Examininig The Extent of Application of Cost-Minimization Analysis and Its Assocaition With the Availability of Anticancer Medications:

An applied study in The Oncology Hospital/ Medical City Complex-Baghdad, Iraq.

Riyam Ali [(1)], Haidar Ibrahim [(2)], Musaab Ibrahim[(3)], and Arwa lbrahim[(4)]

1. Riyam Ali: B.Sc. Pharmacy, Al-Mansoor Technical Medical Institute/ Middle Technical University
2. Haidar Ibrahim: B.Sc. Pharmacy, MABA/Healthcare Management, Al-Yarmouk University College, Pharmacy Department/ Clinical Pharmacy.
3. Musaab Ibrahim: M.B.Ch.B., MRCS, Medecins Sans Frontieres (MSF).
4. Arwa Ibrahim: B.Sc. Biology, College of Education-Ibn Al-haitham/ University of Baghdad

Abstract

Background: The availability of chronic diseases medications is an essential component of any welfare healthcare system. As a result of the inflated demand for these drugs, and the substantial cost they incur, several managerial approaches have been used to ensure the optimum use of the usually scarce financial healthcare resources. Cost-Minimization Analysis is an approach of pharmacoeconomics that deals with the use of generic medications wherever the legal and bioequivalence conditions are available. **Objective:** to determine whether the usually scarce financial resources are used in an optimum manner, through examining the level of application of Cost-Minimization Analysis (CMA) approach, as a mean of evaluating different bioequivalent alternatives, in order to incur maximum cost saving in the process of product procurement. **Methods:** This is an observational, cross-sectional study through reviewing the manufacturing sources, originator or generic, of the available anticancer medications in the surveyed oncology hospital, and how that affects the availability of these medications at the moment of conducting the study. **Results**: Out of 71 drugs in the Iraqi National Anticancer Drugs List, only 21 drugs (29.58%) were available. Twelve drugs out of the available twenty one medicines are originators (57.12%), seven

medicines are generics (33.33%) and two drugs are available in both generic and originator form (9.53%). Out of the twelve products available from the original sources, only Rituximab is an available originator where no bioequivalent alternative generic is legally available (8.33%), while bioequivalent alternative generics are internationally available for the other eleven drugs (91.67%). **Conclusions:** there is a clear shortage of anticancer drugs in the surveyed oncology hospital. The Iraqi public healthcare sector is struggling to meet the actual needs of the medications listed in the national drug list, although the list does not contain unproven cost-effective anticancer medicines. The study demonstrated potential mismanagement of the scarce financial resources in the scope of non-application of Cost-Minimization Analysis; significant financial resources are devoted to originator- source medicines, the alternative bioequivalent generics of which are available.

Keywords: Cost-Minimization Analysis (CMA), originator drugs, bioequivalent generics, cost effective drugs, Iraqi National Anticancer Drugs List, Orange Book, Cancer Drugs Fund (CDF).

العلاقة بين مدى تطبيق (تحليل تقليل الكلفة) ووفرة الادوية السرطانية

دراسة تطبيقية في مستشفى الاورام/ مجمع مدينة الطب/ بغداد-العراق

حيدر خليل ابراهيم

ريام باسل علي

مصعب خليل ابراهيم

اروى خليل ابراهيم

الخلاصة

يعد توفير ادوية الامراض المزمنة ركنا اساسيا في بناء النظم الصحية المتطورة. وكنتيجة للطلب المتسع على هذه الادوية فأن كثيرا من المقاربات الادارية اخذت بنظر الاعتبار لضمان التوظيف الامثل للموارد المالية في القطاع الصحي والتي عادة ما تكون شحيحة.

ويعد (تحليل تقليل الكلفة) أحد مقاربات (اقتصاديات الدواء) والتي تهتم باستعمال (الادوية الجنيسة) حيثما توفرت الشروط القانونية ومحددات التكافؤ الحيوي مع نظيره من المنشأ الاصلي.

هدف الدراسة: لتحديد مدى توظيف المورد المالي الشحيح في القطاع الصحي بطريقة مثلى، من خلال دراسة مدى تطبيق (تحليل تقليل الكلفة) كوسيلة تقييم بين مجموعة من النظائر المتكافئة حيويا وبما يضمن حسن توظيف المورد المالي.

منهجية البحث: دراسة استقصائية مقطعية تنطوي على دراسة مناشئ الادوية السرطانية (الاصلية والجنيسة) في مستشفى الاورام بمدينة الطب ببغداد، ومدى تأثير ذلك على توفر هذه الادوية لحظة اجراء الدراسة.

النتائج: تحتوي قائمة الادوية الاساسية العراقية واحدا وسبعين دواءا. عند اجراء البحث وجد ان المتوفر من الادوية كان واحدا وعشرين دواءا (29.58%). اثنا عشر دواءا من أصل 21 كان من منشأ أصلي بما يمثل (57.12%) فيما كان عدد الادوية الجنيسة سبعة ادوية (33.33%) واخيرا دواءان توفرا بصيغتهما الاصلية والجنيسة (8.33%).

البحث وجد انه من بين الادوية الاثني عشر المتوفرة من مناشئ عالمية، فأن مادة الريتوكسيماب هي المادة الوحيدة التي لا يتوفر لها بديل جنيس مقر من الهيئات العالمية، فيما وجد البحث وجود بديل جنيس مكافئ ومقر عالميا للمواد الاحدى عشرة الاخرى.

الاستنتاج: هناك عجز واضح في توفر الادوية السرطانية في القطاع الصحي العراقي من خلال عدم توفير متطلبات القائمة الوطنية المحلية للأمراض السرطانية. الدراسة اشرت قصورا في ادارة المورد المالي الشحيح من خلال تفويضه لتأمين ادوية اصلية المنشأ برغم وجود الجنيس المتكافئ حيويا والمقر قانونيا وذلك يتعارض مع مبدأ (تحليل تقليل الكلفة) المعمول به في ادارة الاقتصاد الدوائي لاسيما ان السياسة الدوائية الحالية عجزت بالأساس عن توفير جميع متطلبات قائمتها المحلية للأدوية السرطانية.

الكلمات الدالة: تحليل تقليل الكلفة، الادوية المبتكرة، الادوية الجنيسة، الادوية الفعالة من حيث التكلفة، القائمة الوطنية الاساسية للأدوية السرطانية، الكتاب البرتقالي، منظومة تمويل الادوية السرطانية

1. Introduction

Healthcare should be provided through a well-designed organizational structure capable of providing equitable, accessible, affordable, and sustainable healthcare services. However, healthcare services, unlike other commodities, are unusually costly in origin. According to Kenneth Arrow, the founder of the health economics, this unusual cost can be partially expressed by the “nature of demand”, where the “illness” which initiates the need for medical services is unpredictable, cannot be avoided, and potentially accompanied with a partial or total loss of earning ability. That makes the illness “not only risky but a costly risk in itself”[1]. Evaluating the performance of various healthcare systems (despite their immense variation) is measured through

achieving the optimum level of objectives, with the minimum available resources, in order to ensure the sustainability of that system [2].

Inflated healthcare costs and the continuous demand for expensive novel technologies and pharmaceutics were the trigger to integrate the economic factor, in an attempt to recognize ineffective practices and systemic waste, as a mean to maximize clinical outcomes from existing resources [3].

The term "Pharmacoeconomics" was coined by Ray Townsend in 1986 [4]. Generally, four different types of pharmacoeconomic approaches have evolved. These are cost-minimization analysis, cost-effectiveness analysis, cost-benefit analysis, and cost-utility analysis [5].

The application of cost-minimization analysis is one of the simplest approaches to conduct a pharmacoeconomic evaluation; however, its application is of great value. It ensures devoting of the financial resources for the pharmaceutics that achieve significant affordability when compared to other bioequivalent alternatives [5]. Eventually that will achieve a sustainable supply of the medicines.

The tertiary healthcare services represent a remarkable zone of interest, as they mostly deal with chronic conditions, and the medicines are too expensive to be covered through Out Of Pocket (OOP). CMA is considered as a tool to achieve that objective as it ensures the availability of the originators' bioequivalent efficacy with the generics' affordability. When the resources are scarce; the availability of high-cost products reduces the equitable access to a healthcare system, especially when the bioequivalent, more affordable alternatives are available.

The numbers of cancer patients significantly increased in Iraq during last few years, based on data released from the Iraqi Cancer Board. The cause of this increment is multifactorial; it may be attributed to the improvement of diagnostic tools, the damage inflicted on the Iraqi environment last three decades or due to increased levels of precancerous health conditions [6].

Iraqi cancer patients live a life of daily suffering in pursuing healthcare services. This suffering is socially perceived. Mac Skelton, a member of the Costs of War Project at Brown University believes that the diagnosis and treatment failure of cancer patients in Iraq led to exploding of medical travelling phenomenon. Many of middle-class

families turned down directed to Beirut, Amman, or even India seeking for life-saving treatment. However, Skelton found the total expenditure of the surveyed patients ranged from $20,000 to $100,000 [7].

Several studies advocated for the use of Cost-Minimization Analysis (CMA) to incur higher cost-save burden, especially in developing countries where cancer-fighting programs usually face financial obstacles.

For instance, in Colombia, the cost-saving burden of anticancer drugs was examined through conducting cost-minimization approach study. The study assessed the savings that could be incurred through replacing the originator pharmaceutical products with their bioequivalent generics in oncology domain, as different types of cancer are responsible for a major portion of disease burden. The study methodology was based on calculating the price difference between the originator drugs Bortezomib, Decitabine, and Capecitabine and their bioequivalent, previously determined generics. The saved-cost per unit was multiplied by the number of units consumed in the Colombian healthcare sector in 2015. The savings were 63%, 26%, and 46% respectively [8].

Another example is the study that was conducted by Alexandra Cameron et al. This is a “hypothetical switch in pharmaceutical consumption” study conducted in 17 low and middle-income countries; the most frequently surveyed pharmaceutics in these countries were included, in addition to three statins, as the consumption of this group has consistently increased in the last few years. Unlike the Colombian study, Cameron et al tried to account for the potential cost saving in the private sector. The prices were calculated through a standardized methodology developed by the World Health Organization (WHO). The volume of consumption of the selected seventeen products in the private sector was obtained from IMS Health, Inc. The scholars concluded that cost-savings in the range of 9% to 89% could be earned by switching from the examined originators to their bioequivalent generics. Most importantly, one of the scholar, an employee at Essential Medicines and Pharmaceutical Policies-World Health Organization, strongly advised to include the cost-saving policies as a reference in releasing new national medicines policies in developing countries [9].

In another study, cancer was again the focus of a cost-saving study conducted in a low-income developing country; India. In this study, the author used the cost of

chemotherapy per cycle as a reference to compare originators to their relevant generics. Five chemotherapeutic agents were involved, which are Paclitaxel, Docetaxel, Gemcitabine, Oxaliplatin, and Irinotecan. The potential cost-savings per cycle in Indian Rupees were 27654, 15680, 23352, 11782, and 93052 respectively. It is important to highlight that these five cytotoxic drugs are included in the Iraqi National Anticancer Drugs [10].

Patients, as well as the healthcare providers, tend to have a negative impression of the efficacy of the generic copies. For example, according to an applied study in Iraq, switching from originator Imatinib to the generic one was associated with significant loss of hematological, cytogenetic, and molecular control in patients with chronic myeloid leukemia. [11]. Inclusion of CMA in the procurement function may mitigate that concern as long as it offers bioequivalent alternatives [5].

Finally, in addition to the selection of the bioequivalent generic; cost saving can be earned through the identification of Quality-Adjusted Life Years (QALY) value, as it will be the limit that a healthcare system can afford for a certain proven cost-effective drug. In United Kingdom, in late stages of cancer for example, the drug may be included in the routinely used drugs list if the cost is less than 30000 Pounds per (QALY). The cost of the novel anticancer agent trastuzumab Emtansine (Kadcyla) was 166000 pound per QALY in 2014. Roche offered the drug for 90000 Pounds a year per patient. The drug was provided via the Cancer Drugs Fund [12]. In December 2016 National Health Services (NHS) announced the rejection of the use of the drug on cost-benefit grounds [13].

On 2017, Baroness Delyth Morgan, Chief Executive at Breast Cancer announced that “tough negotiation and flexibility by NICE and NHS England, and the willingness of Roche to compromise on price….ensure this crucial lifeline drug is routinely available to those that need it [14]” .

1.1 Research Problem: scarce financial resources are not optimally used to ensure the availability of anticancer drugs. i.e. This study was conducted on September 1st 2018 as a cross-sectional study in the oncology hospital/ Medical city teaching complex.

1.2 Research Goal: to figure out the extent of application of Cost-Minimization Analysis (CMA) and its correlation to the availability of anticancer medications in the surveyed hospital.

1.3 Research Statement: When the financial resources are limited, Cost-Minimization Analysis (CMA) can be used as a tool to choose among bioequivalent alternatives, in order to optimize the cost-save burden.

1.4 Research Questions:

- What is the availability of anticancer drugs in the surveyed tertiary healthcare centre at the time of conduction of the study?
- How many of the available surveyed medications are from an original manufacturer, and how many are generics?

These two questions generated two sub-questions:

- Were the policymakers legally forced to obtain the original medications because of legal constraints (patents for example)?
- Is the shortage of anticancer medications a result of devoting financial resources to unproven cost-effective medicines?

2. Limitations

The process of product procurement in the Iraqi public health sector does not rely on a national registered drug list to compare different bioequivalent alternatives. The national list of registered medicines is limited to the private sector. It is quite possible that a certain medicine available in the public sector is not registered in the national list of registered medicines. To overcome this obstacle the study relies on the" Approved Drug Products with Therapeutic Equivalence evaluations", commonly known as the "Orange Book"; an FDA-released reference of the prescribed originator drugs and their bioequivalent generics, which is a highly esteemed source to retrieve the presence of bioequivalent alternatives that meet legal requirements [15].

3. Methods

The selected study design is an observational, cross-sectional study. It is the most suitable design for "estimating the prevalence" of a particular merit in a population [16]. This study was conducted in the Oncology Hospital/ Medical City Teaching Complex in Baghdad, Iraq on September 1st 2018. It is an attempt to examine the availability of anticancer drugs and then to attribute the findings to the level & effect of the application of Cost-Minimization policies at a single moment. However, this study can be considered as a benchmark for a cause-effect, longitudinal future study; if new pharmacoeconomic policies were involved.

4. Conceptualization and Operationalization of the variables:

4.1 Quantifying of the Independent Variable:

The extent of application of Cost-Minimization Analysis: this was quantified through comparing the percentage of the originator medicines to the generic ones at the moment of data collection. Sometimes; there are legal determinants forcing the decision maker to procure the originator. For example, if the "Marketing Exclusivity period" has not expired yet, i.e. the originator is the only legally allowed option to be supplied. The National Registered Drugs List can be used as a reference to clarify the legal status of the originator and their corresponding bioequivalent. The national registered drug list in Iraq is used a reference to control the process of importing medications by the private sector only. The process of medications supply for the public health sector is highly centralized and is exclusively the domain of The State Company for Drug and Medical Appliances (KIMADIA), and the process of drugs procurement for the public sector is not limited to the National Registered Drugs List. This makes the procurement process more flexible, since the decision maker can proceed with the purchase of any internationally available, bioequivalent generic to the originator, even if it has not been yet registered in the national list. In addition, it gives the supplier an opportunity to make an advantage of the economies of scale, as the process is performed on a national level. Based on that, all surveyed medicines were reviewed in the Orange Book, a highly esteemed reference edited by United States Food and Drugs Administration, to ensure the legal status of each drug, and to determine how many generics are available as bioequivalent, interchangeable, cost-saving alternatives to the decision makers.

Furthermore, this study investigated whether the national anticancer list in Iraq is too extensive and sophisticated to be met. To answer this question the national

anticancer list was cross-matched to the anticancer medication list adopted by National Health Services (NHS) in United Kingdom. NHS list was selected for comparison because it is based on strong Evidence-Based Medicine. NHS anticancer list is a reflection of the latest National Institution of Clinical Excellence (NICE) guidelines in which the pharmacoeconomic dimension is already incorporated in the process of product selection.

4.2 Quantifying of Dependent Variable:

Availability of anticancer medications: This was quantified through measuring the percentage of the available medications at the moment of the data collection compared to the Iraqi National Anticancer Drugs List.

5. Sampling:

The population employed in this study is a record represented by the:

1. The available anticancer drugs at the time of data collection: which will be processed to retrieve the percentage of originators and generics.
2. The national Anticancer List: as a reference, to calculate the availability of these drugs at the time of the conduction the study.

The selected sampling technique was the Total Population Sampling because the population is relatively small whether in term of actually available medicines or the national anticancer list that is potentially available.

6. Data Collection

Primary Data: this includes counting the available medications in the surveyed tertiary centre at the time of conducting the research. Multiple methods can be used as a tool for data collection in the observational, cross-sectional study. However, “Record Review” was selected, as the existing examined data are in the form of database.

Secondary Data: that includes:

- The Iraqi National Anticancer Drugs List: to be used as a reference to identify the percentage of the available medications.

- The Orange Book: released by FDA, used to identify the number of available bioequivalent generic for each item available in the originator form.
- National Cancer Drugs Fund List: released by NHS. It is used to figure out the level of uncertainty of the cost effectiveness profile of the new anticancer agents. These data are used as a reference to find out the number of non-proven cost-effective profiles in the Iraqi National Anticancer Drugs List.

7. Results

The national list of anticancer drugs is the sample list used as a reference to evaluate the availability of these medications in the tertiary healthcare centre. The national list is quite diverse from a pharmacological point of view, as can be seen in table 1.

Table 1. Illustrates the different pharmacological groups and the corresponding number of products registered in the Iraqi National list of Anticancer Drugs:

No.	Pharmacological Group	Number of drugs in each group
1.	Chemotherapy	50
2.	Immune modulating drugs	14
3.	Drugs Used in Neutropenia	2
4.	Taxane Group	2
5.	Cytostatic Topoisomerase-I Inhibitors	1
6.	Others: CFU TICE BCG, (RIVM) BCG	2
	Total	**71**

The total number of products that should be available in any Iraqi oncology center at any time is 71 drugs, according to the national anticancer drugs list. The study was conducted in September 1st, 2018. The total available medications found at the time of conducting the study was 21 drugs, a percentage of 29.58%. This percentage reflects how the scarcity of resources in Iraq is a major challenge in ensuring the desired response to the actual needs of healthcare services in the oncology field. Accordingly,

it is necessary to set the proper pharmacoeconomic policies to ensure the optimum use of those scarce resources. Our next step was to examine the extent of application Cost-Minimization Analysis as a pharmacoeconomic tool to ensure cost saving, and subsequently to improve the availability of anticancer medications, as shown in table 2.

Table 2 exhibits the manufacturer of the available medications, in term of originator and generic:

No.	Pharmaceutical Active Ingredient	Available Brand Name	Origin
1.	Cyclophosphamide	Endoxane	Originator
2.	Doxorubicin	Doxorubicin-Ebewe	Generic
3.	5-Fluorouracil	5-FU-Ebewe	Generic
4.	Gemcitabine	Gemzar, Gemcitabine medac	Originator & Generic
5.	Carboplatin	Carboplan	Generic
6.	Etoposide	Citroposide	Generic
7.	Trastuzumab	Herceptin	Originator
8.	Ifosfamide	Holoxan	Originator
9.	Bevacizumab	Avastin	Originator
10.	Irinotecan	Camptosar	Originator
11.	PEGylated Liposomal Doxorubicin	Caelyx	Originator
12.	Vinorelbine	Navelbine	Originator
13.	Pemetrexed	Alimta	Originator

14.	Paclitaxel	Paclitaxol-Ebewe	Generic
15.	Vincristine Sulfate	Vincristine Pfizer	Originator
16.	Epirubicin HCL	Farmorubicine	Originator
17.	Topotecan	Topotecan Actavis	Generic
18.	Capecitabine	Xeloda, Kapteral	Originator & Generic
19.	Cisplatin	Onco-tain	Generic
20.	Rituximab	Mabthera	Originator
21.	Filgrastim	Neupogen	Originator
	Total	**21**	

According to table 2; Out of the twenty-one available medications, there are twelve originator drugs (57.14%). Seven medications are of generic sources (33.33%). Only two drugs were available in both generic and originator forms (9.53%).

Before drawing any conclusions and recommendations based on these findings, it is important to answer the following questions:

1. Were the decision makers forced to obtain the originators because of legal constraints?
2. Is the Iraqi National Anticancer list too sophisticated to be fully fulfilled?

7.1 Legal Constraints: manufacturing of pharmaceutical generics obeys market exclusivity regulations. When market exclusivity period is over, the manufactured generic can be produced as a bioequivalent to the originator. In Iraq, there is a national list of officially registered drugs. However, that list regulates the process of importing pharmaceuticals to the private market. The State Company for Drug and Medical Appliances (KIMADIA), a company under the auspices of the Ministry of Health, is the only authorized part allowed to conduct procurement of pharmaceutical products to the public health sector. KIMADIA has the right to sign contracts for the purchase of any medication, even if it is not registered in the National List of Registered Drugs.

To find out whether legal constraints did actually force the decision maker to purchase the originators, we cross-checked the collected data with a highly respected standard reference; the Orange Book (2017). The Orange Book documents all available drugs in term of originators and their corresponding generics. The availability of generic alternatives in the orange book does not only ensure the legal situation of the drug in term of patency constraint, but also it ensures that the available generic is bioequivalent to the originator, which in turn refute any ethical claims about the inferiority of a generic compared to the corresponding originator. As shown in Table (3).

Table 3. The availability of alternative, bioequivalent generics in FDA's Orange Book.

No.	Pharmaceutical Active Ingredient	Available Brand Name	Number of available generics based on Orange Book
1.	Cyclophosphamide	Endoxane	6
2.	Doxorubicin	Doxorubicin-Ebewe	10
3.	5-Fluorouracil	5-FU-Ebewe	25
4.	Gemcitabine	Gemzar	18
5.	Carboplatin	Carboplan	25
6.	Etoposide	Citroposide	13
7.	Trastuzumab	Herceptin	1
8.	Ifosfamide	Holoxan	4
9.	Bevacizumab	Avastin	1
10.	Irinotecan	Camptosar	19
11.	PEGylated Liposomal	Caelyx	2

	Doxorubicin		
12.	Vinorelbine	Novalbine	9
13.	Pemetrexed	Alimta	6
14.	Paclitaxol	Paclitaxol-Ebewe	13
15.	Vincristine Sulfate	Vincristine Pfizer	9
16.	Epirubicin HCL	Farmorubicine	13
17.	Topotecan	Topotecan Actavis	14
18.	Capecitabine	Xeloda, Kapteral	7
19.	Cisplatin	Onco-tain	9
20.	Rituximab	Mabthera	No generic available yet
21.	Filagrastim	Neupogen	1
	Total	**21**	

According to Table 3; Out of 12 originator anticancer drugs available in the surveyed public oncology hospital, only one product cannot be provided because of patency issue, a percentage of 8.33% of the available originators. This particular medicine is Rituximab. On the other hand, eleven medications were supplied in an originator form, when different alternative generics were available (91.67% of the available originators). These drugs are (Cyclophosphamide, Trastuzumab, Ifosphamide, Bevacizumab, Irinotecan, Pegylated Liposomal Doxorubicin, Vinorelbine, Pemetrexed, Vincrystine Sulfate, Epirubicin HCL, and Filgrastim) In addition, there were two drugs available in both originator and generic, however, the

patency expiry date of these two medicines (Gemcitabine and Capecitabine) is over and procuring generics could be an affordable alternative.

These results show evidently that the selection of the manufacturer in the process of anticancer drugs procurement cannot be justified on Cost-Minimization basis. Once more, the data about the availability of legal and bioequivalent alternative generics were derived from the Orange Book.

7.2 The Rationality of the National Anticancer Drug List: Scarcity and mismanagement of the financial resources have a frank impact on the availability of anticancer drugs in Iraq. However, a highly sophisticated national drugs list could be quite challenging to be met. In another words there is a need to clarify whether the poor availability of essential anticancer agents was the result of devoting limited financial resources to new medicines with unproven cost-effectiveness profile. This is particularly important since that the National Anticancer Drugs list was not compiled based on national treatments protocols or guidelines. To evaluate the rationality of the Iraqi national anticancer drug list, the authors decided to cross-check the data with the British Cancer Drugs Fund list (CDF) released by the (NHS). The selection of the NHS system is based on the fact that NHS anticancer drugs list is supported by clinical and economic evidence, released by (NICE).

NHS anticancer drugs list is classified into two parts [17]:

- Anticancer drugs routinely available in the NHS
- The Cancer Drugs Fund (CDF): Includes new anticancer drugs not approved by (NICE), because these drugs are not yet proven to be cost-effective.

According to the latest update from the Cancer Drugs Fund (CDF), there are several new drugs or existing drugs with new potential indications. These new drugs or indications have promised clinical benefits, but with an uncertainty regarding their cost effectiveness [17]. Latest CDF list contains ten previously existing drugs with new indications. On the other hand, there are sixteen new drugs with potential clinical benefits, however; according to (NICE), their cost effectiveness still debatable. The Iraqi National List does not include any medicine with unproved cost effectiveness profile. This is a good indicator of the rationality of the Iraqi National Anticancer Drugs List.

Regarding drugs approved by NICE since the application of the CDF system on April 1st, 2016; out of 52 new, cost-effective medications, there are only 10 common drugs between the NICE-approved CDF list and the Iraqi National List. However, only one drug was available in the hospital at the time of conducting the study, representing 4.76% of the available medications.

That means that updated anticancer medications represents a mere 14% of the Iraqi national List, with limited financial resources devoted for those items. These numbers could be a benchmark for a further study about non-listed drugs with better potential cost-effectiveness compared to the currently listed ones. However, identification of the QALY value is an important step in examining the ability of the public healthcare system to afford the best cost-effective medication.

8. Conclusion & Recommendations

There is a clear scarcity in the availability of anticancer medications in the surveyed public tertiary healthcare sector. In spite of not endorsing medications with unproven cost-effectiveness, the Iraqi Ministry of Health, who released the National Anticancer Drugs List, is struggling to provide the actual need of these medications. Out of 71 medicines in the Iraqi National Anticancer List, only 21 products were available at the time of collecting the data (29.58%). The shortage of anticancer drugs is a multifactorial crisis. It is usually justified by the scarcity of financial resources and the unexpected rise in the number of cancer patients in Iraq. However, there is an observed mismanagement of the limited financial resources, due to the absence of sound pharmacoeconomic policies in the management of the supply chain in the public sector. Cost-minimization Analysis (CMA) is a tool to provide the bioequivalent alternative medication in cost-saving manner. Procuring originators when the bioequivalent generics are available reflects the exclusion of Cost-Minimization Analysis in the process of decision-making concerning product procurement. Availability of particular drugs in both originator and generic forms confirms that conclusion. The use of international, highly trustful references, e.g. the FDA released Orange Book, or any other esteemed source, could be a proper mean to identify the generics that meet the originators' standards.

Although the Iraqi National Anticancer Drugs List does not involve any new, emerging and unproven Cost-effective drugs, the list, however, misses many well-proven cost-effective medications.

Based on these conclusions; the authors strongly recommend the incorporation of Cost-Minimization criteria in the process of product procurement in order to ensure the optimal use of the scarce financial resources. It is highly recommended to highlight the legal status and the availability of bioequivalent alternatives in any updated release of the Iraqi National Anticancer Drugs List, to ensure the incorporation of CMA approach in the supply chain, specifically drug procurement function.

The authors also recommend the conduction of a further study to determine the level of application of Cost-Effectiveness analysis in the product selection process for the national anticancer list. However, proper application of Cost-Effectiveness Analysis requires the development of local guidelines where QALY value should be determined. Unfortunately, there is no such guideline in Iraq at the mean time.

Acknowledgment

We would like to express our grateful appreciation for Dr.Fawaz Sa'ad, oncologist-at the Iraqi Cancer Board, for his role in providing us with the official Iraqi National Anticancer Drugs List and his helpful ideas and continuous support in conducting this research.

Abbreviations

CMA: Cost-Minimization Analysis

OOP: Out OF Pocket

WHO: World Health Organization

QALY: Quality-Adjusted Life Years

NHS: National Health Services

NICE: National Institution of Clinical Excellence

KIMADIA: The State Company for Drug and Medical Appliances

FDA: Food and Drug Administration

CDF: Cancer Drugs Fund

References

1. Arrow K. Uncertainty and the welfare economics of medical care. The American Economic Review. 1963;53(5):948-9.
2. Hejdukova P, Kurekova L. Performance and sustainable of healthcare systems and approaches to its measuring and evaluating. International Journal of Social Sciences. 2017;6(2):32-42.
3. Harris C, Allen K, Ramsey W, King R, Green S. Sustainability in health care by allocating resources effectively (SHARE) 2: identifying opportunities for disinvestment in a local healthcare setting. BMC Health Services Research. 2018. Available from: <https://doi.org/10.1186/s12913-018-3172-0>.
4. Mauskopf J. Why study pharmacoeconomics?. Expert Review of Pharmacoeconomics & Outcomes Research. 2001;1(1):1-3.
5. Kumar S, Baldi A. Pharmacoeconomics: Principles, methods, and economic evaluation of drug therapies. PhTechMed. 2013;2(5):362-9.
6. Habib O, Al-Elwe W. Pattern of cancer: Comparison of risk in Basrah with national pattern. Medical Jouranl of Babylon. 2018;15(2):195-196.
7. Skelton M. Health and health care decline in Iraq-The example of cancer and oncology. Brown University Costs of War Project. 2013.
8. Akku S, Garg A, Khandarkar S. Cost-minimization analysis of generic equivalents (Bortezomib, Decitabine, and Capecitabine) in comparison to the originator brand medicines in Colombia. Generic and Biosimilar Initiative Journal. 2016;5(4):164-7.
9. Cameron A, Mantel-Teeuwusse A, Leufkens H, Laing R. Switching from originator brand medicines to generic equivalents in selected developing countries: How much could be saved?. Value in Heath. 2012;15(5):664-73.
10. Lopes G. Cost comparison and economic implications of commonly used originator and generic chemotherapy drugs in India. Annals of Oncology. 2013;24(5):13-16.
11. Alwan AF, Matti BF, Naji AS, et al. Prospective single-center study of chronic myeloid leukemia in chronic phase: switching from branded imatinib to a copy drug and back. Leukemia and Lymphoma Journal. 2014;55(12):2830-6.
12. The National Institution for Clinical Excellence. Pressure grows on Roche to lower breast cancer drug price. 2014. NICE. Available from: <https://www.nice.org.uk/news/article/pressure-grows-on-roche-to-lower-breast-cancer-drug-price>
13. Boseley S. Breast cancer drug rejected for NHS use on cost-benefit grounds. The Guardian [internet].2016, December 29th. Available from: <https://www.google.com/amp/s/amp.theguardian.com/society/2016/dec/29/breast-cancer-drug-kadcyla-rejected-for-nhs-use-on-cost-benefit-grounds>
14. NHS England. Strikes deal to make innovative breast cancer drug routinely available on the NHS, 2017. NHS England. Available from: <https://www.england.nhs.uk/2017/06/breast-cancer-drug-routinely-available-on-the-nhs/>
15. Approved Drug Products with Therapeutic Equivalence Evaluations [internet]. 2017, 39th edn. Available from: <http://s9423e139345e2186.jimcontent.com/download/version/1499144253/module/11139577298/name/obannual%20.pdf>
16. Sedgwick P. Cross-sectional studies: Advantages and disadvantages. BMJ. 2014; 348: g2276

17. NHS England. Appraisal and Funding of Cancer Drugs from July 2016 (Including the New Cancer Drug Fund) A New Deal for Patients, Taxpayers, and Industry. 2017. [internet]: NHS England. Available from: <http://www.england.nhs.uk/wp-content/uploads/2013/04/cdf-sop.pdf>