

## Prescribing Patterns in Chronic Diseases, Evaluation of 1326 Medical Prescriptions from the Area of Mount Lebanon

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### Research article

#### ABSTRACT

**Objective:** to analyze the cost and type of pharmaceuticals prescribed to treat chronic diseases in Lebanon, particularly hypertension and diabetes.

**Methods:** 1326 medical prescriptions were collected from 3 different pharmacies in Mount Lebanon during the period July 2015 and February 2017. Costs were analyzed using the list of drug prices of March 21, 2017 provided by the ministry of public health. We also included the composition and therapeutic class of each medication.

**Results:** Out of 168 hypertension prescriptions, 50% included beta-blockers, 43.5% angiotensin receptor blockers, 41.7% diuretics and 40.5% calcium channel blockers. The most prescribed hypertensive medication was bisoprolol (35.1%), followed by hydrochlorothiazide (30%) which was also the most prescribed ingredient in association. Diuretics and beta-blockers were the least expensive (with medians of 5.4 and 6.6 USD respectively), while ACE inhibitors and angiotensin receptor blockers were the most expensive ones (with medians of 19.8 and 25.4 USD respectively). The most common association encountered was angiotensin receptor blockers and diuretics, present in 23.5% of total hypertension prescriptions.

Metformin was the most prescribed ingredient (91.3% of total diabetes prescriptions) and the most prescribed in association, followed by glimepiride (26.1%), vildagliptin (18.8%) and insulin (8.7%). The most prescribed classes in association for treating diabetes were biguanides and gliptins (36.2%) followed by biguanides and sulfonylureas (30.4%).

The median prescription cost of hypertensive medications was 22 USD, lipid disorders (26.1 USD), anxiety/depression (11.1 USD) and diabetes (18.7 USD).

**Conclusion:** the prescribing patterns in our sample were in accordance with the guidelines of hypertension and diabetes management. The current range of drug prices in the Lebanese market makes these treatments affordable for patients of all socioeconomical classes.

**Keywords:** Cost, Community pharmacy, Chronic diseases, Hypertension, Diabetes.

#### INTRODUCTION

Chronic diseases are among the most common, costly and preventable of all health problems. In the USA, as of 2012, about half of all the adult population had 1 or more chronic illness and 1 out of 4 had 2 or more chronic illnesses<sup>[1]</sup>. They are by far the leading cause of mortality in the world, representing 60% of all deaths<sup>[2]</sup>.

Over time, the consequences of these chronic conditions also have a devastating effect on the quality of life of the patients. For instance, diabetic retinopathy is an important cause of blindness; it occurs as a result of long-term

accumulated damage to the small blood vessels in the retina and accounts for 2.6% of global blindness [3]. Combined with reduced blood flow, neuropathy in the feet increases the risk of foot ulcers, infections and eventual need for limb amputation [4]. The severity of anxiety and depression is associated with a decrease in the quality of life. [5]. Hypertensive patients also present lower quality of life scores in all domains, particularly in case of high administration frequency and occurrence of drug related side effects [6]. In 2016, a study reported diabetes, hypertension and dyslipidemia were the most prevalent diseases in the older adult population in Lebanon [7]. Several factors are taken into account when a physician decides on a chronic condition treatment such as the disease stage, newest guidelines, patient profile and other illnesses, drug-drug and drug-food interactions, choosing between a brand-name and a generic alternative.

Before the introduction of the Unified Medical Prescription (UMP), it was hard to assess the most used drugs to treat a certain chronic condition, the most used combinations of drugs/classes of drugs in treating a specific disease, the median cost of a prescription and how much this cost varies within and between chronic diseases. However, after it was introduced in July 2015, the UMP has been a positive step for the healthcare system in Lebanon, since it is one component of a broader policy that seeks to lessen the burden of health costs for citizens. This new policy allows the pharmacist, with the permission of the patient's physician, to substitute high cost brand-name drugs with generic equivalents in case of inability of the patient to purchase those [8]. Following this law, the medical prescription is made of 3 carbon copies: one for the physician, one for the pharmacist and one for the patient. The objective of the study is to describe/analyze the drugs prescribed in Lebanon for the treatment of hypertension and diabetes, as well as their cost.

## METHODS

### Data Collection

A sample of 1326 medical prescriptions was collected from 3 different pharmacies in Mount Lebanon during the period July 2015 and February 2017. All information was entered manually with the help of a piece of software written in Python. The names of the prescribing doctors were not entered, neither the date of the prescription nor the posology. The patients' names were only entered to ensure that the same treatment was not entered twice; from that step onwards the patients' names were discarded.

The ministry of health (MOPH) public price list of March 21, 2017 used was downloaded from the ministry of health's website. Additional features created are composition [9] and therapeutic class [10,11] of each drug in the sample. All prices were converted from Lebanese pounds to US dollars using the 24/5/2017 exchange rate of

### Tools

The analysis was carried out using Python version 3.5 through the Anaconda distribution. The main libraries used were Numpy, Pandas, Matplotlib and Seaborn.

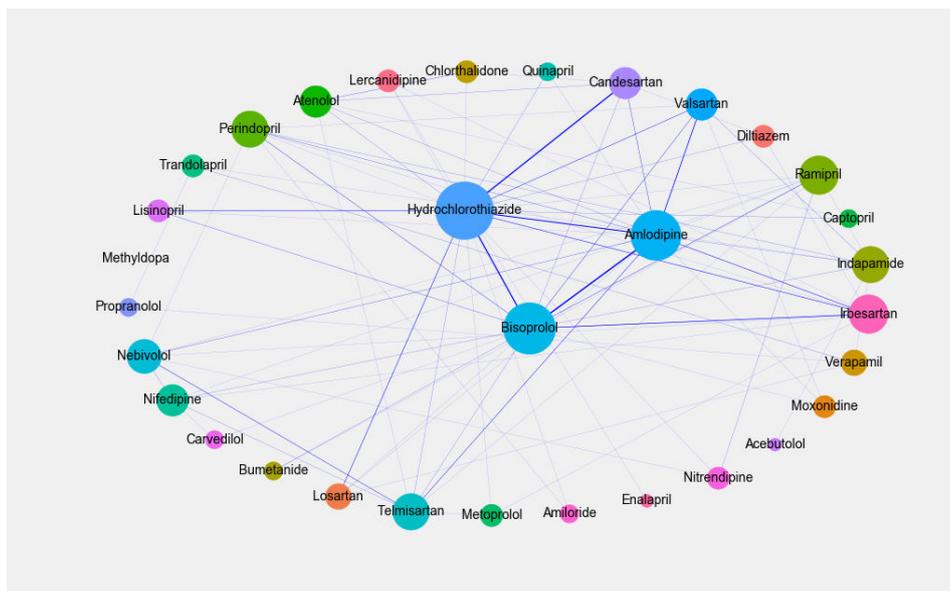
## RESULTS

Our sample of 1326 prescriptions contained a total of 4265 drugs, of which 945 unique brand names out of the population of 5685 drugs in MOPH price list of March 21, 2017. 749 (56%) of these prescriptions included antimicrobials, 517 (39%) analgesics and anti-inflammatory drugs, 432 (33%) medications for the gastrointestinal system, 319 (24%) for the respiratory system, 250 (19%) for the cardiovascular system, 131 (10%) and 128 (10%) for the central nervous and metabolic systems respectively. It is of note that the sum exceeds 100% because the same prescription can contain drugs belonging to more than one category.

### Prescribed Medications in Chronic Diseases

**Hypertension:** Our sample contained 168 hypertension prescriptions of which, 60 were monotherapy prescriptions (35.7%). Looking into classes, beta-blockers are present in 38.7% of monotherapy only prescriptions, calcium channel blockers in 25.8%. Overall, the most prescribed classes were: beta-blockers (50% of hypertension prescriptions) followed by angiotensin receptor blockers (43.5%), diuretics (41.7%) and calcium channel blockers (40.5%) then ACE inhibitors (21.4%). The most prescribed hypertensive medication was bisoprolol (35.1%), followed by hydrochlorothiazide (30%), amlodipine (27%), Irbesartan (12%) and Telmisartan (10%).

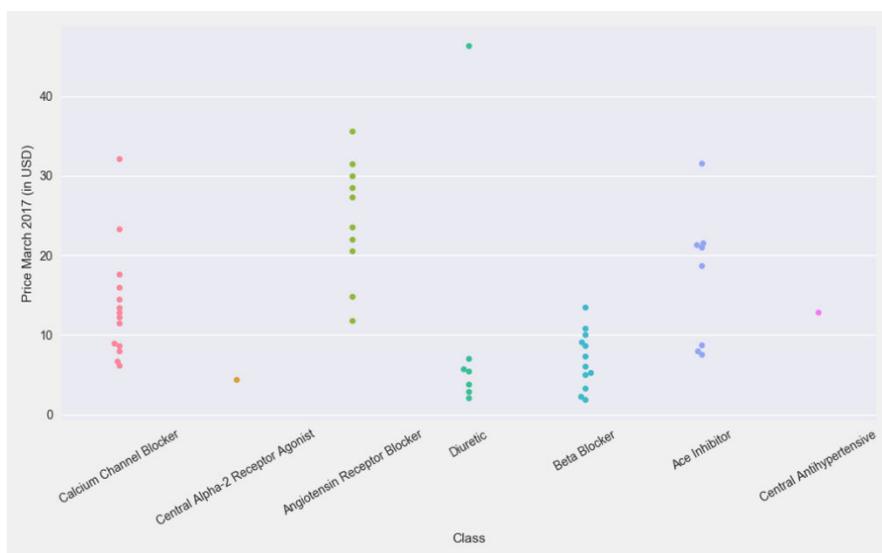
**Figure 1** represents the network of hypertension drugs. Each drug is a node (disk) with a size proportional to its degree (number of connections it has), and has an edge (link) that connects it to another node if the 2 drugs are prescribed together, with the width of the edge proportional to the number of times the 2 drugs appeared together in hypertension prescriptions. Hydrochlorothiazide was the most prescribed ingredient in association, followed by bisoprolol and amlodipine. Methyldopa is represented as a node with size 0, which is not surprising since it is mostly used alone to treat pregnancy related hypertension.



**Figure 1.** Graph of prescribed hypertension ingredients, Node size = degree, Edge width ~ number of appearances

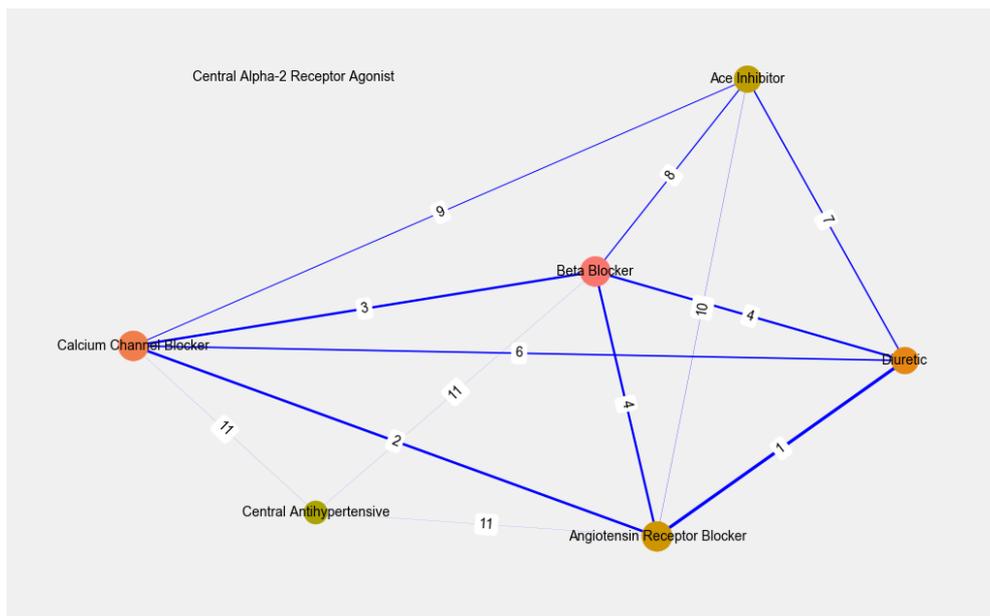
### Cost Analysis

In terms of prices of prescribed hypertension drugs, diuretics and beta-blockers were the least expensive (with medians of 5.4 and 6.6 USD respectively), while ACE inhibitors and angiotensin receptor blockers were the most expensive ones (with medians of 19.8 and 25.4 USD respectively). The full distribution of prices in each class is shown in **Figure 2**.



**Figure 2.** Swarm plot of prices of prescribed hypertension drugs for each class (prices of combination drugs are not included)

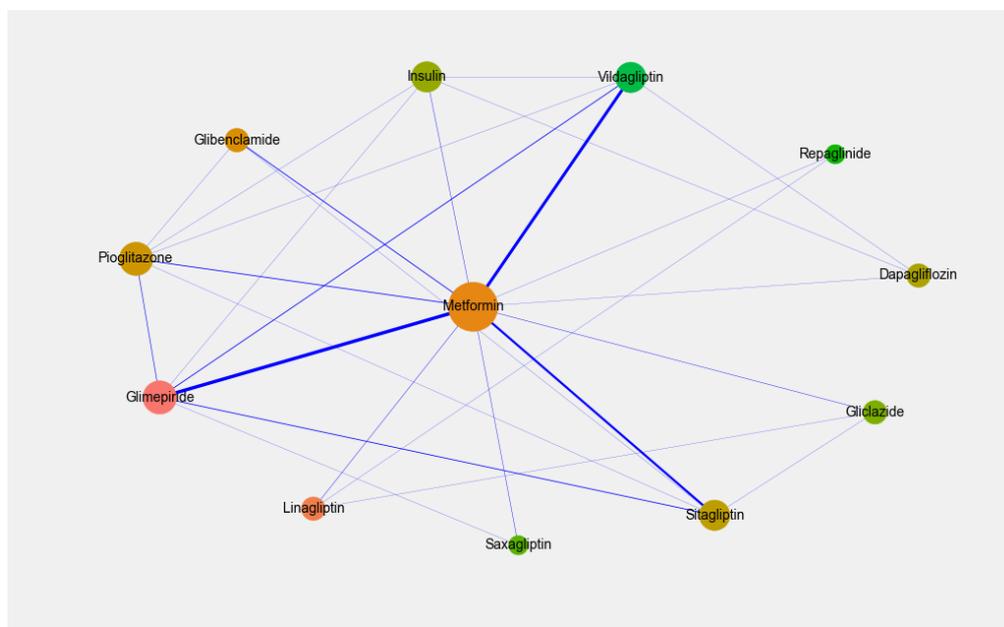
**Figure 3** looks into which hypertension classes are prescribed together. The edges are numbered starting from the most to the least prescribed association. The number 1 most prescribed association was found to be angiotensin receptor blockers and diuretics (present in 23.5% of total hypertension prescriptions), followed by angiotensin receptor blockers and calcium channel blockers (18.8%) then beta-blockers and calcium channel blockers (17.6%).



**Figure 3.** Graph of prescribed hypertension classes, Node size = degree, Edge width ~ number of appearances

### Diabetes

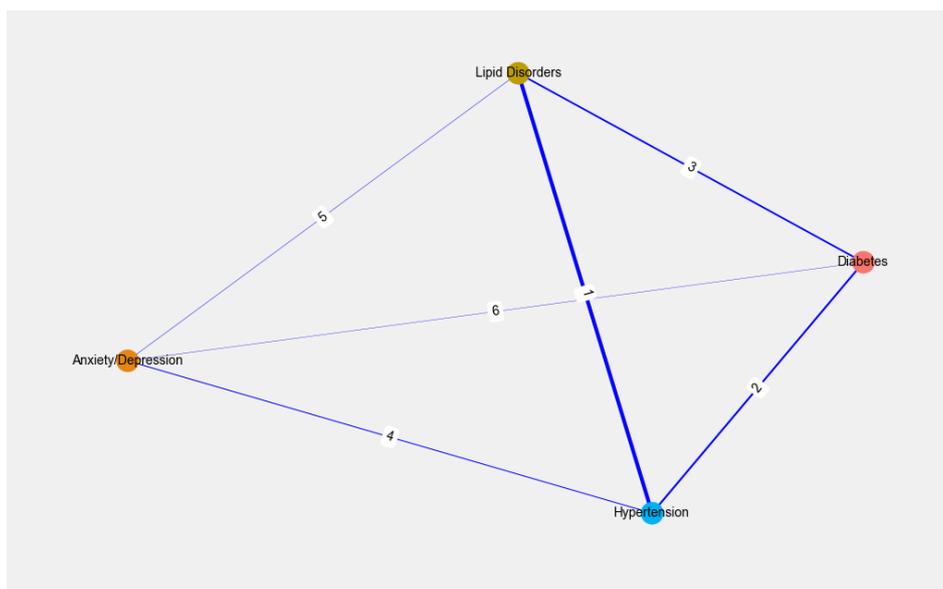
From the total of 69 diabetes prescriptions in the sample, metformin was the most prescribed ingredient (91.3% of total diabetes prescriptions), followed glimepiride (26.1%), vildagliptin (18.8%) and insulin (8.7%). In monotherapy, metformin was used 69.7% of the times, while sulfonylureas were used 9.1% and insulin 12.1%. **Figure 4** shows the network of ingredients prescribed in diabetes and their associations. Metformin was also the most prescribed drug in association.



**Figure 4.** Graph of prescribed diabetes ingredients in association, Node size = degree, Edge width ~ number of appearances

The most prescribed classes in association for treating diabetes were biguanides and gliptins (present in 36.2% of all diabetes prescriptions) followed by biguanides and sulfonylureas (30.4%) then gliptins and sulfonylureas (17.4%) (**Figure 5**).





**Figure 7.** Graph of chronic diseases associations, Node size = degree, Edge width ~ number of appearances

## DISCUSSION

Hypertension affects more than 1 in 5 adults worldwide [12] and is estimated to cause about 12.8% of the total of all deaths [13]. Its treatment varied widely over time in terms of initial drug of choice from diuretic to ACE inhibitor (ACEI)/angiotensin receptor blocker (ARB)/calcium channel blocker (CCB), from monotherapy to low dose combination single pill therapy [14]. Over the past 20 years, there had been a consistent increase in the use of ACEIs, ARBs and CCBs, with many robustly conducted clinical studies showing no consistent differences in antihypertensive efficacy, side effects and quality of life within these drug classes [15].

Looking into classes in our sample, the most prescribed classes were beta blockers, followed by angiotensin receptor blockers, diuretics, calcium channel blockers and ACE inhibitors. A retrospective time series data from China from 2007 to 2012 found that the most frequently prescribed antihypertensive drug classes were CCBs and ARBs, with prescriptions of the latter increasing most rapidly [16]. In India, ARBs are the most used, followed by ACEIs, BBs and CCBs respectively [17].

The association of ARBs, the most expensive class of drugs, and diuretics, the least expensive one, was the most prescribed combination in our sample. Al-Drabah et al. in Jordan in 2013 found that ACEIs were the most commonly prescribed antihypertensive agents in monotherapy and diuretics were the most common in combination therapy [18]. The researchers further observed that target blood pressure provide sufficient control was not achieved in most patients which imply that monotherapy may not provide sufficient control [18].

In 2014, the global prevalence of diabetes was 8.5%, WHO projects that it will be the 7th leading cause of death in 2030 [4]. In the past 10 years, there have been 4 new oral antidiabetic medication classes and 9 new injectable agents and insulin products approved by the FDA for the treatment of type-2 diabetes [19].

In our sample, we had 69 diabetes prescriptions, of which 33 were monotherapy. Metformin was the most used drug in monotherapy and all prescriptions. This is in accordance with the guidelines stating that we should always start with metformin, if tolerated and not contra-indicated, and continued when other agents are added to the treatment [20]. Conversely in the US, from 2003 through 2012, the use of sulfonylureas, DPP-4 inhibitors, thiazolidinediones, and glucagon-like peptide 1 analogs was not accompanied by metformin in 33.4% to 48.1% of the cases [21], suggesting a non-compliance with the guidelines.

In 2013, metformin prescribing peaked at 83.6%, while sulfonylureas prescribing reached a low of 41.4%. Both remained, however, the most commonly used pharmacological treatments as first-line agents and add-on therapy. Thiazolidinediones and gliptins were also prescribed as alternate add-on options [22].

In our sample, the most prescribed classes in association for treating diabetes are biguanides and gliptins followed by biguanides and sulfonylureas. This is interesting since the potential benefits of DPP-4 inhibitors (gliptins) include their complementary mechanism of action with other antidiabetic medications, a favorable adverse-effect profile (lower incidence of hypoglycemia) and a neutral effect on weight [23]. Patients with type-2 diabetes who receive DPP-4 inhibitors could still achieve almost similar glycemic targets as sulfonylureas [24].

## Limitations

The patient's age was not included on the majority of the prescriptions and we did not have any other information to distinguish type I from type II diabetes. In fact, in 4 prescriptions insulin was prescribed alone, and these were considered, along with all the other prescriptions, a treatment for type II diabetes. This is why the percentages calculated above for diabetes can be a little biased if our assumption was false.

Our results cannot be generalized since the prescriptions were collected from 3 pharmacies in Mount Lebanon only. Further studies are needed taking a bigger sample from all governorates in Lebanon. Since the patient's name was not always present or legible on the prescription copies we used, we could not follow the same patient over time, nor analyze the posology and duration of the treatment.

## CONCLUSION

In conclusion, despite the limitations of studying chronic diseases without the dosages, duration of treatment and any other information related to the patient's profile, we can argue that the general trend in treating these illnesses found in our sample is still within the margin of expectations, if the physicians are following the guidelines properly. The prices of these prescriptions are also in reasonable ranges with respect to the minimum wage, especially with the variety of generics available in minimal prices.

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## CONFLICTS OF INTEREST

The authors have nothing to disclose.

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