) | 340 | 731 | 72.05 | (590; 872) |
| | Zelterman ($\hat{N}_Z$) | 340 | 756 | 75.56 | (608; 904) |
| | Weighted ( $\hat{N}_W$) | 340 | 647 | 52.74 | (544; 751) |
| | MLE ($\hat{N}_{MLE}$) | 144 | 189 | 11.88 | (166; 212) |
| Selling of | | 144 | 236 | 18.76 | (199; 273) |

| Offence | Estimator | Obs. | Estimated | SE | 95% CI |
|---|---|---|---|---|---|
| expired | Turning ($\hat{N}_T$) | 144 | 344 | 60.15 | (226; 462) |
| drug | Chao ($\hat{N}_C$) | 144 | 379 | 30.34 | (320; 438) |
| | Zelterman ($\hat{N}_Z$) | 144 | 287 | 30.28 | (228; 346) |
| | Weighted ( $\hat{N}_W$) | | | | |
| Selling of unregistered drug | MLE ($\hat{N}_{MLE}$) | 78 | 105 | 9.77 | (86; 124) |
| | Turning ($\hat{N}_T$) | 78 | 142 | 21.48 | (100; 184) |
| | Chao ($\hat{N}_C$) | 78 | 349 | 132.79 | (89; 609) |
| | Zelterman ($\hat{N}_Z$) | 78 | 411 | 163.00 | (91; 731) |
| | Weighted ( $\hat{N}_W$) | 78 | 252 | 81.76 | (92; 412) |
| Selling of banned drug | MLE ($\hat{N}_{MLE}$) | 51 | 76 | 10.98 | (54; 98) |
| | Turning ($\hat{N}_T$) | 51 | 128 | 31.09 | (67;189) |
| | Weighted ( $\hat{N}_W$) | 51 | 102 | 21.04 | (61; 144) |

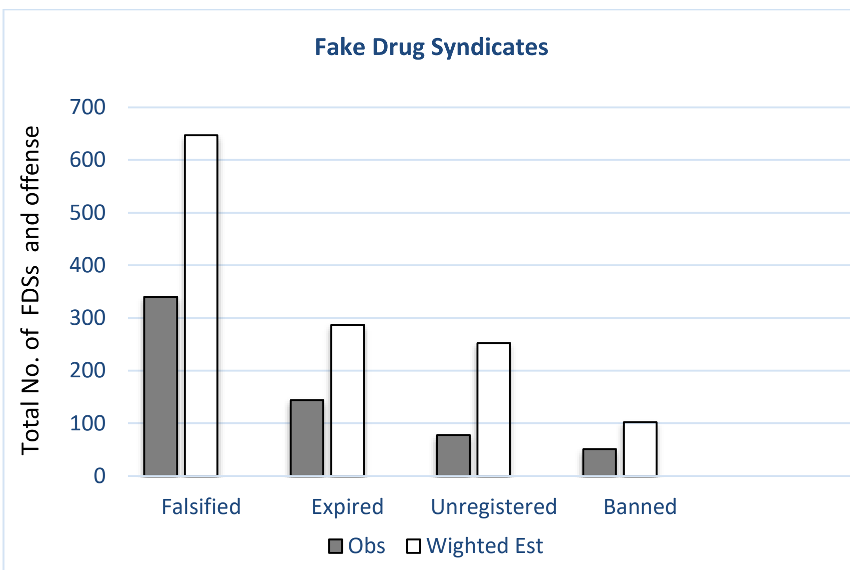


**Figure 2:** Histograph showing the observed cases of offences and the weighted estimates

## 5. Discussion

Before we begin the discussions on outcome of our findings, let us briefly discuss the importance of numbers in any research. Throughout the Western world today, there exists a general belief that one knows something only when it has been counted (Douglas, 1967). Several studies have looked specifically at the use of numbers in constructing drug problems. For instance, Orcutt & Turner (1993) examined how *Newsweek* transformed survey data to justify the claim that a cocaine epidemic was hitting the United States of America.

While considerable efforts have been made by NAFDAC to flush out fake drug circulation in Nigeria, this study calls for a state-of-the-art method. Often, the fight by NAFDAC has entailed the confiscation of counterfeit drugs which are published in various newspapers and other media outfits. But most research work on how the media handles numbers have shown that it is done for political purposes (Himmelstein, 2013). Having explained why numbers are very important in any research work, we now discuss our findings.

The results show (Table 2) that NAFDAC arrested 613 syndicates of fake drugs. While four candidate estimators namely, ML, Turing, Chao, and Zelterman estimated the population size of FDSs in Lagos to be 817, 1095, 1538 and 1657 respectively. The weighted estimator ($\widehat{N}_W$) of the four candidate estimators gives the population size of FDSs as 1277. Since 613 FDSs were arrested, this means that only about 48% of FDSs have been observed with 95% CI (1145-1409), leaving about 52% FDSs still in the distribution chain. The histograph in Figure 1 also confirmed it. This is in contrast with what happened in Onitsha, Southeastern, Nigeria where the scourge is high (Osisiogu, Efor, & Chinwuba, 2023). Their study found that only about 22% of the population of FDSs in Onitsha were observed, leaving about 78 percent of them still in the business.

We also looked at the most common offence committed.We observed that falsification of genuine drugs was the most committed offence, followed by selling of expired drugs. The four candidate estimators ML, Turing, Chao, and Zelterman yielded 472, 360, 731 and 756 respectively, while their weighted estimator yielded 647 with 95% CI (544 -751). In Onitsha, Osisiogu, Efor, & Chinwuba (2023) also found that falsification of genuine drugs was the most frequently committed offence, followed by selling of expired drugs.

## 6. Conclusion

NAFDAC chose to publicize fake drugs more than fake drug syndicates (FDSs). Its choice was to reflect the immediate political context and routine practices. We argued that FDSs are the cause of fake drug circulation in Nigeria. Since FDSs are a hidden population, we used a state-of-the-art method to estimate their population size.

Moreover, proper and regular record keeping of fake drug syndicates that have been arrested, which was advocated by Osisiogu, Efor, & Chinwuba (2023) is also reemphasized in this study. We therefore recommend as follows:

1. That NAFDAC records on fake drugs and FDSs shall not be for political context and routine practices alone, it shall be for appraisal of its performance;
2. To a large extent, surveillance of fake drug circulation and FDSs shall be carried out by a team of NAFDAC officers who are knowledgeable enough in statistics, mathematics etc.;
3. For more reliable record-linkage, NAFDAC shall keep files, specifying the nature of offence, name of the offender, etc.,
4. In that regard, we are advocating for the establishment of a research institute that will be funded by the Federal Government of Nigeria to help NAFDAC gather data on fake drugs and FDSs annually and arrange them for the purpose of statistical analysis. The institute will use the data to carry out comparisons. The comparisons over a period of time will help NAFDAC know the trend and current prevalence of all the illicit drug circulations in Nigeria.

   The limitation of this study is that only the population size of fake drug syndicates (FDSs) was estimated. Other researchers may seize the opportunity to use the same state-of-the-art method to estimate the prevalence of fake drug circulations in Nigeria.

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