Accessibility to Essential Medicines in New York City by Zip Code Income Levels and Boroughs

Yan Aronson, PharmD[1], Joyce Addo-Atuah, PhD[2]

[1]Was a PharmD candidate, 2013, at the Touro College of Pharmacy, New York, at the time of this study which was the required students' Capstone Project. [2] Associate Professor of Pharmacy & Health Outcomes and the student's Capstone Project Advisor.

Abstract

Access to essential medicines is fundamental to medication adherence, continuity of care and hence population health outcomes and overall quality of life. Disparities in the availability and the cost of these medications in New York City, especially for low income neighborhoods, would compound the underlying health disparities in these neighborhoods. This study examined the physical and financial accessibility to 8 of the 150 Most Frequently Prescribed Drugs in New York, 2 each for Asthma, Diabetes, Hypertension, and Hyperlipidemia, 4 conditions that are among the top 10 most costly conditions in the United States. The study did not find any significant differences in mean drug prices between the high, medium, and low income neighborhoods in the City. However, the significantly different income levels and uninsured rates across neighborhood income strata in the City (p<0.001 for both), coupled with the high disease burden and other underlying disparities in low income neighborhoods, would point to potential affordability challenges for needed medications in these neighborhoods. On the other hand, significant differences in mean prices between the 5 City boroughs were found for 3 of the study drugs: Advair[®], p=0.009; Amlodipine 10mg, p<0.001; and Lisinopril 10mg, p=0.046. No such significant differences were observed for the mean prices of the other 5 study drugs-Proventil HFA,[®] Metformin HCL 500mg, Glipizide ER 5mg, Simvastatin 20mg, and Atorvastatin 10mg. The study findings did not also suggest that drug prices are dictated by the number of pharmacies in a neighborhood.

Further studies would be needed to better understand the complexities associated with the accessibility of essential medicines in New York City. These studies could include qualitative ones which would examine the perceptions and experiences of City residents with respect to the accessibility of prescribed medications as the basis for targeted interventions directed at promoting access to needed medications for all New Yorkers.

Introduction

Essential medicines have been defined as "those that satisfy the priority health care needs of the population."[1] In the United States[2-5] as a whole and also in the State [6]and City[7] of New York, the high morbidity and mortality associated with costly health conditions such as asthma, diabetes, hypertension, hyperlipidemia and their complications, qualify the medicines for the treatment of these conditions to be labeled as "essential medicines."[1] Access to essential medicines have been defined as their continuous availability and affordability in public or private health facilities or pharmacies within a reasonable distance from the homes of those who need them.[8] Equitable access to safe and affordable medicines is considered to be of the utmost importance by the global health community.[9]

Four main dimensions of access to essential medicines, vaccines, and other health commodities have been identified and operationalized.[10] They consist of: (a) Physical Availability, (b) Affordability [financial accessibility], (c) Geographic Accessibility, and (d) Acceptability [satisfaction].[10] Physical availability has been defined as the relationship between the type and quantity of product(s) or service(s) needed and the product(s) or service(s) actually provided. Some of the key indicators proposed for physical availability include: percentage of a set of unexpired key items in stock, percentage of time out of stock for a set of key items.[10] Affordability defines the relationship between prices of the products or services and the user's ability to pay for them. Key indicators proposed for affordability include the average price differential between a generic and brand product for the treatment of key health conditions; and public and private sector prices as compared to the median international prices of drugs for those conditions.[10]

Geographic accessibility on the other hand describes the relationship between the location of the product or service and the location of the eventual user of the product or service.[10] Some key indicators include the percentage of

Corresponding Author: Yan Aronson, PharmD[1]
4742 Burnet Ave, Sherman Oaks, CA 91403
Phone: (818) 398-8818; Email: yan624@yahoo.com

households located more than five kilometers from a health facility or pharmacy that has a set of key items in stock at all times.[10] Acceptability (or satisfaction), defines the relationship between the user's attitudes and expectations about the products and services and the actual characteristics of products and services. Key indicators for this dimension include clients' satisfaction with outcome of their most recent visit to the pharmacy or other outlets for their medications.[10]

Barriers to accessing needed medications are a global public health concern. Reports from global monitoring indicate that only 51.8% of public and 68.7% of private health facilities in developing countries were able to provide essential medicines to their populations in 2012.[9] High medicine prices have been identified as one such barrier to medication access in these countries. Essential medicines, when available, were found to have prices that were between 2.5-6.5 times those of their international reference prices (IRPs).[9] Although generic equivalent drugs are much cheaper than their innovator brands, they may not always be available, especially in the private sector in these countries.[9]

The 8 Millennium Development Goals (MDGs), which provide a framework for promoting global health in the context of development, has a specific target-Target 8E of MDG 8-which addresses access to essential medicines.[11] Target 8E seeks to promote access to essential medicines for the populations in developing countries through global cooperation between pharmaceutical companies and the governments of these countries.[11] The indicator for monitoring progress for this target is, "Proportion of the population with access to affordable essential medicines on a sustainable basis."[11]

Medication access is also very relevant to the United States population; several factors can create gaps in the accessibility to medications for those who need them. These include affordability challenges arising from lack of health insurance coverage which necessitates people having to pay for their medications out-of-pocket[12] However, even individuals with health insurance coverage may face prescription drug accessibility challenges as a result of the use of various prescription drugs utilization management strategies by their health plans.[13-14] These strategies include prior authorization, stepped therapy, with increasing out-of-pocket payments for higher tier drugs, full payment for non-formulary drugs, and utilization reviews.[13-14]. Seniors in America faced affordability challenges for their outpatient prescription drugs before the implementation of the Medicare Part D program in 2006.[15] It is important to note however, that the Part D program was designed such that Medicare beneficiaries would have to pay for their full outpatients prescription drug costs out-of-pocket

once they hit the coverage gap, commonly referred to as the "donut hole."[16] This could have serious implications for prescription drugs accessibility, and hence by inference medication adherence and outcomes, for the Medicare population in most need of medications. Fortunately, this accessibility challenge is being addressed by the Affordable Care Act of 2010 with the ultimate aim of eliminating the "donut hole" in the Part D Program.[17]

With the goal of addressing the escalating expenditures on prescription drugs for public programs like Medicaid, many states have been promoting generic prescribing and empowering pharmacists to substitute generically equivalent drugs for branded products in the absence of any contraindication.[18-21] Although generic drugs can bring consumers significant savings, they may not be as readily available as their brand-name innovator equivalents.[21] People in neighborhoods where needed generics are not available would have no option but to pay the higher prices for brand name drugs; those with the means may have to travel distances to obtain needed generics. However, generic drug shortages in the United States are increasingly becoming problematic; about 251 such shortages were recorded in 2011 alone.[22] In a study by Baumer et al on drug shortages in acute care hospitals,[23] nearly all pharmacy directors surveyed believed that shortages had changed practice and had compromised patient care. Their results suggested that shortages increase the acquisition cost of pharmaceuticals in the United States by over $99 million annually.[23] In another study which looked at the impact of drug shortages on U.S. health systems, most respondents surveyed felt that the information resources available to manage drug shortages were not adequate, costing the U.S. $216 million annually in labor costs to manage the shortages.[24]

High prescription drug prices are a significant barrier to appropriate medication use especially among populations with limited resources. This can potentially compromise medication adherence and thus the health outcomes of vulnerable and under-served populations.
In the state of New York, the Drug Retail Price List Law mandates pharmacies to (1) maintain a price list for the 150 Most Prescribed Medicines in the state, (2) update this list weekly, (3) post a sign in the pharmacy informing clients of the availability of this list, and (4) make copies available to consumers upon request.[25] This Law was intended to make the above information available to consumers so that they could lower their drug costs by shopping around for competitive prices.[25] However, studies by the New York City Council Investigation Division in both 2002 and 2004 reported widespread noncompliance to the Law; more importantly, there was no indication of any serious enforcement-

enhancing changes between the 2 year period.[25] The 2004 City investigation, for example, found gross disparities between drug prices within and between New York City boroughs; some drug price differences ranged from $30 to $80.[25] Furthermore, only about 28% of pharmacies had actual Drug Price Lists and 70% of pharmacies did not comply with the requirement to make their Drug Price Lists available to consumers on request.[25] The researchers recommended that properly enforcing the State Law on Drug Retail Price Lists and making these prices available online could potentially make drug prices in the City become more transparent and competitive for the benefit of consumers.[25] Another study in New York City has reported significant disparities in geographic access to neighborhood pharmacies and the availability of commonly-prescribed medications across neighborhood income levels.[26] Commonly-prescribed medications were found to be more likely out of stock , OR=1.24; 95% CI (1.02-1.52) in poorer neighborhoods than in the medium and higher income ones.[26] Entire neighborhoods could be described as "medication deserts" because both geographic access to pharmacies and the availability of common medications were very poor in these communities, according to this study.[26] Significant differences were also reported in the relative proportion of independent to chain pharmacies across neighborhood incomes in the City.[26]

Another study conducted by Gellad et al in Florida, using available state drug prices data, sought to determine whether there were significant differences in retail drug prices based on neighborhood income strata.[27] Their findings indicated that mean drug prices were 9% above the statewide average in the poorest zip codes.[27] More importantly, mean drug prices in the independent pharmacies in the poorest zip codes were about 15% higher than those in the chain pharmacies.[27]

In the context of the Healthy People 2020 goal of achieving health equity, eliminating disparities, and improving the health of all population groups,[28] and given the great disparities in incomes among the very diverse populations of NYC, examination of the accessibility to essential medicines in the City is of important public health relevance. This study therefore sought to evaluate 2 dimensions of accessibility (physical availability and drug prices/financial) to essential medicines in New York City by answering the following research questions:

1) Are there significant differences in mean drug prices across neighborhood income levels and boroughs in New York City?
2) Are drug prices in a zip code associated with the number of pharmacies in the zip code?

Methods
This was a cross sectional study of mean drug prices by zip code income levels and boroughs (The Bronx, Brooklyn, Manhattan, Queens, and Staten Island) in New York City. "Zip code definitions of New York City Neighborhoods" available on the website of the New York State Department of Health was used to identify the zip codes in the 5   New York City boroughs.[29] The NYC Census Fact Finder website and the EpiQuery search engine of the New York City Department of Health and Mental Hygiene provided neighborhood characteristics including the mean household income, the predominant racial/ethnic group of the resident population based on the 2000 and 2010 census data, and the percentage of the population uninsured in the neighborhoods.[30-31]

For the purposes of this study and in an effort to adequately cover the wide range of mean household incomes reported for the neighborhoods in NYC, zip codes or neighborhoods were categorized as high income ones if the mean household incomes were greater than or equal to $80,000; medium income ones were those below $80,000 but above $57,000; and low income neighborhoods were those with mean household incomes below $57,000. Within each NYC borough, 2 zip codes each were randomly selected from the high, medium, and low income neighborhoods, yielding a total of 30 zip codes (6 per borough) for the study.

Two prescription medications each for Asthma, Diabetes, Hypertension, and Hyperlipidemia were targeted for the study. The targeted medical conditions are among the most costly conditions in the United States according to the Medical Expenditure Panel Survey.[5]
The specific study drugs, selected from the "150 Most Frequently Prescribed Drugs in New York State," which is published annually by the New York State Board of Pharmacy,[32] were:

Asthma: Advair Diskus® 250/50 (GlaxoSmithKline) [Fluticasone propionate 250 mcg & Salmeterol 50 mcg] and Proventil HFA Inhaler® 6.7gm (MERCK & Co) [Albuterol sulfate]
Diabetes: Metformin HCL 500mg and Glipizide ER 5mg
Hypertension: Amlodipine 10mg and Lisinopril 10mg
Hyperlipidemia: Atorvastatin 10mg and Simvastatin 20mg

The "Prescription Drug Prices in New York State" search engine on the New York State Department of Health's webpage [33] was used to collect data on drug prices. The search engine allows for the selection of drugs of interest, target zip code(s), and the distance around the zip code(s) in order to generate a list of the names and number of pharmacies,   along with their drug prices, in the selected zip

code(s). We chose a 2-mile radius around the target zip codes for the search on drug prices in this study. From the list of available pharmacies in each zip code so generated, we calculated the mean prices for the study drugs in that zip code by averaging drug prices from 2 randomly-selected chain (Rite Aid and Walgreens) and 2 independent pharmacies from that neighborhood. The mean drug prices so determined were for 1 inhaler each (Advair® and Proventil HFA®) and for 30 tablets each of Glipizide ER 5mg, Amlodipine 10mg, Lisinopril 10 mg, Simvastatin 20, Atorvastatin 10mg and for 60 tablets of Metformin HCL 500mg.[32] Advair® and Proventil® are listed as such on the list of 150 Most Prescribed Drugs; the other 6 drugs have been listed by their generic names with an indication of their innovator brand names.[32]

Data Analysis

Data collected for each zip code included neighborhood demographics, drug prices, and the number of pharmacies available within a 2-miles radius of each zip code. Neighborhood data covered zip codes with their associated cities and boroughs. Zip code demographic data consisted of population size, predominant racial/ethnic group, socio-economic status (expressed as mean household income) and percent of population uninsured in 2010.

To determine whether there were significant differences in mean drug prices by zip code household income in NYC, we pooled the mean drug prices in the 3 zip code income levels across the City, coming out with City-wide mean prices for each drug in the high, medium, and low City neighborhoods and compared them for significant differences using One Way Analysis of Variance (ANOVA). We also used ANOVA to analyze differences in mean drug prices across the 5 NYC boroughs. The strength and the direction of the relationships between the number of pharmacies in a neighborhood and mean drug prices were examined by Pearson Product-Moment Correlation. All statistical tests were performed using IBM SPSS Statistics 19 software package (IBM Corporation, Armonk, NY). P-values for statistical test results ≤ 0.05 were taken as indicative of statistically-significant differences or relationships between the study variables.

Results

Table 1 gives the demographic characteristics of the populations in the 30 study zip codes in New York City and the number of pharmacies within a 2-mile radius of each zip code. The information in Table 1 is summarized in Table 2. Mean prices of the study drugs with their corresponding zip codes and NYC boroughs, household income levels, and the number of pharmacies are presented in Table 3.

The mean (95% CI) prices of the study drugs across neighborhood income levels in the City have been presented

in Table 4. Mean prices (95% CI) of Advair®250/50 inhaler was found to be $290.44($284.62-$296.26), $293.02 ($284.75-$301.29), and $295.15($286.92-$303.38) in the high, medium, and low income neighborhoods, respectively. No statistically significant differences in these prices were observed (p=0.689). Similarly, the mean prices of the remaining 7 study drugs were not found to be significantly different across neighborhood income strata in the City (Table 4). Table 5 presents the mean drug prices across the 5 NYC boroughs. Among the 8 study drugs, only 3 of them (Advair® 250/50 inhaler, Amlodipine 10mg, and Lisinopril 10mg), were found to have mean prices that varied significantly across the boroughs. Whereas Advair®250/50mg's mean price was $289.36($281.86-$296.96) in the Bronx, it was $294.39 ($284.14-$304.62), $299.05 ($290.20-$307.90), $280.74($ 272.61-$288.11), and $301.03($298.30-$304.10) in Brooklyn, Manhattan, Queens, and Staten Island, respectively (p=0.009). Similarly, 30 tablets of Amlodipine 10mg ranged from $44.48 ($$42.75-$46.21) in the Bronx to $63.49 ($62.19-$64.79) in Staten Island (p<0.001). Furthermore, Lisinopril 10mg prices were found to differ significantly across boroughs (p=0.0406).

Given that an earlier study by Amstislavski et al[26] had reported significant disparities in geographic access to neighborhood pharmacies across neighborhood income strata in the City, this study further sought to determine whether there were significant correlations between mean drug prices in New York City neighborhoods and the number of pharmacies within a 2-mile radius of the neighborhood. Positive linear relationships of varying strengths were observed between the number of pharmacies and the mean prices of 4 of the study drugs but none achieved statistical significance-Advair® (r=0.53; p=0.643); Proventil HFA® (r=0.62; p=0.575); Glipizide ER 5mg (r=0.086; p=0.945); and Simvastatin 20mg (r=0.394; p=0.742). The mean prices of the remaining 4 study drugs were negatively correlated to the number of pharmacies in the neighborhood but again, none of these relationships were found to be statistically significant.

Discussion

Prices of essential medicines determine their affordability (financial accessibility) which in turn may have major implications for medication adherence, continuity of care, and hence population health outcomes. Significant price differences for frequently-prescribed medications for 4 of the most common and costly medical conditions in the United States-asthma, diabetes, hypertension, and hyperlipidemia-will undoubtedly compound the challenges of health disparities which the United States is already grappling with. Such drug price variations in NYC, with its very diverse

racial/ethnic, income, and uninsured rates, among others, will be even more problematic.

It is gratifying therefore to note that, unlike the Florida study of mean drug prices by Gellad et al,[27] the findings in this current study, of mean drug prices by neighborhood income levels and boroughs in NYC, did not reveal any significant differences in drug prices between the high, medium, and low income neighborhoods in the City. However, attention should be drawn to the differences in the mean household income levels across the 3 neighborhood income strata in the City. Whereas a low income neighborhood (10453) in Morris Heights in the Bronx has a mean household income of $37,383, that of a similar neighborhood (10303) in Mariner's Harbor in Staten Island is $54,956. Similarly, a high income neighborhood (10464) in Pelham Bay in the Bronx has a mean household income of $81,856, compared to that of a similar neighborhood (10038) in Seaport, Manhattan of $124,271. More importantly, mean household income levels, especially in the low income strata, in Staten Island were found to be outliers when compared with those in the other 4 boroughs in the City. For example, a low income zip code (10302) in Staten Island has a mean household income of $56,518, which is equivalent to that of a medium income ($56,838) zip code (10466) in the Bronx. These income differences were statistically significant ($p<0.001$). In addition to these income differences, the percentage of the population without health insurance coverage in the high, medium, and low income neighborhoods were also significantly different ($p<0.001$); they were 8.80%, 15.76% and 18.74%, respectively, in 2010.[12] Unlike the insured populations, those uninsured would have to pay for their needed medications at the full undiscounted retail prices out of pocket, in the absence of any other assistance. Health insurance plans normally negotiate with drug manufacturers for discounted prices; a benefit that will not be available to the uninsured.

Another factor for consideration is the differences in the predominant racial/ethnic composition of the resident populations in the 3 neighborhood income levels of the City. With the exception of Elm Park (10302) in Staten Island, Table 1 indicates that the predominant racial/ethnic populations in the low income neighborhoods in all 5 boroughs of the City are African Americans or Hispanics. Hence, low income, along with lack of health insurance, in the context of disproportionately high disease burden, poor access to health care, and poor health outcomes,[34-35] would suggest a potential for medications affordability challenges for these populations, even though no significant drug price differences were observed across neighborhood income levels in the City.

On the other hand, mean drug prices differed significantly across the boroughs for 3 of the 8 study drugs- Advair®, Amlodipine 10mg and Lisinopril 10mg. However, the price differences observed for these drugs in this study did not reach the ranges ($30-$80) reported in the City in 2004.[25] Those researchers suggested that City residents could shop for competitive drug prices across boroughs and hence make substantial savings.[25] It is also important to note that although the study of Amstislavski et al[26] reported significant disparities in the geographic access to neighborhood pharmacies and the availability of commonly-prescribed medications across neighborhood income levels in the City, the findings in this study would suggest that mean prices of prescription medications are not dictated by the number of neighborhood pharmacies in NYC.

This study has a number of limitations. Since the New York City Council Investigations Division found serious compliance challenges with the State Drug Retail Price List Law in 2 consecutive studies conducted in the City,[25] it is possible that similar challenges still persist, which would mean that the drug prices data used in this study may not reflect the most current ones in use in the respective pharmacies. Thus primary data collection from pharmacies would be important to authenticate the reported medication prices. Another possible limitation is that only 4 pharmacies per zip code were randomly selected for computing the mean prices for the 8 study drugs, given the limited time period available for the study. A more representative sample of pharmacies, systematically selected per zip code may yield a more representative data on drug prices in the City.

Conclusion
Accessibility to essential medicines is fundamental to desired medication adherence and optimum outcomes with respect to therapeutic benefits of drug treatment and population health. Disparities in the geographic access to neighborhood pharmacies and also in the physical availability of medications and in their costs have been reported in earlier studies conducted in NYC.[25-26] A Florida study has also reported significant disparities in mean drug prices across neighborhood income strata and between independent and chain pharmacies.[27] Although this current study did not find any significant differences in drug prices across neighborhood income levels in the City, the fact still remains that medicines in the United States, especially branded products such as Advair® and Proventil HFA® are not cheap.[36] Whereas insured people benefit from their health plans' negotiated discounted drug prices, populations without health insurance coverage do not enjoy this luxury. This can be especially problematic for, minority, under-served populations already facing significant health disparity challenges,[33-34] and hence the

public health importance and relevance of this study. Medicines affordability (financial accessibility) challenges could have implications for prescription filling and re-filling, medication adherence, and general continuity of care for the chronic diseases and conditions targeted in this study, thus adversely affecting the health outcomes and quality of life of minorities and low income populations in the City. Accessibility challenges to the medications targeted in this study would have a special public health relevance given that they are among the most frequently prescribed for 4 of the top 10 most costly conditions among the noninstitutionalized adult population 18 years and above in the United States.[5]

Further studies, using a more representative sample of NYC zip codes and which also examine differences in mean drug prices between chains versus independent pharmacies, would be useful. Follow up studies could also be enriched if resources would allow for the collection of primary data from a representative sample of pharmacies in the City in line with the study protocol of Amstislavski et al.[26]

Furthermore, a qualitative study examining New Yorkers' perceptions of the accessibility of essential medicines and their personal experiences of accessing needed prescription medications would be needed to assist policy makers, healthcare providers and drug manufacturers and distributors in taking the requisite steps to promote access to essential medications for all populations irrespective of race/ethnicity, socio-economic status, and geographic residence in the City. Similar qualitative studies on access to medicines, such as the one carried out in Ghana,[37] could be replicated elsewhere in and outside the United States to inform policy and promote access. Finally, studies which examine the relationships between access to medicines, medication utilization and adherence, and health outcomes would be very useful towards promoting population health.

References

1. World Health Organization. Essential Medicines. Available at: http://www.who.int/medicines/services/essmedicines_def/en/index.html Accessed 6/20/2013.
2. CDC National Center for Health Statistics. National Surveillance of Asthma: United States, 2001-2010. Available at: http://www.cdc.gov/nchs/data/series/sr_03/sr03_035.pdf Accessed 6/20/2013.
3. Centers for Disease Control & Prevention. National Diabetes Fact Sheet: National Estimates and General Information on Diabetes & Prediabetes in the United States, 2011. Available at: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf Accessed 6/20/2013.
4. Centers for Disease Control and Prevention. High Blood Pressure Facts, Available at: http://www.cdc.gov/bloodpressure/facts.htm Accessed 6/15/2013.
5. Soni, A. Top 10 Most Costly Conditions among Men and Women, 2008: Estimates for the U.S. Civilian Noninstitutionalized Adult Population, Age 18 and Older. *Statistical Brief #331. July 2011*. Agency for Healthcare Research and Quality, Rockville, MD. Available at: http://www.meps.ahrq.gov/mepsweb/data_files/publications/st331/stat331.shtml Accessed 6/15/2013.
6. New York State Department of Health. Leading Causes of Death, New York State 2001-2010. Available at: http://www.health.ny.gov/statistics/leadingcauses_deaths/nys_by_year.htm Accessed 6/15/2013.
7. New York State Department of Health. Leading Causes of Death, New York City, 2001-2010. Available at: http://www.health.ny.gov/statistics/leadingcauses_deaths/nyc_by_year,htm Accessed 6/15/2013.
8. World Health Organization. Access to Medicines. Available at: http://www.who.int/trade/glossary/story002/en/ Accessed 6/20/2013.
9. World Health Organization. Access to Affordable Essential Medicines. Available at: http://www.who.int/medicines/mdg/MDG08ChapterEMedsEn.pdf Accessed 6/20/2013.
10. Center for Pharmaceutical Management. Defining and Measuring Access to Essential Drugs, Vaccines, and Health Commodities. Available at: http://www.msh.org/seam/reports/Access_Meeting_Ferney_Voltaire_1.pdf Accessed 6/20/2013.

11. United Nations. Millennium Development Goal 8. The Global Partnerships for Development: Making Rhetoric a Reality-MDG Gap Task Force Report 2012. Available at: http://www.un.org/millenniumgoals/2012_Gap_Report/MDG_2012Gap_Task_Force_report.pdf Accessed 6/20/2013.

12. New York City Department of Health and Mental Hygiene. NYC Community Health Survey 2010. Percentage with No Insurance by Neighborhood. Available at: https://a816-healthpsi.nyc.gov/SASStoredProcess/guest?_PROGRAM=%2FEpiQuery%2FCHS%2Fchs2&year=2010&var=insure5&strat1=allsex2&strat2=none&qtype=neighbor&bivar=genhlt4. Accessed 4/11/2013.

13. Horizon Blue Cross Blue Shield of New Jersey. Pharmacy & Prescriptions Utilization Management. Available at: http://www.horizonblue.com/members/services/pharmacy-prescriptions/utilization-management Accessed 6/15/2013.

14. AARP Public Policy Institute. Strategies to Increase Generic Drug Utilization and Associated Savings. Available at: http://assets.aarp.org/rgcenter/health/i16_generics.pdf Accessed 6/20/2013.

15. Millett C, Everett CJ, Matheson EM, Bindman AB, Mainous AG. Impact of Medicare Part D on Seniors' Out-of-pocket Expenditures on Medications. Arch Intern Med. 2010; 170(15):1325-1330. doi:10.1001/archinternmed.2010.208.

16. Medicare. Prescription Drug Coverage: Things to Consider. Available at: http://www.medicare.gov/pdp-things-to-consider.asp Accessed: 3/8/2013.

17. Centers for Medicare & Medicaid (CMS). Closing the Coverage Gap-Medicare Prescription Drugs Are Becoming More Affordable. Available at: http://www.medicare.gov/Pubs/pdf/11493.pdf Accessed 6/20/2013.

18. Kaiser Family Foundation. Prescription Drug Trends, May 2010. Available at: http://www.kff.org/rxdrugs/upload/3057-08.pdf Accessed 4/11/2013.

19. Jesse CV. Generic-Substitution Laws. US Pharm. 2008;33(6) (Generic Drug Review):30-34. Available at: http://www.uspharmacist.com/content/s/44/c/9787/ Accessed 4/11/2013.

20. Shrank, WH, Choudhry, NK, Agnew-Blais, J. Federman, AD, Liberman JN, Liu J et al. State Generic Substitution Laws can Lower Drug Outlays Under Medicaid . *Health Affairs.* 2010; 29(7):1383-1390.doi: 10.1377/hlthaff.2009.0424.

21. National Conference of State Legislatures. Use of Generic Prescription Drugs and Brand-Name Discounts. Available at: http://www.ncsl.org/portals/1/documents/health/GENERICS-2010.pdf Accessed 4/20/2013.

22. Thomas K. The New York Times. Drug Shortages Persist in U.S., Harming Care. Available at: http://www.nytimes.com/2012/11/17/business/drug-shortages-are-becoming-persistent-in-us.html?pagewanted=all&_r=0 Accessed 3/13/2013.

23. Baumer AM, Clark AM, Witmer DR, Geize SB, Vermeulen LC, Deffenbaugh JH. National Survey of the Impact of Drug Shortages in Acute Care Hospitals. *American Journal of Health-System Pharmacy.* 2004; 61(19):2015-22.

24. Kaakeh R, Sweet BV, Reilly C, Bush C, DeLoach S, Higgins B. Impact of Drug Shortages on U.S. HealthSsystems. *American Journal of Health-System Pharmacy.* 2011; 68(19):1811-1819. doi: 10.2146/ajhp110210.

25. The Council of the City of New York. Prescription Drug Prices: All Over the Map. Available at: http://www.nyc.gov/html/records/pdf/govpub/859prescdrugs.pdf Accessed 4/11/2013.

26. Amstislavski P, Matthews A, Sheffield S, Maroko AR, and Weedon J. Medication Deserts: Survey of Neighborhood Disparities in Availability of Prescription Medications. *International Journal of Health Geographics* 2012;11:48.

27. Gellad WF, Choudhry NK, Friedberg MW, Brookhart MA, Haas JS, Shrank WH. Variation in Drug Prices at Pharmacies: Are Prices Higher in Poorer Areas? *Health Services Research online*. 2009; 44(2p1): 606–617.doi: 10.1111/j.1475-6773.2008.00917.

28. Department of Health & Mental Hygiene. Healthy People 2020 Framework. Available at: http://www.healthypeople.gov/2020/consortium/HP2020Framework.pdf Accessed 6/20/2013.

29. New York State Department of Health. Zip Code Definitions of New York City Neighborhoods. Available at: http://www.health.ny.gov/statistics/cancer/registry/appendix/neighborhoods.htm Accessed 4/11/2013.

30. NYC Government. NYC Census FactFinder Available at: http://maps.nyc.gov/census/ Accessed 4/11/2013.

31. NYC Department of Health & Mental Hygiene. EpiQuery: NYC Interactive Health Data. Available at: https://a816-healthpsi.nyc.gov/epiquery/ Accessed 7/4/2013.

32. New York State Department of Health. 150 Most Frequently Prescribed Drugs. Available at: https://apps.health.ny.gov/pdpw/DrugInfo/DrugInfo.action Accessed 6/20/2013.

33. New York State Department of Health. Prescription Drug Prices in New York State. Available at: https://apps.health.ny.gov/pdpw/SearchDrugs/Home.action Accessed 6/20/2013.

34. AHRQ. Addressing Racial and Ethnic Disparities in Health Care. April 2013. Agency for Healthcare Research and Quality, Rockville, MD. Available at: http://www.ahrq.gov/research/findings/factsheets/minority/disparit/index.html. Accessed 6/15/2013.

35. Kawachi I, Daniels N, and Robinson DE. Health Disparities by Race and Class: Why Both Matter. *Health Affairs.* 2005; 24(2):343-352.

36. Lopert R and Gleeson D. The High Prices of "Free" Trade: U.S. Trade Agreements and Access to Medicines. *The Journal of Law, Medicine & Ethics*. *Special Issue: Symposium-Global Health & the Law*. 2013;41(1):199-223.

37. Addo-Atuah J, Gourley D, Gourley G, White-Means SI, Womeodu RJ, Faris RJ, Addo NA. Accessibility of Antiretroviral Therapy in Ghana: Convenience of Access. *Journal of Social Aspects of HIV/AIDS*. 2012;9 (2):74-87.

Table 1. Demographic Characteristics of Populations in the Study Zip Codes

Zip Code	City	Borough	Income Status	Mean Household Income ($)	Population	Predominant Race/Ethnicity	% Uninsured (2010)
10471	Riverdale	Bronx	High	104,139	22,922	White	13.8
10466	Edenwald	Bronx	Medium	56,838	67,813	African American	13.2
10453	Morris Heights	Bronx	Low	37,383	78,309	African American	21.5
10464	Pelham Bay	Bronx	High	81,856	4,534	White	11.7
10461	Morris Park	Bronx	Medium	63,417	50,502	White	18.1
10454	Mott Haven	Bronx	Low	33,417	37,337	Hispanic	21.5
11231	Carroll Gardens	Brooklyn	High	101,734	33,336	White	5.5
11204	Borough Park	Brooklyn	Medium	59,739	78,134	White	16.9
11212	Brownsville	Brooklyn	Low	38,168	84,500	African American	18.4
11217	Boerum Hill	Brooklyn	High	111,074	35,881	White	5.5
11235	Brighton Beach	Brooklyn	Medium	62,842	79,132	White	15.9
11239	Starrett City	Brooklyn	Low	34,784	13,393	African American	14.5
10025	Upper West Side	Manhattan	High	115,200	94,600	White	8.6
10026	Morningside Heights	Manhattan	Medium	64,751	34,003	African American	20.5
10035	East Harlem	Manhattan	Low	45,516	33,969	Hispanic	17.6
10038	South Street Seaport	Manhattan	High	124,271	20,300	White	12.9
10009	Alphabet City	Manhattan	Medium	83,700	61,347	White	13.8
10039	Upper Manhattan	Manhattan	Low	43,417	24,527	African American	25.0
11697	Breezy Point	Queens	High	105,975	4,079	White	8.1
11355	Flushing	Queens	Medium	59,124	85,871	Asian	14.9
11692	Arverne	Queens	Low	44,816	37,337	African American	12.4
11362	Little Neck	Queens	High	95,762	17,823	White	9.1
11106	Astoria	Queens	Medium	61,476	38,875	White	21.1
11433	Jamaica	Queens	Low	41,274	32,687	African American	21.7
10307	Tottenville	Staten Island	High	113,102	14,096	White	5.4
10305	Arrochar	Staten Island	Medium	79,425	41,749	White	11.6
10302	Elm Park	Staten Island	Low	56,518	19,088	White	17.4
10308	Bay Terrace	Staten Island	High	104,300	27,357	White	7.4
10301	St. George	Staten Island	Medium	74,852	39,706	White	11.6
10303	Mariners Harbor	Staten Island	Low	54,956	26,337	African American	17.4

Table 2. Summary Demographic Information and Number of Pharmacies Per Zip Code Income Levels in NYC

Borough	Income Status	Mean Household Income ($)	Total Population	% Uninsured (2010)	# Pharmacies
Bronx	High	92,998	27,456	12.8	56
	Medium	60,128	118,315	15.3	116
	Low	35,400	115,646	21.5	329
Brooklyn	High	106,404	69,217	5.5	174
	Medium	61,291	157,266	16.4	284
	Low	36,476	97,893	16.4	149
Manhattan	High	119,736	114,900	10.8	301
	Medium	74,226	95,350	17.3	399
	Low	44,467	58,496	21.3	367
Queens	High	100,869	21,902	8.6	186
	Medium	60,300	124,746	18.0	204
	Low	43,045	70,024	17.1	70
Staten Island	High	108,701	41,453	5.9	29
	Medium	77,139	81,455	11.6	41
	Low	55,737	45,425	17.4	27

High Income=Mean Household Income≥$80,000; Medium Income =Mean Household Income (X) $57,000 ≤ X<$80,000; Low Income=Mean Household Income <$57,000.

Table 3. Mean Drug Prices ($) by Zip Code

Zip Code	Income Level	Number of Pharmacies	Advair °250/50	Proventil HFA°	Metformin HCL 500mg	Glipizide ER 5mg	Amlodipine 10mg	Lisinopril 10 mg	Simvastatin 20mg	Atorvastatin 10mg
10471	High	40	293.85	53.74	40.65	13.78	44.79	22.86	84.80	141.80
10466	Medium	53	306.96	55.96	28.37	13.35	44.61	23.77	84.80	145.15
10453	Low	184	284.29	53.23	31.89	16.94	40.68	23.99	84.21	146.60
10464	High	16	284.57	59.63	28.23	13.46	46.51	21.07	81.15	141.81
10461	Medium	63	282.71	60.31	38.62	21.00	46.52	21.08	81.15	142.36
10454	Low	145	283.76	70.76	40.35	17.97	43.76	22.15	94.57	144.49
11231	High	68	272.47	51.88	27.76	13.42	52.73	24.51	95.10	144.13
11204	Medium	184	308.94	49.82	48.23	17.71	53.76	28.89	91.34	146.44
11212	Low	103	302.50	55.29	32.96	21.45	66.47	25.32	90.43	154.06
11217	High	106	289.56	54.45	40.14	17.21	61.25	28.11	81.32	145.46
11235	Medium	100	292.55	52.98	41.10	14.13	64.78	29.15	85.25	145.67
11239	Low	46	300.31	65.47	33.32	19.93	48.17	32.22	89.73	146.79
10025	High	142	304.46	55.65	40.03	20.43	40.03	19.97	64.28	140.36
10026	Medium	168	298.55	66.62	29.41	14.63	41.16	29.84	90.03	149.42
10035	Low	177	306.64	55.12	36.04	13.80	46.68	36.46	90.78	148.51
10038	High	159	283.74	57.43	37.33	16.41	43.84	22.02	80.40	141.88
10009	Medium	231	288.48	54.58	35.95	17.47	43.13	22.27	81.44	145.77
10039	Low	190	312.40	56.98	44.12	18.11	58.18	28.41	92.32	148.69
11697	High	164	284.45	53.54	41.11	14.59	51.57	28.35	85.26	142.73
11355	Medium	68	267.84	59.36	28.76	17.84	40.52	18.95	79.84	140.52
11692	Low	8	272.81	58.73	28.41	17.71	44.37	22.16	84.75	142.66
11362	High	22	295.75	55.70	38.28	17.77	44.97	25.66	81.54	152.04
11106	Medium	136	279.64	51.51	28.12	15.92	39.93	18.57	90.28	147.33
11433	Low	62	281.69	57.73	24.54	17.86	52.73	18.32	79.35	146.42
10307	High	17	295.43	48.79	28.68	17.21	61.59	24.62	86.20	143.49
10305	Medium	19	304.67	51.52	32.11	16.88	62.10	25.33	93.15	141.76
10302	Low	16	301.79	50.44	35.39	17.54	65.45	24.28	92.77	141.80
10308	High	12	300.09	49.39	24.65	15.79	65.39	25.66	91.40	147.61
10301	Medium	22	299.87	58.28	22.38	18.44	63.21	19.13	77.94	138.91
10303	Low	11	305.34	48.75	22.37	17.30	63.21	24.52	90.12	139.48

Table 4. Mean Drug Prices (95%CI) Across Neighborhood Household Income Levels in NYC

Drug	High Income	Medium Income	Low Income	ANOVA F (p-values)
Advair® 250/50	$290.44 ($284.62-$296.26)	$293.02 ($284.75-$301.29)	$295.15 ($286.92-$303.38	0.377 (0.689)
Proventil® 6.7gm	$54.02 ($51.93-$56.11)	$56.09 ($52.90-$59.28)	$57.25 ($53.14-$61.36)	0.983 (0.387)
Metformin HCL 500mg	$34.67 ($30.64-$38.70)	$33.31 ($28.57-$38.05)	$57.25 ($28.81-$$37.07)	0.171 (0.843)
Glipizide ER 5mg	$16.01 ($14.61-$17.41)	$16.74 ($15.32-$18.16)	$17.76 ($16.64-$19.08)	1.830 (0.180)
Amlodipine 10mg	$51.27 ($45.83-$56.71)	$49.97 ($43.73-$56.21)	$52.97 ($46.97-$58.97)	0.250 (0.781)
Lisinopril 10mg	$24.28 ($22.54-$26.02)	$23.70 ($20.96-$26.44)	$25.78 ($22.50-$29.06)	0.624 (0.543)
Simvastatin 20mg	$83.15 ($78.09-$88.21)	$85.52 ($82.18-$88.86)	$88.90 ($86.00-$91.80)	2.128 (0.139)
Atorvastatin 10mg	$144.13 ($141.97-$146.29)	$144.13 ($141.97-$146.29)	$145.95 ($143.39-$148.51)	0.802 (0.459)

High Income=Mean Household Income ≥$80,000; Medium Income = Mean Household Income (X) $57,000 ≤ X< $80,000; Low Income=Mean Household Income < $57,000.

Table 5.Mean Drug Prices (95% CI) Across New York City Boroughs

Drug	Bronx	Brooklyn	Manhattan	Queens	Staten Island	ANOVA F (p-values)
Advair®250/50	$289.36 ($281.76-$296.96)	$ 294.39 ($284.14-$304.62)	$299.05 ($290.20-$307.90)	$280.74 ($272.61-$288.11)	$301.03 ($298.30-$304.10)	4.23 (0.009)
Proventil HFA® 6.7gm	$58.93 ($53.75-$64.13)	$54.98 ($50.59-$59.37)	$57.66 ($54.14-$61.32)	$56.10 ($53.63-$58.58)	$51.10 ($48.30-$54.10)	2.311 (0.08)
Metformin HCL 500mg	$34.69 ($29.99-$39.99)	$37.25 ($31-39-$43.11)	$37.15 ($33.24-41.06)	$31.54 ($26.29-$36.79)	$27.60 ($23.29-$31.91)	2.745 (0.051)
Glipizide ER 5mg	$16.09 ($13.60-$18.56)	$17.31 ($14.80-$19.82)	$16.81 ($14.87-$18.75)	$16.95 ($15.85-$18.05)	$17.19 ($16.49-$17.89)	0.249 (0.907)
Amlodipine 10mg	$44.48 ($42.75-$46.21)	$52.76 ($51.97-$63.75)	$45.51 ($40.20-$50.80)	$45.68 ($41-35-$50.01)	$63.49 ($62.19-$64.79)	16.907 (<0.001)
Lisinopril 10mg	$22.49 ($21.47-$23.51)	$28.03 ($25.79-$30.27)	$28.03 ($21.51-$31.49)	$22.00 ($18.64-$25.36)	$23.93 ($21.99-$25.83)	2.823 (0.046)
Simvastatin 20mg	$85.12 ($81.16-$89.06)	$88.86 ($84.97-$92.75)	$83.21 ($74.77-$91.65)	$83.50 ($80.20-$86.80)	$88.60 ($83.97-$93.23)	1.060 (0.397)
Atorvastatin 10mg	$143.71 ($142.09-$145.31)	$147.10 ($144.26-$149.92)	$145.77 ($142.70-$148.84)	$145.29 ($141.94-$148.62)	$142.18 ($139.66-$144.70)	1.851 (0.151)