

ORIGINAL RESEARCH**EVALUATION OF ANTICANCER GENERIC DRUGS AND BRANDED DRUGS****Bhavani P, Prasanthi G, Amruth Raj S, Hari Krishna T, Sowjanya K, Shantha Kumari K, Subba Reddy D***

Department of Pharmacology and Pharmacy practice, Nirmala college of Pharmacy, Atmakuru, Guntur-522503

Submitted on: 28.03.18;**Revised on: 05.05.18;****Accepted on: 10.05.18****ABSTRACT:**

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other body parts. Till now we have many drugs for the treatment of cancer which are available in branded and generic versions. In the present research, we studied about the difference between the branded and generic drugs in terms of their cost effectiveness, adverse effects, drug interactions, contraindications of the drugs used for cancer. we have collected the data from various retail pharmacies, authorized web sources and from up to date software. In our research we identified that the generic drugs shows huge variation in terms of cost effectiveness, adverse reactions, drug interactions & contraindications when compared with the branded one. This information provides us to choose better therapeutic approach towards cancer treatment.

KEY WORDS: Generic drug, branded drug, cost effectiveness, adverse effects, drug interactions, contraindications.**Corresponding Author:** Dr. D. Subba Reddy**E-mail:-** dsreddy7@gmail.com**Phone:** +919494805749.**Indian Research Journal of Pharmacy and Science; 16(2018)1378-1391;****Journal Home Page: <https://www.irjps.in>****DOI: 10.21276/irjps.2018.5.1.16**

INTRODUCTION:-

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other body parts. Till now we have many drugs for the treatment of cancer. Commercially medications are available in branded and generic names. A generic drug is chemically equivalent to brand drug, it is lower-cost version of brand. A brand drug & its generic version have the same active ingredients, dosage, safety, strength, usage directions, quality, performance & intended use. Here, we studied about the difference between the branded and generic drugs in terms of their cost effectiveness, adverse effects, drug interactions, contraindications. When a company develops a new drug submits it for FDA approval, then patented, manufactured and licensed for the first time. In contrast, generic drugs are these type of medications which are bioequivalent to the brand name drugs and have identical active ingredients but produced after patent expirations by another manufacturer¹. Economically, generic drugs are less costly in production than brand name drugs and therefore, they are less cost in the market². Previous studies concluded that saving up to 10 billions of dollars every year can be achieved upon replacing brand name drug by generic drug³. Another economical study reported that saving of up to 158 billions of dollars every year can be achieved³. This can explain the reason behind the preference of choosing generic drugs over brand name drugs in the health sector, such as hospitals, healthcare centers and health insurances⁴. Overall, generic drugs are less costly due to the avoidance of repeating many costly requirements to place brand names drugs on the market such as, preclinical studies, clinical trials, advertising, marketing, and promotion. As a result, at least 80% of prescriptions filled in the US are for generic drugs according to FDA. A number of studies have demonstrated that replacing brand name drugs by generic drugs has no differences⁵. In contrast, adverse drug reaction was reported to be found in some patients during a trial. Generic medicines are now commonplace in most countries, many patients view them negatively compared to branded alternatives⁶, they believe to be generics have inferior quality and producing more side effects than the branded alternatives⁷⁻⁹. Patients also view generics as less powerful and less suitable for treating serious illnesses than branded medication. The active ingredient does not differ in the brand name drug and

generic drug, other excipients, may be different and they may have contraindicated effect¹⁰. Since a wide variety of excipients are used in the drug formulation¹¹⁻¹³. Therefore differences in excipients between brand name drugs and their generic versions can cause adverse drug reactions¹⁴ even with rational drug use.

MATERIALS AND METHODS:

We collected the about various anticancer drugs and its generic and branded names. For the both generic and branded versions we collected cost and calculated the cost variation and % cost variation. We also collected the adverse drug reactions, drug interactions, contraindications of both generic and branded copies by going through retail pharmacies and from various websources like MARG® Pharmacy Software, www.pharmacytimes.com, upto date software, <https://www.fda.gov/MedicalDevices>, <https://www.1mg.com/>, <https://www.drugbank.ca>, <https://www.universaldrugstore.com/>, www.medplusiindia.com.

Some of drugs like amsacrine, criasantaspase, chlorambucil, irinotecan, having the high cost variation around above 12000/- . Some of drugs are oxaliplatin, mitomycin, methotrexate, dactinomycin etc having less cost variation. Some of drugs like capecitabine, flurouracil, cisplatin, idarubicin & pemetrexed having the same adverse drug reactions as that of the branded. most drugs are shows the serious adverse drug reactions then compared to the branded once - dacarbazine, chlorambucil, dactinomycin, mercaptopurine, leucovorin, mitoxantrone, pentostatin etc....,

Drugs like amsacrine, cyclophosphamide, fludarabine, dactinomycin, docetaxel, melphalan, lomustine, irinotecan having same drug interactions as that of branded drugs. Some drugs produces the serious drug interactions then compared to the branded drugs – carbaplatin, streptozocin, oxaliplatin, mitoxantrone, and methotrexate. Most of the drugs having the same contraindications as that of the branded drugs. Examples – busulfan, capecitabine, fludarabine, flurouracil, mercaptopurine, ifosamide, cytarabine, raltitrexed etc..., having the common contraindications. Cladarabine, carmustine, dactinomycin, chlorambucil are having the different contraindications compared to the branded.

Table No 1: Drugs with their generic and brand name.

S.No	Generic name	Brand name
1	amisacrine	amisidine
2	bleomycin	blenoxane
3	busulfan	busulfex
4	capecitabine	xeloda
5	carbaplatin	paraplatin
6	cyclophosphamide	cytoxan
7	decarbazine	dtic-dome
8	fludarabine	fludara
9	flurouracil	adrucil
10	criasantaspase	erwinase
11	cladribine	leustat
12	cisplatin	platinol
13	chlorambucil	leukeran
14	carmustin	bicnu
15	dactinomycin	cosmegen
16	docetaxel	taxotere
17	mercaptopurine	purinethol
18	melfhalan	allkeran
19	lomustine	ceenu
20	leucovorin	wellcovorin

S.No	Generic name	Brand name
21	gemcitabine	gemzar
22	idarubicin	idamycin
23	ifosfamide	ifex
24	irinotecan	campto
25	floxuridine	fudr
26	etoposide	vepesid
27	epirubicin	ellence
28	daunorubicin	cerubidine
29	cytarabine	cytosar-u
30	streptozocin	zanosar
31	raltitrexed	tomudex
32	procarbazine	matulane
33	pentostatin	nipent
34	paclitaxel	taxol
35	oxaliplatin	eloxatin
36	mitoxantrone	noxantrone
37	mitomycin	mutamycin
38	methotrexate	rhematrex
39	mesna	mesna
40	pemetrexed	almita

RESULTS:**TableNo:2: Generic and Branded drugs with their cost variation and % cost variation.**

S.No	Drug name	Cost	Cost variation	%cost variation
1	Amsacrine	10,184/-	52,353/-	83%
	Amisidine	62,537/-		
2	Bleomycin	600/-	3,921/-	86%
	Blenoxane	4,521/-		
3	Busulfan	375/-	420/-	52%
	Busulfex	795/-		
4	Capecitabine	1002/-	998/-	49%
	Xeloda	2000/-		
5	Carbaplatin	771.1/-	1,640/-	68%
	Paraplatin	2411.1/-		
6	Cyclophosphomide	60/-	119/-	66%

	Cytoxan	179/-		
7	Decarbazine	100/-	300/-	75%
	DTIC-DOME	400/-		
8	Fludarabine	5,601/-	3,523/-	38%
	Fludara	9,124/-		
9	Flurouracil	29.16/-	105/-	78%
	Adrucil	135/-		
10	Criansantaspase	1589/-	50,324/-	96%
	Crwinase	51,913		
11	Cladaribine	8,800/-	7,324/-	45%
	Leustat	16,124/-		
12	Cisplatin	333/-	147/-	30%
	Platinol	480/-		
13	Chlorambucil	533/-	15,850/-	96%
	Leukeran	16,383/-		
14	Carmustin	4,712/-	11,138/-	70%
	BiCNU	15,850/-		
15	Dactinomycin	400/-	125/-	23%
	Cosmegen	525/-		
16	Docetaxel	3,051/-	3,934/-	56%
	Taxotere	6,985/-		
17	Mercaptopurine	1,017/-	495/-	32%
	Purinethol	1,512/-		
18	Melphalan	1,514/-	400/-	20%
	Alkeran	1,914/-		
19	Lomustine	719/-	6,553/-	90%
	ceeNU	7,272/-		
20	Leucovorin	120.5/-	977/-	89%
	Wellcovorin	1,097/-		

21	Gemcitabine	1,855/-	5,846/-	75%
	Gemzar	7,701/-		
22	Idarubicine	4,250/-	921/-	17%

	Idamycin	5,171/-		
23	Ifosfamide	467/-	1,080/-	69%
	Ifex	1,547/-		
24	Irinotecan	4,969/-	16,866/-	77%
	Campto	21,835/-		
25	Fluoxuridine	7,650/-	10,984/-	68%
	FUDR	8,954/-		
26	Etoposide	546/-	408/-	42%
	Vepesid	954/-		
27	Epirubicin	522/-	518/-	49%
	Ellence	1,040/-		
28	Daunorubicin	340/-	125/-	26%
	Cerubidine	465/-		
29	Cytarabine	387/-	533/-	57%
	Cytosar-U	920/-		
30	Streptozocin	5,016/-	10,984/-	68%
	Zanosar	16,000/-		
31	Raltrexed	2,291/-	8,911/-	79%
	Tomudex	11,202/-		
32	Procarbazine	350/-	1,597/-	82%
	Matulane	1,947/-		
33	Pentostatin	12,000/-	5,683/-	32%
	Nipent	17,683/-		
34	Paclitaxel	5000/-	3,076/-	38%
	Taxol	8,076/-		
35	Oxaliplatin	2,350/-	70/-	2.80%
	Eloxatin	2,420/-		
36	Mitoxantrone	950/-	600/-	38%
	Noxantrone	1550/-		
37	Mitomycin	290/-	151/-	34%
	Mutamycin	441/-		
38	Methotrexate	246/-	92/-	17%
	Rhematrex	533/-		
39	Mesna	91/-	163/-	64%
	Mesnex	254/-		
40	Pemetrexed	3,750/-	8,750/-	70%
	Almita	12,500/-		

Table No:3: Drugs with the Adverse effects and Interactions.

S.No	Drug name	Adverse effects	Interactions
1	amsacrine	cardio toxic effect, hepatotoxicity, renal failure, allergic reactions	amiodarone- decreases the metabolism of amsacrine
	Amisidine	cardiotoxic effect, bone marrow failure gout	Same
2	Bleomycin	pulmonary toxicity, myocardial infraction, hyperpigmentation, mucocutaneous toxicity	bleomycin+brentuximab - increases the risk of damage to your lung
	blenoxane	pulmonary fibrosis, integument of mucous membrane, myocardial infraction	Same
3	Busulfan	lung diseases, difficulty in breathing, it may effect the hormones, coughing up blood	busulfan + acetaminophen - increases the levels of busulfan by decreasing metabolism
	Busulfex	neutropenia, myelosuppression, thrombocytopenia, depression, seizure, cardiac tamponade	busulfex + cisplatin - synergism & toxicity
4	capecitabine	low WBC count, blurred vision, constipation, pain in back, bone, joint, muscle	capicitabine+phenytoin - increases the level of phenytoin in serum
	Xeloda	Same	xeloda+warfarin - altered coagulation parameters/bleeding - including death
5	carbaplatin	blood in urine, allergic reactions, central neurotoxicity, peripheral neuropathy, leukopenis	cyclophosphamide+carbaplatin - toxicity/ synergism
	Paraplatin	bone marrow depression, central toxicity, ototoxicity, nephrotoxicity, abnormal blood electrolytes, bleeding	paraplatin + bacitracin - increases nephrotoxicity
6	cyclophosphamide	kidney/bladder problems, bloody stools, joint pains, frequent urination	cyclophosphamide+allopurinol - increases toxicity of cyclophosphamide by decreasing metabolism
	Cytosan	frequent urination, swollen glands, trouble in breathing, serious effects of heart	Same
7	Decarbazine	muscle pain, skin rashes, flu-like symptoms, difficulty in breathing, decrease blood cells in bone marrow, chest pain	dacarbazine + thiotepa - increases toxicity of other pharmacodynamic synergism
	DTIC-DOME	hemopoietic depression, hepatic necrosis, anorexia, alopecia,	DTIC - DOME + trimethoprim - decreases bone marrow function
8	fludarabine	risk of infection, severe neurotoxicity, tumor lysis syndrome, blood in urine, hemolytic anemia	fludarabine+pentostatin - risk of fatal pulmonary toxicity
	Fludara	pneumonitis, hyperglycemia, dysuria, pharyngitis, chest pain, shortness in breath, myelosuppression	
9	flurouracil	myocardial ischemia, agranulocytosis, gastrointestinal ulceration, acute cerebral	fluorouracil+leucovorin calcium - enhance the toxicity of flurouracil

		syndrome, photophobia	
	Adrucil	Same	Same
10	crisantaspase	Hepatotoxicity, coma, hemorrhage, tremors, thrombosis, pancreatitis. Bronchospasm, anaphylaxis, urticaria - discontinuating of crisanaspase	crisantaspase + decitabine (demethylating agent) - synergism/ cytotoxic effect
	Erwinase	anaphylaxis, hypersensitive reactions, pancreatitis, glucose intolerance, hyperglycemia, hyperbilirubinemia, thrombosis	erwinase + dexamethasone - increases the serum concentration of dexamethasone
11	Cladribine	nerve damage, thrombocytopenia, kidney problems, myelosuppression anemia, neutropenic fever	cladribine + rituximab - increases the risk of serious infection
	Leustat	neutropenia, dyspnea, myelosuppression, kidney problems	leustat + rituximab - increases the risk of serious infections
12	Cisplatin	cumulative renal toxicity, nephrotoxicity, myelosuppression, ototoxicity, bronchoconstriction, tachycardia	cisplatin + bacitracin - nephrotoxicity / ototoxicity
	Platinol	Same	platinol + chlorambucil - increases toxicity / synergism
13	chlorambucil	bone marrow depression, liver damage, thrombocytosis, epidermal necrolysis, steven - johnson syndrome	chlorambucil + nalidixic acid - increases the risk of toxicity
	Leukeran	pulmonary toxicity, secondary malignance, bone marrow depression, liver damage, hives & welts, toxic epidermal necrolysis	Same
14	Carmustin	low blood count, nephrotoxicity, pulmonary toxicity, retinal bleeding, thrombocytopenia, tachycardia	carmustin + cimetidine - increases toxicity of other by pharmacodynamic synergism
	BiCNU	myelosuppression, pulmonary toxicity, thrombocytopenia, liver problems	BiCNU + cimetidine - greater myelosuppression
15	dactinomycin	liver failure, hepatotoxicity, febrile neutropenia, thrombocytopenia, pancytopenia, anaphylaxis, acrinogenicity	dactinomycin + bevacuzumab - increases the cardiotoxic activities of dactinomycin
	Cosmegen	carcinogenicity, mutagenicity, teratogenicity,	Same
16	docetaxel	toxic death, hepatotoxicity, neutropenia, fluid retention, low WBC count, anemia,	docetaxel + itracnozole - eliminates the docetaxel from the body
	Taxotere	neutropenia, anemia, febrile neutropenia, hypersensitivity, fluid retention, mucositis	Same
17	mercaptopurine	low blood count, liver toxicity, hyperpigmentation, darkening of the skin,	mercaptopurine + allopurinol - increase serum conc of mercaptourin

	purinethol	anorexia, myelosuppression, liver dysfunction, gastroenteritis	Same
18	Melphalan	decreases blood cells in bone marrow, bleeding, risk to develop other type of cancers, nephrotoxicity, anemia,	melphalan + nalidixic acid - cause haemorrhagic enterocolitis
	Allkeran	bone marrow depression, leukopenia, pulmonary fibrosis, acute nonlymphocytic leukemia,	Same
19	Lomustine	thrombocytopenia, decrease urination, pulmonary fibrosis, leukopenia, nephrotoxicity	lomustin + cisplatin - increases toxicity / synergism
	CeeNU	thrombocytopenia, pulmonary fibrosis, myelosuppression, bone marrow depression, anemia	Same
20	Leucovorin	thrombocytosis, anaphylactoid reactions, liver disease, nephrotoxicity, leukopenia	leucovorin + fluorouracil - enhances the cytotoxicity & toxicity of fluorouracil
	wellcovorin	anemia, nephrotoxicity, thrombocytopenia, difficulty in breathing	Same
21	gemcitabine	myelosuppression, pulmonary toxicity, hepatic toxicity, hemolytic uremic syndrome	gemcitabine + docetaxel - increases the risk of bone marrow depression
	Gemzar	myelosuppression, blood in urine, shortness in breath, pulmonary toxicity, hepatotoxicity	Same
22	Idarubicin	myelosuppression, urticaria, hepatotoxicity, nephrotoxicity, myocardial infraction	idarubicin + bevacizumab - increased risk of cardiotoxicity
	Idamycin	Same	Same
23	ifosfamide	neurotoxicity, decreased number of blood cells in bone marrow, kidney problems,	ifosfamide + doxorubicine - increased risk of bone marrow depression, GIT problems
	Ifex	neurotoxicity, cardiotoxicity, hepatotoxicity, encephalopathy, thrombocytopenia	Same
24	Irinotecan	obstructive pulmonary disease, kidney & liver disease, gilbert syndrome	irinotecan + carbamazepole - increases the risk of myelosuppression
	Campto	low WBC count, anemia, pulmonary toxicity, hepato toxicity	Same
25	floxuridine	myocardial ischemia, atrial thrombosis, hepatic necrosis, neurotoxicity, leukopenia	floxuridine + aneastim - severity of cytotoxicity can be increased
	FUDR	serious allergic reactions, trouble breathing, blood in urine, heartburn, neurotoxicity	FUDR + Sulfamethoxazole - decreases the bone marrow function
26	Etoposide	acute leukemia, allergic reactions, bone pain, toxic epidermal necrolysis, hepatotoxicity,	etoposide + bevacuzimab - increases the cardiotoxic activities of etoposide
	Vepesid	peripheral nephropaty, leukemia, pulmonary fibrosis, thrombocytopenia	vepeside + bortezomib - the metabolism of etoposide can be decreased

27	Epirubicin	ventricular tachycardia, ulceration, erythema, low blood count, amenorrhea	epirubicin + fluorouracil - acute myelogenous leukemia
	Ellence	leukopenia, thrombocytopenia, hyperpigmentation, CHF, hyperuricemia	ellence + ancestim - increases the risk of cytotoxicity
28	daunorubicin	myelosuppression, supraventricular tachycardia, nephrotic syndrome, gout	daunorubicin + bacampicillin - the serum conc. Of daunorubicine is decreased
	cerubidine	hyperuricemia, myelosuppression, cardiotoxicity, severe allergic reactions.	daunomycin + bromocriptine - increases the risk of severe adverse effects
29	Cytarabine	pulmonary edema, renal dysfunction, neurotoxicity, hyperuricemia, thrombocytopenia	cytarabine + atazanavir - the metabolism of cytarabine decreases
	cytosar-U	hepatotoxicity, renal toxicity, neurotoxicity, blood in urine, thrombocytopenia	cytosar-U + cyclophosphamide - increases the cardiotoxic activities of cytarabine
30	streptozocin	myelosuppression, nephrotoxicity, hematological toxicity, edema	streptozocin + cidofovir - increases nephrotoxicity/ ototoxicity
	Zanosar	hypoglycemia, liver dysfunction, nephrotoxicity, renal toxicity	zanosar + cisplatin - increases the toxicity of the other by pharmacodynamic synergism
31	Raltitrexed	leukocytopenia, asthenia, fatal liver failure, malaise, mouth ulceration	raltitrexed + leucovorin - may reduce the efficacy of raltitrexed
	Tomudex	breathlessness, muscle cramps, red inflamed peeling skin, liver failure	tomudex + ancestim - risk of severity of cytotoxicity can be increased
32	procarbazine	reduction in platelets, angioedema, low blood cell count, central neurotoxicity, pneumonitis	procarbazine + captopril - procarbazine increases the hypotensive activities of captopril
	Matulane	leukemia, neurotoxicity, hypotension, gynecomastia, hemorrhage, hepatic dysfunction	matulane + atomoxetine - it may increase the central neurotoxic activities of atomoxetine
33	pentostatin	anorexia, upper respiratory infections, muscle weakness, mouth sores, blood in urine	pentostatin + fludarabine - increases the toxicity by unknown mechanism, lung function decreased
	Nipent	unusual bleeding, difficulty in breath, muscle aches, fatigue, low blood count	nipent + carmustine - risk of fetal pulmonary toxicity
34	Paclitaxel	arthralgias, myalgias, mouth sores, edema, discolouration of nails and skin, low BP, painful urination	paclitaxel + docetaxel - increases the risk of nerve damage
	Taxol	peripheral neuropathy, hair loss, hypersensitivity, liver problems	taxol + carboplatin - increases the risk of nerve damage
35	Oxaliplatin	shortness of breath, peripheral nephropathy, low blood count, severe allergic reactions	oxaliplatin + amiodarone - increase risk of QT prolongation, cardiac arrhythmias
	Eloxatin	anemia, loss of appetite, liver problems, arthralgias, blood in stools	eloxatin + carboplatin - increases the risk of nephrotoxicity
36	mitoxantrone	developing of blood cancer such as	mitoxantrone + idarubicin - risk of

		leukemia, blood in stools, discolouration of eyes, low blood count	cariotoxicity
	noxantrone	low blood pressure, leukemia, heart burn, depressed mood, hair loss, urinary tract infections	noxantrone + clozapine - risk of myelosuppression
37	Mitomycin	pneumonitis, hemolytic-uremic syndrome, mouth ulcers, kidney failure, bladder inflammation	mitomycin + vinblastin - acute shortness of breath & severe bronchospasm
	mutamycin	pulmonary fibrosis, damage of the linings og blood vessel walls, bladder inflammation	Same
38	methotrexate	hair loss, lower male fertility, trouble in breathing, kidney disease, ulcers	methotrexate + cisplatin - increses the nephrotoxicity
	rhematrex	dizziness, seizures, allergic reactions, pulmonary fibrosis	rhematrex + sulfasalazine - increases the pulmonary toxicity
39	Mesna	severe allergic reactions, blood in urine, low blood pressure, water retension	mesna + dicumarol - decreses the effects of dicumarol
	Mesnex	muscle weakness, cardac arrest, hypersensivity reactions, dermatologycal toxicity	Same
40	pemetrexed	low blood count, blood In urine, depression, kidney damage, liver problems, blood clots in lungs, allergic reations	pemetrexed + carboplatin - increses the risk of boe marrow supression, & gastrointestinal infections
	Almita	Same	alimta + cisplatin - increses the blood conc of almita & can effect the kidney function

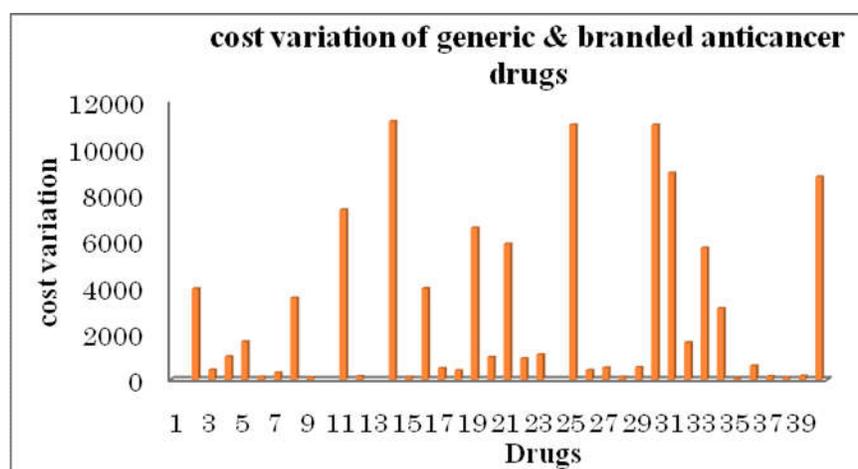


Figure 1: Cost variation of generic and branded anticancer drugs.

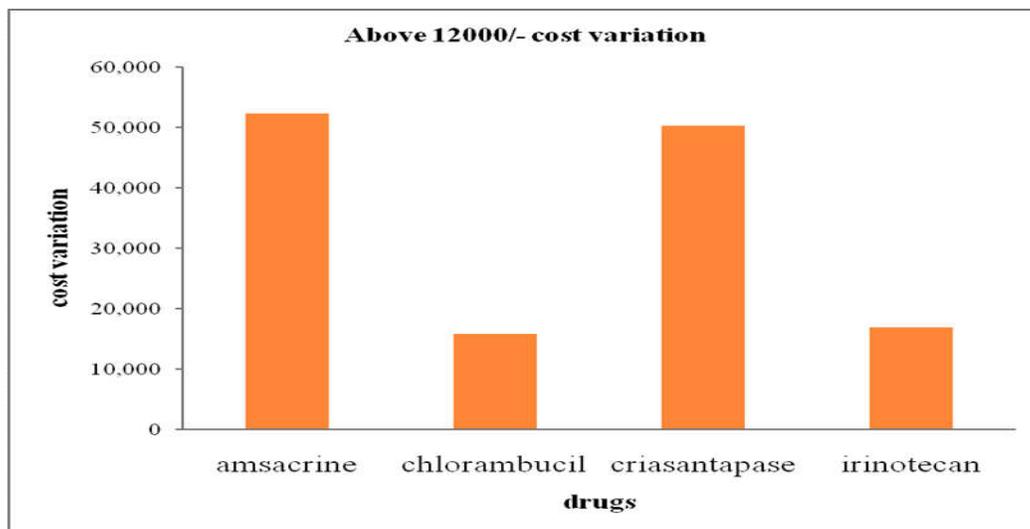


Figure 2: Drugs with huge cost variation with their numbers.

Amisidine is the brand name and its generic is amisacrine. It is having the cost variation about Rs.52,353. Crwinase is the branded copy and its generic is criasantapase is having the cost variation about Rs. 50,324. Leukeran is the branded drug and its generic form is chlorambucil is having the cost variation about Rs. 15,850. Campto is the branded drug and its generic form is irinotecan having the cost variation about Rs. 16,866.

Eloxatin is the branded version and its generic version is oxaliplatin. Its having the less cost variation i.e Rs.70. mutamycin is the branded drug and its generic is mitomycin. Its having the cost variation about Rs.151. rhematrex is the branded one and its generic is methotrexate. Its cost variation is about Rs. 92. Similarly, cosmegen is brand name drug and its generic is dactinomycin. Its cost variation is about Rs. 125. Like this some of drugs are having the more cost variation and some are less cost variation.

DTIC-DOME is the brand name of drug and its generic name is decarbazon. generic decarbazon produces the more adverse drug reactions like serious skin allergies, muscle pain, difficulty in breathing, then compared to branded drug. Cosmegen is the brand name of the drug and its generic is dactinomycin. Dactinomycin produces the anaphylaxis, carcinogenicity, hepatotoxicity effects. Purinethol is the brand name and its generic copy is mercaptopurine it produces the low blood count, hyperpigmentation, darkening of skin. Wellcovorin is

the brand name of the drug and its generic version is leucovorin it shows the anaphalactoid reactions, leucopenia, thrombocytopenia. Nipent is the branded drug and its generic copy is pentostatin. The generic pentostatin produces the anorexia, blood in urine, respiratory tract infections.

In this study we observed that maximum number of generics shows the similar drug interactions with branded one. But few generics like carbaplatin, streptazocin, oxaliplatin, mitoxantrone, methotrexate shows the severe interactions. When carbaplatin reacts with cyclophosphomide- it increases the toxicity. Streptozocin reacts with cidofovir- it increases the nephrotoxicity. Noxantrone is the brand name of the drug and its generic copy is mitoxantrone. Mitoxantrone when reacts with idarubicin – it increases the risk of cardio toxicity.

Either generic or branded (anticancer drugs) should not be given in following contraindicated conditions. They are myelosuppression, hypersensitivity, vaccination, bone marrow suppression, idiosyncratic reactions, kidney impairment, anemia when low amount of Mg, K in blood, lung fibrosis, autoimmune disorders, during the pregnancy etc.,

DISCUSSION:

To the best of our knowledge, there was no study done to evaluate the variability of prices, adverse effects, drug interactions, contraindications, of anti-cancer branded and generic drugs which are available

in India. Some studies evaluate the variability of price for some anticancer drugs. Our study for the first time analyzed the variation of cost, ADRs, drug interactions, contraindications among different brands of anti-cancer drugs available in the Indian market.

Cancer is associated not only with physical symptoms but also with a tremendous psychological impact¹⁵. The cost of anti-cancer drugs plays a major influence on the availability and utilization of them by the patients especially in resource poor country like India. Due to lack of information on comparative drug prices and quality, it is difficult for physicians to prescribe the most economical treatment.

The difference in cost between the various brands of the same drug varies from two fold to more than 100-fold¹⁶. In our study some drugs shows 1000 folds variations also. There are various reasons for this price variation which include majority of them being under patent protection and also the present market for new chemical entities being monopolistic in nature. In this market structure, the sellers retain appreciable influence over the price of a product¹⁷. Prescribing physicians are usually influenced by information provided to them in the form of formularies, promotional literature and marketing tactics of the medical representatives of that particular brand. The notion that new drug is always better than old drugs is also prevalent among physicians which need not be true always. This kind of biased information restricts both prescribers and patient's choices¹⁷. Lack of information on quality, non-availability and conflicts of interest are also responsible for physicians not prescribing the least expensive medication. Manufacturing companies claim high cost of research involved in developing new anti-cancer drugs as a reason for higher pricing of drugs. There are many middlemen involved in the process of a drug reaching to the consumer after it gets manufactured. Even though many times, the manufacturing cost of a particular anti-cancer drug is less, these middlemen who are involved in distribution and retail sale of drugs because of their bargaining power and based on demand are quite often responsible for high and indiscriminate variability of prices seen among various drugs¹⁸. Differences in guidelines of drug regulating authorities of various countries and their pricing

policies account for the varying prices of drugs among different countries. Drug Price Control Order (DPCO) is an order issued by the Indian government in 2013 to fix the price of drugs, which covers 680 formulations at present. Once any medicine is brought under the purview of DPCO, it cannot be sold at a price higher than that fixed by the government. In the past few years, the number of medicines that are under DPCO have been decreasing slowly due to which the cost of drugs are escalating^{19,20}. So, it becomes the need of the hour by not only government, but also by all the stake holders like NGOs, health care providers and general public to make a concerted effort in order to put pressure on the pharmaceutical manufacturing companies whereby the prices of both branded and generic drugs can be brought down and can be made affordable to common man. Cancer cure today revolves around chemotherapy. Toxic anticancer drugs with low therapeutic index are routinely prescribed to more than 50% cancer patients though their contribution to overall cure is only about 2%–5%. ADRs are considered an unavoidable component of cancer chemotherapy and are stoically accepted by both patients and health-care providers alike. All patients receiving chemotherapy through branded and generic drugs in this study had an ADR; similar to the previous reports of 100% patients receiving anticancer drugs having at least one ADR. In this study we observed that compared to the branded drugs generic drugs produces the severe ADRs. we observed that the variations of drug interactions, contraindication in generic and branded (anticancer drugs).

CONCLUSION:

This study shows that there is a wide variation in the prices of most of the anti-cancer drugs available in India. Health care providers must be aware of availability of low cost brands or generics available among anti-cancer drugs and prescribe accordingly based on the economic status of the patient for successful treatment of cancers. And also the government should use the appropriate inactive ingredients in the preparation of generics, which reduce allergic reactions of generics. There is an urgent need to decrease the cost of anti-cancer drugs by the government in order to save many lives due to cancer related mortality.

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