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Research Paper

Economic Implications of Packaging of Some Multi-Dose Eye Drops

Medical Science

KEYWORDS : Economic implications, eye drops, packaging volumes, multi-dose

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ABSTRACT

Background: Economic recession is a global issue and as such, many nations, corporate organizations and individuals are applying measures to reduce waste. Pharmaceutical companies who make multi-dose eye drops are advised to key into this principle in order to reduce cost in health care delivery. Objective: To determine the volumes of multi-dose eye drops that are needed for one course of treatment to determine how these tally with the volumes of eye drops packaged. Methodology: Twelve (12) multi-dose eye drops were dispensed to hypothetical patients and the number of drops in a 28 day course of treatment calculated. The number of drops per bottle was divided by the frequency of application per day to get the observed duration in days. The excess or deficit in days after 28days was converted into volume (mls). Results: Out of the twelve different topical eye drops used in the study, seven packaged in 10mls volume had observed excess days ranging from 25 to 78 days. Those packaged in 5mls volume but were used four times a day had deficit of one day (they lasted only 27 days) while those packaged in 5mls volume but were applied two times daily had excess of 25 days. Latanoprost which was applied once a day packaged in 2.5mls volume had excess of 22days.
Conclusion: The selected eye drops evaluated in this study were not packaged in optimal volumes. Drug manufacturers are encouraged to improve on the formulation of these eye drops to increase their half-lives thereby reducing frequency of administration and packaged volumes.

Introduction
With the global economic recession, many nations, federating units and corporate bodies have learnt to maximize both human and material resourses[1]. Even families and individual are not left out. What used to be regarded as waste materials have now been recycled and turned into raw materials. In effect, nations, corporate organizations, and individuals have declared zero tolerance for wastage[1,2].

In spite of these realities, wastages still persist in some corporate and individual lives. In ophthalmology, the drug companies who produce multi-dose eye drops usually instruct the users to discard multi-dose eye drop containers 28days after opening them[3,4,5,6]. The packaging of these eye drops come in different volumes of 2.5 mls (Latanoprost), 5 mls (Timolol, fluconozole), 10 mls (Timolol, chloramphemcol, Gentamycin), and 15 mls (chlormphenicol).

Experience shows that majority of these patients do not use these medications for up to four weeks especially in non chronic conditions thereby leaving a large volume of the eye drops unused. This also occurs in situations where the drops are applied once or twice daily. On the other hand, some of these eye drops are applied three or four times daily and occasionally more frequently[7], thereby rendering the eye drops insufficient. The optimization of the eye drops during packaging by the pharmaceutical companies will help in minimizing costs for both the patients and the manufacturers.

Aims and objectives: This work is aimed at determining the optimum volume of these multi-dose eye drops required to last for 28 days (beyond which the patients are advised not to use the eye drops). Specific objectives included:

To determine if excess volumes of these eye drops are packaged by the pharmaceutical companies.

To determine if deficit volumes of these eye drops are packaged by the pharmaceutical companies.

Materials and methods
This research was conducted at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Amaku, Awka between January and December, 2015. Samples of packaged eye drops were collected from the Ophthalmology Clinic at the hospital.

The researchers applied those eye drops according to prescription on hypothetical patients to determine how long each would last. The volumes of the eye drops medications were noted as follows: Timolol 10 mls, Timolol 5 mls, Chloramphenicol 15 mls, Chloramphenicol 10 mls, Gentamycin 10 mls, sodium chromoglycate 10 mls, Antazolin hydrochloride 10 mls, Betamethasone 10 mls, Dexamethosone 5 mls, Flurbiprofen 5 mls, Methylcellulose 10 mls, Fluconazole 5 mls, and Latanoprost 2.5 mls. All the medications used were in form of solutions (eye drops).

Each eye drop was applied on the hypothetical patient till it finished. The number of drops per bottle was noted. The total number of drops in a bottle was divided by the frequency of application per day to get the duration of each eye drop in days. The excess or deficit in volume after 28 days was recorded.

Statistical analysis
The figures obtained were presented in simple statistical tables.

Results
Of the 12 different eye drops used in the study, 7 were packaged in 10 ml volumes, 4 were packaged in 5 ml volumes and one was packaged in 2.5 ml volume. The frequencies of administration and duration in days were as shown in Table 1.

Table 2 shows the expected duration (in days), the actual duration (in days), the excess or deficit duration (in days), and the percentage of excess or deficit duration of each eye drop. Of the 7 drugs packaged in 10 mls volume, those that were applied four times a day had 25 days excess duration (47.2% excess duration).The one that was applied three times daily (Methylcellulose) lasted for 69 days

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thereby giving 41 days excess duration (59.4% excess duration) while the one that was applied twice a day (Timolol) lasted for 106 days thereby giving 78 days excess duration (73.6%). Out of the four drugs packaged in 5 ml, two (Dexamethasone and Flurbiprofen) were applied four times daily and each lasted for 27 days thereby giving 1 day deficit (3.7% deficit duration). The other two (Timolol and Fluconazole) which were applied twice daily lasted for 53 days thereby giving 25 days excess duration (47.2% excess duration). Latanoprost packaged in 2.5 ml was applied once a day lasted for 50 days thereby giving 22 days excess duration (44% excess duration).

Table 3 shows the volumes of each eye drop that will last for 28 days when applied at the prescribed frequency and the excess or deficit. For the eye drops that were applied four times a day, the observed needed volume that will last for 28 days is approximately 5.3 mls. Therefore, those packaged in 10 mls had excess volume of 4.7ml while those that were packaged in 5 mls had deficit of 0.3 mls. The eye drops packaged in 10 mls and applied three times a day showed the observed needed volume for 28 days to be 4.1 mls with excess of 5.9 mls. For those packaged in 10 mls and applied twice a day, the observed needed volume was 2.6 mls with excess of 7.4 mls. Those packaged in 5 mls volume and applied twice daily (Timolol and Fluconazole), showed the observed volume needed to be 2.6 mls with excess volume of 2.4 mls. Latanoprost, the only drug that was applied once daily showed the observed needed volume to be 1.4 mls with excess volume of 1.1 mls.

Table1: The packaged volumes (in mls), frequency of application per day, number of drops per bottle, and observed duration (in days) of different eye drops

Drugs	Packaged volume	Frequency of application	Number of drops per bottle	Observed duration
Chloramphenicol	10	X 4	214	53
Gentamycin	10	X 4	219	54
Sodium chromoglycate	10	X 4	214	53
Antozolin hydrochloride	10	X 4	209	52
Betamethasone	10	X 4	214	53
Dexamethasone	5	X 4	109	27
Flurbiprofen	5	X 4	108	27
Methylcellulose	10	X3	216	69
Timolol	10	X2	212	106
Timolol	5	X2	107	53
Fluconozole	5	X2	107	53
Latanoprost	2.5	X1	50	50

Table 2: The expected duration (in days), the actual duration (in days), the excess or deficit duration (in days), and the percentage of excess or deficit duration of each eye drop.

Drugs	Expected duration in days	Observed duration	Excess or deficit duration	% Excess or deficit
Chloramphenicol	28	53	25	47.2
Gentamycin	28	54	26	48.1
Sodium chromoglycate	28	53	25	47.2
Antozolin hydrochloride	28	52	24	46.2
Betamethasone	28	53	25	47.2
Dexamethasone	28	27	-1	-3.7
Flurbiprofen	28	27	-1	-3.7
Methylcellulose	28	69	41	59.4
Timolol(10ml)	28	106	78	73.6
Timolol (5ml)	28	53	25	47.2
Fluconozole	28	53	25	47.2
Latanoprost	28	50	22	44

Table 3: The packaged volume, observed need in volume, observed deficit in volume (all in mls) of eye drops to last for 28 days.

Drugs	Packaged volume	Observed need	Observed excess or deficit
Chloramphenicol	10	5.3	4.7
Gentamycin	10	5.2	4.8
Sodium chromoglycate	10	5.3	4.7
Antozolin hydrochloride	10	5.4	4.6
Betamethasone	10	5.3	4.7
Dexamethasone	5	5.2	-0.2
Flurbiprafen	5	5.2	-0.2
Methylcellulose	10	4.1	5.9
Timolol(10mls)	10	2.6	7.4
Timolol (5mls)	5	2.6	2.4
Fluconozole	5	2.6	2.4
Latanoprost	2.5	1.4	1.1

Discussion

This study shows that most of the eye drops, when used according to prescription, lasted for more than 28 days and as such constitute economic waste.[1,2] However, two drugs packaged in 5 mls volume and applied four times a day have a deficit of one day from the 28 days period. In some instances, the excess in volume of some these medications when packaged can yield a full 28 day (4weeks) course and should be a tonic to the economy.

Product manufacturers often search for ways to become the market leaders in a specific class of drugs.[8,9] In addition to improved drug formulations convenient, user friendly and economy oriented packaging contributes to product acceptance by the patients[10]. Packaging eye drops in optimal volumes ensures that excess volumes which are easily contaminated are not produced. It also ensures that there would be no deficit volumes which could lead to the patient using the eye drop for lesser number of days than recommended thereby encouraging the emergence of drug resistance organisms. Ultimately this increases morbidity and mortality as well as the overall cost of treatment.

Ophthalmologists are aware of the burden posed by a patient's multiple medical regimens, as well as the attendant financial costs and potential side effects. These factors continue to stimulate the need for combined medications such as prostaglandin/beta blockers which has saved costs and increased convenience[4]. The combined prostaglandin and beta blockers not only saved cost but also reduced the frequency of application thereby enhancing compliance rate[11,12] .

It is well known that a drug's rate of absorption plays a significant role in determining its therapeutic value. It is also known that fast absorption and low half-life may necessitate more frequent dosing. In fact, low half-lives of some of these drugs in this study could have accounted for more frequent dosing and large packaging volume. Therefore, pharmaceutical companies are encouraged to search for improved formulations of eye drops that will increase the half-lives of such drugs. This will prolong their therapeutic effects[13,14], thereby reducing the frequency of application and packaging volume. It is also suggested that each of these eye drops should be packaged in different

volumes to provide the physicians with a variety of prescribing options within a given therapeutic class to meet the individual needs of the patients[15].

In conclusion, it can be seen that the selected eye drops evaluated in this study were not packaged in optimal volumes. This constitutes economic waste and also exposes the patients to contamination, emergence of drug resistance, and increased morbidity and mortality. Drug manufacturers are encouraged to improve on the formulation of these eye drops to increase their half-lives thereby reducing frequency of administration and packaged volumes. With this, the patient, pharmaceutical companies and the nation in general will be better economically.

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