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The Effect of Educational Intervention on Rational Prescribing in Public Health Facilities in Selected Local Government Areas of Rivers State: An Interventional Study

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Despite progress made so far in identifying intervention models to improve drug use, irrational use of drugs has remained a serious global health problem. The study intends to determine the effectiveness of an educational intervention on rational prescribing among prescribers in selected local government areas of Rivers State.
Methods: This was a quasi-experimental study that measured the effect of educational intervention on rational prescribing of drugs among prescribers in public health facilities in two selected Local Government Areas (LGA) of Rivers State: Ikwerre LGA (KELGA) which served as the control and Port Harcourt LGA (PHALGA) which served as the intervention by using cluster sampling with randomization. Paired data were analysed using McNemar's Chi-square test and the paired t-test. The level of significance was set at P≤ 0.05. The EPI-INFO version 7.02 statistical software was used in the analysis.

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Results: Findings showed that the largest category of prescribers was nurse/midwives representing 48.61% and 44.4% in the intervention and control LGA respectively. There was an improvement in the knowledge and attitude of respondents in the facilities in the intervention LGA at one month and three months post-intervention (P<0.05). The average number of drugs per encounter (ANDPE), the percentage encounters with an antibiotic (PEA), the percentage encounters with an injection (PEI) were lower for the interventions group compared to the control (P<0.05). Percentage generic drug prescription (PGD) was higher in the intervention group compared to the control (P=0.001).

Conclusion: Educational intervention was an effective and sustainable means of improving rational prescribing in the state. Update courses and continuing medical education on rational drug use should be held periodically for health care professionals by the State and National Primary Health Care Development Agency as well as other interested stakeholders.

Keywords: Primary health care; public health; drug prescribing.

1. INTRODUCTION

According to the words of Rolleston, *"Doctors pour drugs of which they know little, to cure diseases of which they know less, into patients to whom they know nothing* [1]. If this is so, what is Rational Drug Use? The World Health Organisation (WHO) conference on Rational Drug Use in 1985 defined that rational use of drugs requires that patients receive medications appropriate for their clinical needs, in doses that meet their own individual requirement for an adequate period of time, at the lowest cost to them and their community [2]. While the search for the "Gold Standard" of rational drug use indicators is in progress, studies have shown that prescriptions in Nigeria are potentially inappropriate and marked by polypharmacy [3,4]. The World Health Organization estimates that 50% of all medicines are prescribed, dispensed, sold inappropriately and patients fail to use them correctly [2]. This fact undermines the very fabric of therapeutic practice in medical science. Irrational, ineffective and economically inefficient use of drugs is commonly observed in health systems throughout the world,[5, 6] but is worse in developing countries [7,8]. Despite progress made so far in identifying intervention models to improve drug use, irrational use of drugs has remained a serious global health problem.[5] In fact, various forms of inappropriate prescribing often remain unnoticed by persons involved in the health sector-decision making or delivery of health services, and only receives attention when there is an acute shortage of pharmaceutical budget [9]. Appropriate use of medicines goes beyond economic considerations; but is an essential quality of medical care for patients and the community, particularly in Primary Health Care (PHC) settings. Studies in Nigeria indicate that patients' visits to public health facilities dropped by 50%-75% when the commonly used drugs were exhausted [10]. Governments in developing countries spend more of their national budgets on drugs and medical supplies, making the economic impact of pharmaceuticals on these economies substantial [11,12]. One study observed that in most developing countries such as Nigeria, pharmaceuticals are the largest public expenditure on health after personnel costs and the largest household health expenditure [10]. The substantial amount spent on drugs is one of the reasons why countries all over the world are concerned about drug use.

Studies done in Nigeria also indicate that drugs are a valuable health resource in developing countries and their availability is an indicator of the quality of care [10,13,14]. More so, the increasing cost of medicine and its irrational use is threatening the viability of many health systems in developed countries.[5].

Inappropriate use of drugs is a global problem.[2,15] Several studies conducted both in developed and developing nations have shown inappropriate prescribing patterns in form of poly pharmacy, over use of antibiotics and injections, and use of expensive and brand names.[16–18] These practices are common in both the public and private health sectors.

In 1985, World Health Organisation (WHO) convened a conference of experts in Nairobi Kenya where a set of drug use indicators was developed in order to standardize and effectively evaluate drug use practices.[19] These indicators have been extensively field-tested and found to be valid and reliable in primary health care (PHC) settings [19]. Indeed, the introduction of these indicators by WHO, has been described as one of the most notable achievements in the orchestrated effort at promoting rational drug use. The indicators provide objective and reproducible measures of the effectiveness and efficiency of drug use. They are very basic and do not need national adaptation and are recommended for inclusion in drug utilization Studies.

Irrational prescribing habits leads to ineffective and unsafe treatment exacerbation or prolongation of illness, adverse drug reactions, higher morbidity and mortality, pharmaceutical shortages, higher costs and wastage of resources [20]. Worthy of mention is the misuse of antibiotics and injections which promotes the development of resistant strains and transmission of blood-borne infections [21,22]. The consequences of irrational drug use constitute a serious global issue of public health interest necessitating the quest for the development of a sustainable and effective intervention module to improve drug prescribing in health facilities.

A study [23] conducted in Lagos, Nigeria, found 'appreciable' gaps in the knowledge of rational drug use among doctors who participated in the study. None of the doctors was able to enumerate the four steps recommended for good prescribing. Some, advocates of rational drug use do not accept variations in prescribing patterns that cannot be explained by purely clinical factors. Greenhalgh & Gill in their study informs that the prescriber who allows the "*Friday night penicillin*" phenomenon to sway his or her clinical judgment tends to do so surreptitiously and with a guilty conscience and that such behaviour is the rule rather than the exception [24]. Several studies have shown that the prescribing behaviour of even the doctors, is heavily influenced by their perceptions of the social background, beliefs, attitudes, and expectations of the patient, as well as the uncertainty of the diagnosis [25,26]. Some studies have also shown that patients who expect a prescription are many times more likely to receive one than those who do not.[27–29].

This study draws attention and interest to the need to improve prescribing practice. It provides answers to the feasibility and sustainability of the educational intervention in order to improve prescribing practice. Consequently, this will result in a reduction in the emergence of drug resistance (e.g. Antimicrobials), reduction in the unwanted adverse effect of drug therapy, reduction in unnecessary use of injections, improvement in overall quality and efficiency of therapy, improvement in availability and use of essential drugs and reduction in morbidity and mortality arising from the consequences of irrational use of medicines. Importantly, it will cause a reduction in the wastage of resources in the community. It is estimated that improvement in rational prescribing could save up to 50 – 70% of National expenditure on drugs [30].

2. METHODS

2.1 Study Area

Rivers State is located in the South-South region of Nigeria. It consists of 23 Local government Areas with a total population of 7,303,900 persons [31]. Rivers State has two tertiary hospitals located in Port Harcourt and Obio/Akpor Local Government Areas. There are forty secondary health care centers and three hundred and thirty-five primary health care centers in the state. The primary health care centers are not all functional but are currently being renovated and upgraded. Rivers state has a drug policy whose main thrust is the need for 'conscious effort' in order to achieve a rational use of drugs in Rivers State.

2.2 Study Population

The study population was drug prescribers in selected public primary health care facilities in Rivers State. All health staff involved in making prescriptions were eligible to participate in the study. The prescribers included doctors, community health extension officers, nurses, midwives and community health extension workers.

2.3 Study Design

This is a quasi-experimental study. (Non-randomized controlled study with pre-and post-test design).

2.3.1 The sample size for prescribing encounter

The sample size will be calculated using the formula for comparison of proportion [32].

$$n= \frac{(Z\alpha+Z\beta)^2 \times (p1(1-p1) + p2(1-p2))}{(p1-p2)^2}$$

Where;

n= minimum sample size required for each group
Z_α = standard normal deviation (at confidence level of 95%=1.96)

Z_{β} = standard normal deviation for statistical power (at 80%=0.84)
P1= proportion of medicine prescribed (study group) in a study by Akoria and Olowofela = 58.1% (0.581)
P1= proportion of medicine prescribed (control group) in a study by Akoria and Olowofela = 25.8% (0.258)
P1-P2= difference between the two proportions

$$n= \frac{(1.96+0.84)^2 \times (0.581(1-0.581) + 0.258(1-0.258))}{(0.581-0.258)^2}$$

n= 32.72 ≈33

Allowing for non-response of 10%, the minimum sample size will thus be 33+3 = 36 for each group.

Applying a Design Effect of 2, as a cluster sampling is applied for this site selection, the new sample size will be 36 x 2 = 72 for each group

2.3.2 Eligibility

The patient records or prescription encounter used in this study were obtained from the outpatient unit of the health facilities. All public primary health care facilities in both local government areas were included in the study.

2.4 Sampling Techniques

A cluster sampling technique was used.

Selection of local government areas:

Rivers state has a total of 23 LGAs, out of which 16 LGAs had at least ten functional public primary health centers. The WHO/International Network on Rational Use of Drugs (INRUD) recommends a minimum of ten health facilities per group (per L.G.A) [19]. Only LGA's with ten or more functional public primary health care facilities were selected for balloting. This is to ensure the international comparability of the result. The 16 LGAs therefore, constituted the sampling frame, from which two LGA's were selected by random sampling using balloting. The two selected LGA's were subjected to the second round of balloting. Port Harcourt LGA was selected as the intervention LGA while Ikwerre LGA served as the control LGA. Port Harcourt LGA has eleven primary health care facilities while Ikwerre LGA has ten.

2.5 Data Collection

Baseline data were collected initially, over a five-day period prior to intervention. Data was collected from the prescribers and facility outpatient records by the researcher and the research assistants from each facility. The instruments used for data collection were the self-administered questionnaire and the prescribing indicator form. The questionnaire was developed in line with the research objectives. The facility prescribing indicators form was developed from a similar model recommended by WHO/INRUD for drug use studies.[19] The facility prescribing indicators used for the present study were developed to be used as measures of performance in the area related to pharmaceutical prescribing practices by health providers in the primary health care. They are highly standardized, do not need national adaptation, and are recommended for inclusion in any drug use study using indicators. It provides a simple tool for quickly and reliably assessing a few critical aspects of pharmaceutical use in primary health care. Prescribing indicators utilized for the present study were: The average number of drugs per encounter (ANDPE), percentage encounters with an antibiotic (PEA), percentage encounters with an injection (PEI) and percentage generic drug prescription (PGD).

The educational intervention was then conducted only in Port Harcourt Local Government Area for another 5 days in the first month. The second post-intervention assessment was carried out for another 5 days three months post-intervention respectively. The post-intervention data were similarly collected from the prescribers and facility outpatient records by the researcher and the research assistants. The instruments used for data collection were the self-administered questionnaire and the prescribing indicator form. The self-administered, pre-tested, structured questionnaire consists of fourteen questions. The questionnaire had a total number of fourteen questions. Questionnaires were administered over an average period of thirty minutes. This instrument was used to collect data on the knowledge of prescribers on rational prescribing as well as the attitude of prescribers to rational prescribing. The body of the questionnaire had three sections. The first section provided information on the characteristics of the prescribers e.g. age and sex distribution. The second section provided information on the knowledge of prescribers to rational prescribing such as the meaning of rational prescribing. The third section provided information on the attitude of prescribers to rational drug use such as attitude towards branded medication, use of antibiotics and the use of injections.

The Prescribing indicator form was used to collect data in order to assess prescribing practice. The prescribing indicator form was used to collect data on the number of drugs per prescription encounter, number of generics per prescription encounter, presence of an antibiotic in the prescription encounter, number of drugs in the prescription encounter prescribed from the essential drug list and the presence of an injection per prescription encounter.

2.5.1 Pre-intervention phase

At the primary health care centres, the researcher introduced himself and his assistants and explained the purpose of the visit. Participants were assured of the confidentiality of all information given and neither their names nor identity will be required on the questionnaire. Written consent was sought and obtained. Questionnaires were distributed to the prescribers after explaining the contents and purpose of the study to them.

2.5.2 The intervention programme

This session lasted for 5 days. The authors agree this timeline is enough to communicate knowledge to practising health personnel. The health staff (prescribers) of the Port Harcourt LGA were exposed to educational intervention on the rational prescription of medicines. Preliminary analysis of drug use indices had shown areas of deficiency such as high use of injections and antibiotics. There were also attitudinal difficulties and knowledge gaps in understanding of rational use of medicines by prescribers. These were addressed in the educational intervention using:

- I Posters: These were posted strategically at the primary health care centers of the intervention LGA. The posters carried the messages on the definition of rational drug use, steps involved in rational prescribing and consequences of irrational prescribing. This created awareness among the participants before the commencement of the lecture.
- II Lectures: These were held for the prescribing staff of each primary health care center in the intervention LGA during the period of intervention. The lectures were held at each primary health care centre for an average period of about forty-five minutes and questions were addressed at the end of the presentation. Each session had about two to five participants per health centre. The lectures were interactive and covered the following topics:

A. Definition of rational drug use: Patients should receive medications that are appropriate for their clinical needs, in doses that meet their own individual requirements for an adequate period of time, at the lowest cost to them and their community
B. Consequences of irrational prescribing: Leads to ineffective and unsafe treatment, exacerbation or prolongation of illness, adverse drug reactions, higher morbidity and mortality, pharmaceutical shortages, higher costs and wastage of resources. It also promotes the development of resistant strains and the transmission of blood-borne infections.
C. Factors predisposing to irrational prescribing include patient pressure, heavy workload in the facility, knowledge deficit, peer pressure, cultural beliefs and inappropriate advertising. Others are poor regulations, inadequate supervision, incentives and high powered salesmanship, as well as lack of unbiased pharmaceutical information.
D. Indicators of rational prescribing. These are: average number of drugs per encounter, percentage of drugs prescribed by generic name percentage encounters with an antibiotic prescribed, percentage encounters with an injection prescribed and percentage of drugs prescribed from the essential drug list.
E. Advice on rational prescribing as recommended by WHO with special reference to the use of standard treatment guidelines and National essential drug list (NEDL). A few hypothetical prescriptions were then highlighted for criticism.

At the end of the session, participants were allowed to ask questions about the lecture they had received. They were also encouraged to express areas of difficulty anticipated in initiating rational drug use. The participants were very enthusiastic and many negative attributes predisposing to irrational drug use were discussed summarily. The lecture notes including the essential dug list were given to the participants for further revision. The posters were also left at facilities where they had been placed in order to reinforce the message.

2.5.3 Post-intervention

The PHCs were visited one after the other similarly as in the pre-intervention for data collection. Data were collected using the same instruments (self-administered questionnaire and prescribing indicator form) at one month and three months post-intervention in both study and control local government areas. This was done to assess the effect of the educational intervention programme and how much they have been able to retain information learnt after the intervention.

2.6 Data Analysis

The data obtained was analyzed by comparing the baseline data with data obtained at one month and three months after the intervention. The chi-square test was used for comparing differences in proportions and the student t-test differences in means. Paired data were analysed using McNemar's Chi-square test (nominal data) and the paired t-test (numeric data) [110]. The level of significance was set at Probability (p) values less than 0.05. The EPI-INFO version 3.5.1 statistical software was used in the analysis.

3. RESULTS

In Table 1, the highest proportions of prescribers were aged 30-39years in the intervention and control LGAs (36.11% and 36.11% respectively), while 34.72% and 30.56% of prescribers in the intervention and control LGAs respectively represent the youngest group of prescribers (aged 20-29years) who participated in the study. These proportional differences was not statistically significant (P=0.822). The highest proportions of prescribers were females in the intervention and control LGAs (63.89% and 61.11% respectively), (P=0.863). The largest category of prescribers in the health facilities were nurses and nurse/midwives (48.61% and 44.44%) in the intervention and control LGAs respectively. The differences in the number observed in the distribution of categories of health workers in the facilities are not statistically significant (P=0.644). The majority of prescribers in the intervention and control LGAs had worked for < 10 years (58.33% and 55.56% respectively), with no statistically significant difference observed (P=0.866).

In Table 2, none of the prescribers in the control LGA were able to define rational drug use at baseline as well as one month and three months after. In the intervention LGA, no prescriber was able to define rational drug use at baseline. However, 77.76% and 62.5% of the prescribers were able to do so in one month and three months after intervention respectively. These latter values of the intervention LGA were statistically significant respectively when compared with the baseline (P=0.001). Table 2 shows an increase in knowledge of prescribers who knew that drugs should be prescribed rationally from 45.83% to 100% in one month and three months after intervention in the intervention LGA. This difference was statistically significant (P=0.005). The difference in the control group was not statistically significant (P=0.962) in one month and three months after the intervention. In the control group, the knowledge of prescribers who agreed that rational prescribing improves the efficiency of therapy remained the same (48.61%) at one month and three months after the baseline study. In the intervention group, it increased from 45.83% to 94.44% at one month and three months after the intervention. This difference was statistically significant when compared to the baseline value (P=0.01). Finally, in the control group, the knowledge of prescribers who have knowledge of the existence of national essential drug list and standing order decreased slightly from 88.89% to 87.50% with no significant difference (P=0.955) at one month and three months after baseline study. In the intervention group, it increased from 90.28% to 100.0% at one month and three months after the intervention. This difference was not statistically significant (P=0.757).

In the control LGA, 26.39% of prescribers preferred the use of injections at baseline (Table 3). This increased to 34.72% and then 30.56% at one and three months later respectively. These are, however, not statistically significant (P>0.05). In the intervention LGA, the proportion of prescribers who preferred injections at baseline was 27.78% and decreased to 4.17% one month after the intervention and 6.94% three months after the intervention. These values were statistically significant when compared to the baseline value (P<0.05). In the control LGA, there was no statistically significant change in the proportion of health workers who preferred to prescribe antibiotics always (P > 0.05) at one month and three months respectively. In the intervention LGA however, the proportion of prescribers who preferred to prescribe antibiotics fell to 0% at one month and three months post-intervention. This difference was statistically significant (P=0.001) when compared with the baseline value of 25.0%. The change in the proportion of prescribers who agreed that prescribing skills should be continually improved upon in both control and intervention LGA was not statistically significant when compared with their baseline values respectively (P>0.05). The table shows that 15.28% of prescribers in the control LGA preferred to prescribe a large number (>4) of drugs at baseline, one month and three months after, although not statistically significant (P=0.819). In the intervention LGA, this dropped from 18.06% to 0% at one month and three months respectively. This reduction in the intervention group was statistically significant at one month and three months when compared with the baseline (P=0.001).

Table 4 shows that the changes in ANDPE at the control LGA are not statistically significant at one month and three months after when compared with the baseline (4.50 vs. 4.61, P = 0.701; 4.50 vs. 4.56, P= 0.811 respectively), i.e. P>0.05. At the intervention LGA, the average number of drugs per encounter fell from 4.88 to 3.66 and 3.72 in one month and three months post-intervention. This difference was statistically significant when compared to baseline (P=0.01) i. e. P<0.05.

The percentage encounter with an antibiotic in the control group in one month and three months post-intervention was not statistically significant as compared to the baseline value. However, the percentage encounter with an injection in the intervention group fell from 26.97% to 6.67% and 10.61% in one month and three months respectively. This decrease was statistically significant when compared with the intervention baseline value (P=0.001).

The values in the control group showed no statistically significant changes in one month and three months of study with P>0.05. (P=0.50 and 0.50 respectively). In the intervention LGA, the decrease in the percentage encounter with an injection in one month and three months post-intervention (16.97% vs. 5.45% and 5.76%) was statistically significant when compared to the baseline value respectively (P=0.001).

There was no statistical difference in the percentage of drugs prescribed from the essential drug list (PEDL) in one month and three months in the control and Intervention LGAs with P>0.05 (Table 5). The table also shows that in the control LGA the differences in percentage generic drug prescription (PGD) are not statistically significant (P>0.05). In the intervention LGA however, there was a statistically significant number of generic drug prescriptions in one month (59.59% vs. 76.08%) and three months (82.69% vs. 69.19%) post-intervention compared to the baseline values (P=0.001).

4. DISCUSSION

This study showed that the prescriber's knowledge of rational prescribing at baseline was poor in both Port Harcourt and Ikwerre Local Government Areas. Poor knowledge of rational prescribing has similarly been observed in several Nigerian studies conducted by O Brian [33], Ajemigbitse et al [34], and Agu et al [35]. This finding is also similar to that of Chukwuani et al who also found that there are huge knowledge gaps existing amongst doctors in Lagos [23]. The study carried out involved all cadre of prescribers and it was found that the knowledge of prescribers, in general, appears to be deficient. This is to the extent that no prescriber was able to accurately define or explain the meaning of rational drug use prior to intervention. Knowledge has been found to be a very important factor influencing drug use [36]. Poor knowledge results in poor prescribing habits. Interestingly, in the intervention LGA, the value of the knowledge which was found to be poor at baseline in this study, improved to excellent in the intervention LGA following education, at one and three months assessment post-intervention. Thus, the intervention led to an improvement in the knowledge of prescribers. Improvement in knowledge achieved by educational intervention has similarly been demonstrated by Ekedahi et al [37] in Sweden and by Ajemigbitse et al[34] in Nigeria. According to Parks et al, education is meant to improve knowledge, and knowledge shapes attitude which in turn affects behaviour/practice [38]. This was confirmed as the improvement in knowledge translated into an improvement in attitude to rational prescribing seen in this study. The appropriateness of the prescriber's attitude towards prescribing *less number of injections*, *necessary antibiotics, less number of drugs* and *branded medications* was achieved following an educational intervention. These attributes as attitudes improved in the intervention LGA one month after the educational intervention. The

Table 1. Biodata of participants

Characteristics	Intervention LGA n_1=72		Control LGA n_2=72		χ^2 *(p-value)*
	Freq (n)	Percentage (%)	Freq (n)	Percentage (%)	
Age					
20-29	25	34.72	22	30.56	
30-39	26	36.11	26	36.11	0.39 (0.822)
≥40	21	29.17	24	33.33	
Sex					
Male	26	36.11	28	38.89	0.03 (0.863)
Female	46	63.89	44	61.11	
Categories of Health workers					
Doctors	20	27.78	18	25.0	0.88 (0.644)
Nurses and Nurse /midwives	35	48.61	32	44.44	
CHEW and JCHEW	17	23.61	22	30.56	
Working Experience (years)					
<10	42	58.33	40	55.56	0.03 (0.866)
≥10	30	41.67	32	44.44	

χ^2=*Chi-Square*

Table 2. Analysis of the knowledge of rational prescribing among prescribers after an intervention

Characteristics	Intervention LGA n_1=72		Control LGA n_2=72	
	Freq (n)	Percentage (%)	Freq (n)	Percentage (%)
Prescribers who are able to define rational drug use				
Baseline	0	0.0	0	0.0
One-month post intervention	56	77.76	0	0.0
χ^2 *(p-value)*	34.26 *(0.001)**		-	
Baseline	0	0	0	0.0
Three-month post intervention	45	62.5	0	0.0
χ^2 *(p-value)*	41.2 *(0.001)**		-	
Prescribers who knew that drugs should be prescribed rationally				
Baseline	33	45.83	34	47.22
One-month post intervention	72	100.0	35	48.61
χ^2 *(p-value)*	7.84 *(0.005)**		0.00 (0.962)	

Characteristics	Intervention LGA n_1=72		Control LGA n_2=72	
	Freq (n)	**Percentage (%)**	**Freq (n)**	**Percentage (%)**
Baseline	33	45.83	34	47.22
Three-month post intervention	72	100.0	35	48.61
χ^2 *(p-value)*	7.84*(0.005)**		0.00 (0.962)	
Prescribers who agreed that rational prescribing improves efficiency of therapy				
Baseline	33	45.83	35	48.61
One-month post intervention	68	94.44	35	48.61
χ^2 *(p-value)*	6.58 *(0.01)**		0.02 (0.884)	
Baseline	33	45.83	35	48.61
Three-month post intervention	68	94.44	35	48.61
χ^2 *(p-value)*	6.58 *(0.01)**		0.02 (0.884)	
Prescribers who have knowledge of existence of national essential drug list and standing order				
Baseline	65	90.28	64	88.89
One-month post intervention	72	100.0	63	87.50
χ^2 *(p-value)*	0.09 (0.757)		0.00 (0.955)	
Baseline	65	90.28	64	88.89
Three-month post intervention	72	100.0	63	87.50
χ^2 *(p-value)*	0.09 (0.757)		0.00 (0.955)	

***Statistically significant (p<0.050); χ^2=Chi-Square*

Table 3. Analysis of the attitude of prescribers to rational prescribing after the intervention

Characteristics	Intervention LGA n_1=72		Control LGA n_2=72	
	Freq (n)	**Percentage (%)**	**Freq (n)**	**Percentage (%)**
Prescribers who preferred the use of injections				
Baseline	20	27.78	19	26.39
One-month post intervention	3	4.17	25	34.72
χ^2 *(p-value)*	9.51 (*0.002)**		0.38 (0.535)	
Baseline	20	27.78	19	26.39
Three-month post intervention	5	6.94	22	30.56
χ^2 *(p-value)*	6.57 *(0.01)**		0.06 (0.813)	

Characteristics	Intervention LGA n_1=72		Control LGA n_2=72	
	Freq (n)	Percentage (%)	Freq (n)	Percentage (%)
Prescribers who preferred to prescribe antibiotics always				
Baseline	18	25.0	11	15.28
One-month post intervention	0	0.0	11	15.28
χ^2 *(p-value)*	14.23 *(0.001)**		0.05 (0.819)	
Baseline	18	25.0	11	15.28
Three-month post intervention	0	0.0	14	19.44
χ^2 *(p-value)*	14.23 *(0.001)**		0.11 (0.736)	
Prescribers who agreed that prescribing skills should be continually improved upon				
Baseline	65	90.28	61	84.72
One-month post intervention	72	100.0	61	84.72
χ^2 *(p-value)*	0.09 (0.757)		0.02 (0.902)	
Baseline	65	90.28	61	84.72
Three-month post intervention	72	100.0	61	84.72
χ^2 *(p-value)*	0.09 (0.757)		0.02 (0.902)	
Prescribers who preferred to prescribe large number of drugs				
Baseline	13	18.06	11	15.28
One-month post intervention	0	0.0	11	15.28
χ^2 *(p-value)*	10.08 *(0.001)**		0.05 (0.819)	
Baseline	13	18.06	11	15.28
Three-month post intervention	0	0.0	11	15.28
χ^2 *(p-value)*	10.08 *(0.001)**		0.05 (0.819)	

Statistically significant (p<0.050); χ^2=Chi-Square

Table 4. Analysis of average number of drugs per encounter (ANDPE), Percentage encounter with an antibiotic (PEA) and Percentage encounter with an injection (PEI)

Characteristics	Intervention LGA n_1=72		Control LGA n_2=72	
	Mean ± SD/ (%)	**t-test/χ^2 (p-value)**	**Mean ± SD/Freq (%)**	**t-test/χ^2 (p-value)**
Average number of drugs per encounter (ANDPE)				
Baseline	4.88 ± 4.38	5.85	4.50 ± 4.62	0.40
One-month post-intervention	3.66 ± 4.58	*(0.01)**	4.61 ± 4.58	(0.701)
Baseline	4.88 ± 4.38	5.07	4.50 ± 4.62	0.24
Three-month post-intervention	3.72 ± 4.13	*(0.01)**	4.56 ± 4.13	(0.811)
Percentage encounter with an antibiotic (PEA) (I=330; C=300)				
Baseline	89 (26.97)	33.68	80 (26.67)	0.02
One-month post-intervention	22 (6.67)	*(0.001)**	77 (25.67)	(0.902)
Baseline	89 (26.97)	19.03	80 (26.67)	0.04
Three-month post-intervention	35 (10.61)	*(0.001)**	76 (25.33)	(0.854)
Percentage encounter with an injection (PEI) (I=330; C=300)				
Baseline	56 (16.97)	16.58	86 (28.67)	0.00
One-month post-intervention	18 (5.45)	*(0.001)**	85 (28.33)	(0.985)
Baseline	56 (16.97)	15.46	86 (28.67)	0.00
Three-month post-intervention	19 (5.76)	*(0.001)**	85 (28.33)	(0.985)

Statistically significant (p<0.050); χ^2=Chi-Square

Table 5. Percentage of drugs prescribed from the essential drug list (PEDL) and Percentage generic drug prescription (PGD) after an intervention

Characteristics	**Intervention LGA n_1=72**		**Control LGA n_2=72**	
	Mean ± SD/(%)	**t-test/χ^2 (p-value)**	**Mean ± SD/Freq (%)**	**t-test/χ^2 (p-value)**
Percentage drugs prescribed from the essential drug list (PEDL) (I n_1=1611, n_2=1227; C n_1=1351, n_2=1383)				
Baseline	1124 (69.77)	2.09	853 (63.14)	0.29
One-month post-intervention	919 (76.08)	(0.147)	904 (65.37)	(0.592)
(I n_1=1611, n_2=1208; C n_1=1351, n_2=1367)				
Baseline	1124 (69.77)	1.73	853 (63.14)	0.28
Three-month post-intervention	912 (75.50)	(0.188)	893 (65.98)	(0.599)
Percentage generic drug prescription (PGD) (I n1=1611, n2=1208; C n1=1351, n2=1383)				
Baseline	960 (59.59)	16.45	760 (56.25)	0.00
One-month post-intervention	919 (76.08)	*(0.001)**	781 (56.47)	(0.977)
(I n_1=1161, n_2=1227; C n_1=1351, n_2=1367)				
Baseline	960 (82.69)	7.98	760 (56.25)	0.00
Three-month post-intervention	849 (69.19)	*(0.001)**	770 (56.33)	(0.990)

**Statistically significant (p<0.050); χ^2=Chi-Square; I $n_{1=}$ The number of drugs available for the intervention group at baseline; I $n_{2=}$The number of drugs available for the intervention group at one and three months; C $n_{1=}$ The number of drugs available for the control group at baseline; C $n_{2=}$ The number of drugs available for the control group at one and three months* improvement was also significantly sustained three months after the intervention. Interestingly, over 90% of health workers (prescribers) who participated in this study acknowledged that they were influenced into irrational drug use by the factors such as workload in the facility, unethical drug promotions, incentives, patients demand for a particular drug, peer pressure etc. These were found to be similar to those already mentioned in previous studies [34,39]. Their influence reduced significantly following educational intervention in Port Harcourt, the intervention LGA (to less than 35%) at one month and three months post-intervention (P=0.001). More so, the commonest influencing factor was the patient's demand for a particular drug from the prescriber, also called the '*Friday night penicillin*' syndrome [24]. The attitude of entertaining patient's demands was significantly reduced in the facilities in Port Harcourt after the intervention exercise. Similar improvements were also observed with the other negatively influencing factors. The implication of this improvement in prescribing habits is a more efficient drug use pattern with less wastage of resources, better treatment outcomes and safer therapies [5]. This study further revealed that the percentage of subscribers who accepted that the essential drug list/standing order (unbiased information about appropriate drug choice) will influence their prescriptions was no more than 36-38% in the facilities in the control LGA all through the study and in the intervention LGA at baseline. The value rose significantly, following an educational intervention. This improvement in the number of prescribers now influenced by appropriate information on drug use expectedly translated to better prescribing behaviour. Indeed, as argued by Maxwell[40], good drug information is basic to making rational decisions on drug use. Essential drugs are safe effective drugs of good quality and local appropriateness [41]. Their use is associated with rational prescribing, cost-effectiveness and reduction in morbidity [42]. Collated attitude to rational drug use, improved significantly only in the intervention LGA at one month and three months after the educational intervention exercise; from good to excellent attitudinal disposition. Therefore educational intervention can change the prescriber's attitude to be positively oriented towards rational prescribing. Improvement in attitude will translate to better prescribing practice which is akin to efficient and effective use of drugs in the health facilities.

The ANDPE in Nigeria is 3.8.[19] This is also similar to values from a study in Nigeria by Tamuno and Fadare who observed a value of 3.04 [16]. The present study found the ANDPE to be 4-5 drugs pre-intervention. However, it reduced significantly to 3-4 drugs in the facilities at Port Harcourt for up to three months after the intervention exercise. The reduction was still less than values observed in another Nigeria study [43] but still above the ANDPE worldwide (2-3 drugs per encounter),[44] and higher than in most countries like Bangladesh and Lebanon [45]. This suggests a better and efficient drug use pattern with less polypharmacy. Although the ANDPE after intervention remained higher than the benchmark set at 1-2 drugs per encounter, it is possible that reinforcement and updating education could reduce the ANDPE to values similar to the benchmark. However, the value after the intervention is better than that obtained by Bosu et al in the Wassa West district of Ghana.[46].

The PEA was reduced significantly at one month and three months in the intervention LGA to figures all less than values observed in other Nigeria studies, 50.3%[23] and 42%.[47] The values after intervention are still very low than the very high value of 80% documented by Bosu et al in Ghana.[46] Indeed, the antibiotic usage in Port Harcourt and Ikwerre LGAs appears to be lower than that observed in other countries and most regions of Nigeria. This is good but the appropriateness of even this proportion needs to be further validated using standard treatment guidelines. In order words determining rational prescribing by percentages alone is not enough. The appropriateness of the antibiotic (or other drugs) prescribed is important in relation to the diagnosis so as to determine the necessity and adequacy of such prescribing practices. However, reduction in the use of antibiotics is of pertinent public health importance because it eventually translates into a reduction in wastage of resources as well as a reduction in the development of resistant strains.[48].

This study found the value of PEI in the intervention LGA to reduce significantly at one month and three months after. This is attributable to the effective educational intervention in the facilities. Considering the negative consequences of inappropriate injections,[49] this improvement is remarkable and worthy of promotion. Prawitasari et al found that PEI to be 60% in Indonesia.[50] Though a lower value of 0.2% was documented in a study by Karande et al in Pakistan [51], the conformity of prescription to standard treatment guidelines is of critical importance in ascertaining good prescribing.

Percentage generic drug prescription was found to be about 56.25% all through the study in the control LGA. It was also found to be 59.59% in the intervention LGA at baseline. In a study carried out in Warri[42], the value of PGD was estimated to be 54%, 48.9% in Sagamu [52] and 42.7 % in Kano.[16] Following the intervention carried out in this study, the value improved one month and three months after, respectively. Recurrent education will likely achieve the goal of raising the PGD to as near 100% as possible in order to guarantee that drugs use is safe and cost-efficient.

Percentage prescriptions emanating from the essential drug list was found to be between 63-65% in the control LGA. However, in the intervention LGA the values improved after intervention in the health facilities (60-76%), although this finding was not statistically significant but still demonstrates the effectiveness and sustainability of the educational intervention in shifting prescribers behaviour more towards the use of the essential drug list. However, more effort is necessary because the values obtained for PEDL after intervention in the intervention facilities are still low as the more drugs are prescribed from the essential drug list, the more likely the prescriptions are to be rational, cost-effective and efficient.[5] The improvement in percentage prescriptions emanating from the essential drug list is therefore of public health importance since it translates into an improvement in treatment outcomes in the facilities and reducing wastages; as rational drug use, therefore, reduces morbidity and mortality in the health facilities [42].

5. CONCLUSION

The study showed that knowledge of rational prescribing was inadequate at baseline in both facilities. However, after the intervention, knowledge improved tremendously at one month and three months post-intervention respectively in the intervention facility (P<0.05). Similarly, following the intervention, attitude also rose significantly in the intervention LGA at one month and three months post-intervention respectively (P<0.05). In addition, there was an improvement in all the core prescribing indicators namely ANDPE, PEA, PEI, and PGD as accessed at one month and three months post-intervention in the intervention LGA (P<0.05). However, there were no demonstrable statistically significant differences in ANDPE, PEA, PEI, PGD and PEDL in the control LGA at one month and three months assessment in the study (P>0.05).

From the foregoing, educational intervention was effective in improving the knowledge, attitude and practice of prescribers towards rational drug prescribing. Although a limitation in this study is its inability to confirm if the intervention model used is appropriate for all types of health workers. And so the authors feel there is a need for further development and evaluation of educational methods for drug prescribers. Applicably, an educational intervention can be employed as an intervention measure to promote rational drug prescribing in public health facilities.

CONSENT

Informed consent (written) was obtained from the health staff who participated in the study. Information obtained in the course of the study was treated with strict confidentiality. The project conferred no known risk on the research participants. Participants were treated with the utmost respect. After the study, the Ikwerre LGA also received similar educational intervention as was done in Port Harcourt LGA.

ETHICAL APPROVAL

Ethical permission for the study was granted by the training institution University of Nigeria Teaching Hospital Ethics Committee, Enugu (UNTH/CSA.329/VOL.5). Permission was also given by the Primary Health Care Department of the Ministry of Health, Rivers State.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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