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Original Research

One-dollar medications: evaluating the true cost

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Abstract:
Introduction: Dollar stores offer access to medications. Reports of adulteration and violations of good manufacturing practice (GMP) of the medications sold at these stores raise concern. Additionally, medications may be used inappropriately for self-treatment, resulting in suboptimal care and safety concerns. Is the cost of one-dollar medications truly a cost saving for consumers?

Methods: This was a cross-sectional evaluation of medications sold in dollar stores. Medications were reviewed from December 2018 through July 2021. Researchers evaluated price comparisons of medications sold in dollar stores in comparison to those sold in pharmacies, assessed the quantity of the medication products from the manufacturer that had committed violations of GMP, and conducted a qualitative analysis of the safety of the medications for self-treatment with respect to current guidelines. Mann-Whitney U price analysis was performed between dollar store products and generic pharmacy products.

Results: The cost per unit of pain medication was significantly higher for purchases at dollar stores (Mdn = 0.045) in comparison to generic pain medications sold in pharmacies (Mdn = 0.030), W = 251.5, p = 0.013. There was no statistical difference in the costs of all other medications. The majority of the medications (59%) were from the manufacturer that had committed violations of GMP. Only second-line treatment options were available, providing suboptimal treatments and increased risks for adverse effects and poorer control of symptoms.

Conclusion: Consumers are not attaining a cost benefit when purchasing dollar store medications. Medications sold in settings in which a healthcare professional is not accessible should be limited to acute use dosing in place of packaging for chronic use. Additionally, further research is needed to determine if the violations determined for medications sold at the dollar store have been remedied.

Keywords: Dollar store, Self-care, Over-the-counter, Medications

Introduction

Discount variety stores such as dollar stores offer convenient access to many products, including an extensive selection of non-prescription, over-the-counter (OTC) medications. Dollar stores have been criticized for concentrating on areas of low socioeconomic status (SES), preventing access to fresh foods that would otherwise be

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sold in grocery stores [1]. Dollar stores have opened in food deserts servicing low-income shoppers, and fresh produce is often limited [1-3]. They have been associated with an increase in the prevalence of obesity in their surrounding areas [4]. It has been observed that individuals living in low SES neighborhoods do not have optimal nutritional intake, with racial and ethnic disparities prevalent in these areas [5]. Poor nutrition and low SES are known to contribute to negative health outcomes including overweight status and obesity [6]. Risks associated with being overweight and obese include chronic health conditions such as diabetes, hypertension, and osteoarthritis, as well as all-cause mortality and cardiovascular and cancer-related mortality [6-8]. With respect to these patient populations and this setting, the question should be asked as to the safety of the medications provided without access to a pharmacist or other healthcare professionals to advise regarding drug-disease and drug-drug interactions. The concerns with OTC medications sold at dollar stores are amplified by announcements made by the Food and Drug Administration (FDA) in which OTC medications sold in this setting were discovered to be from foreign manufacturers with multiple violations of current good manufacturing practices (GMP) [9]. Therefore, in addition to limited access to healthy foods in low SES neighborhoods, a major concern is access to safe and appropriate medications to self-treat certain health conditions. OTC medications may be used inappropriately for self-treatment without access to a pharmacist or other health care professionals, potentially resulting in suboptimal care and safety concerns. It is important to note that many Americans who utilize OTC medications have admitted to taking more than the recommended dose stated on the label of the OTC packaging, or not reading the label prior to use [10]. This study aims to evaluate OTC medications sold at a dollar store in a low SES area, using evidence-based medicine to determine potential risks and benefits to at-risk populations for the treatment of certain health conditions promoted by the product labeling on OTC medications. Additionally, a cost analysis will be performed to evaluate the cost comparison of these medications to those sold in settings where a pharmacist is available to seek guidance.

Methods

OTC medications sold at a dollar store in a low SES area were reviewed from December 2018 through July 2021. Researchers documented and analyzed product names, ingredients, doses, quantities, and directions. Additional dollar stores were visited once a complete list of medications sold at the dollar store selected for this study was compiled. The medication list was compared with 5 other dollar stores' medication inventory to determine if there were any outliers or differences in products sold at the studied dollar store in comparison to other dollar stores. The other stores were consistent in having the same medications with variability in the number of packages per product but not in the type of medication sold.

OTC medications were categorized by indication. Generic alternatives with the same active ingredients sold at a community pharmacy were documented, and a Mann-Whitney U price analysis was performed between the dollar store products and generic pharmacy products. A Mann-Whitney U test was used to test whether the prices of two samples likely came from the same population by comparing the medians between the two populations. This non-parametric statistical test was chosen because prices were not normally distributed and the sample size among the groups was small [11]. A review of primary literature and current medical guidelines was conducted through PubMed using MeSH terms of disease state (i.e., allergic rhinitis) and treatment guidelines, as appropriate. It is important to note that many of the drugs are indicated for specific symptoms, rather than a condition. For example, heartburn is a symptom of multiple conditions, so a "heartburn medical guideline" does not exist. As such, the guidelines for the treatment of heartburn based on the conditions associated with this symptom (e.g, Gastroesophageal Reflux Disease) were reviewed and additional supporting literature was used to evaluate options for guidance regarding dosage, safety, efficacy, and abuse potential of OTC medications specific for self-treatment considerations. (See Figure 1 for guidelines utilized.)

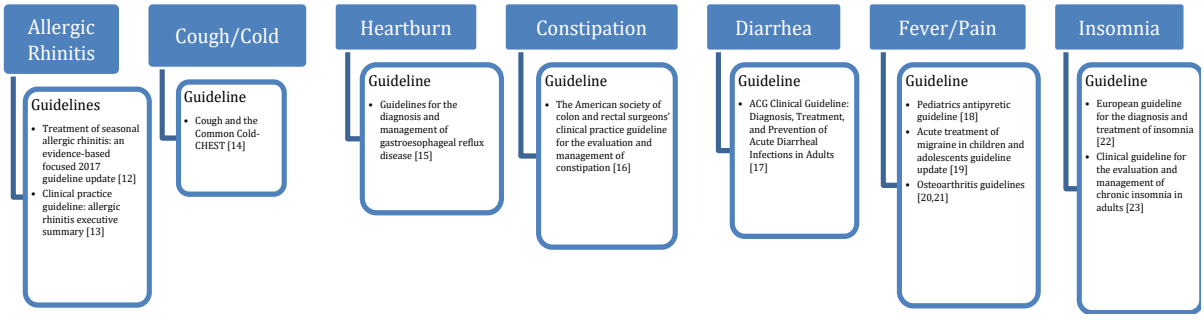

Figure 1. Evidence-Based Guidelines

Results

OTC medications sold at the dollar store totaled 82 products. (See Table 1-7) Forty-eight products (59%) of the OTC medications were the brands found in violation of GMP (Assured) as announced by the FDA in November 2019. The majority of the products available are not consistent with recommendations from evidence-based practice guidelines, and do not provide cost benefit. The difference in total cost per unit of dollar store medications in comparison to generic pharmacy brand medications was calculated to not attain significance through a Mann-Whitney U test, W = 2524, p = 0.79. However, the cost per unit of pain medication at dollar stores (Mdn = 0.045) was significantly higher in comparison to generic pain medications sold in pharmacies, (Mdn = 0.030), W = 251, p = 0.013, as shown in Table 8. Figure 2 illustrates through a box plot the significantly higher cost per unit of pain medication at dollar stores in comparison to generic pain medications sold in pharmacies. Of the OTC medications evaluated, second-line treatment options are available, providing suboptimal treatment with increased risk of adverse effects. Adverse effects considered are both from the risks associated with medications themselves and the outcomes associated with not properly treating a condition.

Table 1. Allergic rhinitis medication products & cost comparison

Allergic Rhinitis; price per unit* $1.02 dollar store vs $1.51 generic, p = 0.12						
Active ingredient	**Dollar store product**	**Quantity**	**Price/unit**	**Equate product**	**Quantity**	**Price/unit**
Acetaminophen 325 mg, Diphenhydramine 12.5 mg, Phenylephrine 5 mg	Assured Multi-symptom Allergy Plus Sinus Headache	12	$0.08	Equate Maximum Strength Severe Allergy and Sinus Headache	20	$0.12
Acetaminophen 325 mg, Guaifenesin 200 mg, Phenylephrine 5 mg	Assured Severe Sinus Congestion & Pain	12	$0.08	Equate severe sinus congestion and pain	24	$0.12
Cetirizine 10 mg	Assured All Day Allergy Relief	14	$0.07	Equate Allergy Relief	300	$0.11
Diphenhydramine 12.5 mg	Assured Children's Allergy Relief	118 mL	$0.25/fl oz	Children's allergy relief	237 mL	$0.65/fl oz
Diphenhydramine 25 mg	Assured Allergy	36	$0.03	Equate Allergy Relief	100	$0.04
Fexofenadine 180 mg	Readyincase Allergy Relief	3	$0.33	Equate non-drowsy allergy relief	120	$0.17
Oxymetazoline 0.05%	Assured Original Nasal Relief Spray	15 mL	$0.07/mL	Equate No Drip Nasal Spray	30 mL	$0.11/mL
Oxymetazoline 0.05%	Assured Severe Congestion Nasal Relief Spray	15 mL	$0.07/mL	Equate No Drip Nasal Spray	30 mL	$0.11/mL
Phenylephrine 10 mg	Assured Non-Drowsy Nasal Decongestant	24	$0.04	Suphedrine PE	72	$0.08

Table 2. Heartburn medication products & cost comparison

Heartburn; price per pill $0.17 dollar store vs $0.39 generic, $p = 0.72$						
Active ingredient	**Dollar store product**	**Quantity**	**Price/unit**	**Equate product**	**Quantity**	**Price/unit**
Calcium Carbonate 1000 mg	Tums Ultra Strength	12	$0.08	Equate ultra-strength antacid	160	$0.02
Calcium Carbonate 500 mg	Assured Antacid	60	$0.02	Equate regular strength antacid	150	$0.01
Citric acid 1.9485 g, Sodium Bicarbonate 2.4850 g	Picot Citric Acid-Antacid Sodium Bicarbonate-Antacid	6	$0.17	No equate equivalent	N/A	N/A
Esomeprazole 20 mg	Readyincase Acid Reducer	14	$0.07	Equate Acid Reducer Esomeprazole	42	$0.36

Table 3. Cough and cold medication products & cost comparison

Cough and Cold; price per pill $1.55 dollar store vs $2.89 generic, $p = 0.56$						
Active ingredient	**Dollar store product**	**Quantity**	**Price/unit**	**Equate product**	**Quantity**	**Price/unit**
Acetaminophen 325 mg, Dextromethorphan 10 mg, Guaifenesin 200 mg, Phenylephrine 5 mg	Assured Severe Cold Multi-Symptom	12	$0.08	Equate Daytime Severe Cold and Flu	24	$0.17
Acetaminophen 325 mg, Dextromethorphan 10 mg, Guaifenesin 200 mg, Phenylephrine 5 mg	Assured Maximum Strength Mucus Relief Cold, Flu, & Sore Throat	8	$0.13	Equate Daytime Severe Cold and Flu	24	$0.17
Acetaminophen 325 mg, Dextromethorphan 10 mg, Phenylephrine 5 mg	Assured Multi-Symptom DayTime	10	$0.10	Equate Daytime Cold and Flu Liquid Caps	24	$0.18
Acetaminophen 325 mg, Dextromethorphan 10 mg, Phenylephrine 5 mg	Assured Multi-symptom DayTime Cold & Flu Relief	4 fl oz, 118 mL	$0.25/fl oz	Equate Daytime Cold & Flu Liquid	12 fl oz, 355 mL	$0.50/fl oz
Acetaminophen 325 mg, Dextromethorphan 15 mg, Doxylamine Succinate 6.25 mg	Assured Multi-Symptom NiteTime	10	$0.10	Equate NiteTime Cold & Flu Multi-Symptom Relief	24	$0.18
Acetaminophen 650 mg, Dextromethorphan 30 mg, Doxylamine Succinate 12.5 mg	Assured Multi-Symptom NiteTime Cold & Flu Relief	4 fl oz, 118 mL	$0.25 / fl oz	No equate equivalent	N/A	N/A

Dextromethorphan 15 mg	Assured Adult Long Lasting Cough Relief	15	$0.07	No equate equivalent Minimum dose 30 mg	N/A	N/A
Dextromethorphan 20 mg, Guaifenesin 400 mg	HealthA2Z Immediate Release Mucus Relief DM	10	$0.10	Equate Maximum Strength Mucus Relief DM Guaifenesin 1200mg Dextromethorphan 60 mg	14	$0.64
Guaifenesin 200 mg	Assured Adult Tussin Mucus & Chest Congestion	4 fl oz, 118 mL	$0.25/ fl oz	No equate equivalent Minimum dose 600 mg	N/A	N/A
Guaifenesin 400 mg	Assured Expectorant Mucus Relief	15	$0.07	Equate Mucus ER Guaifenesin 600 mg	20	$0.44
Menthol 7.5 mg	Assured Honey Lemon Cough drops	35	$0.03	Equate Honey Lemon Cough Drops	160	$0.02
Menthol 1.7 mg	Vicks VapoDrops	20	$0.05	No equate equivalent	N/A	N/A
Menthol 4.8 mg	Assured Herbal Cough Drops	18	$0.06	Equate Natural Herbal Cough Drops	50	$0.06
Menthol 5.4 mg	Assured Menthol Eucalyptus Cough Drops	35	$0.03	Equate Sugar Free Cough Drops Menthol 5.8 mg	70	$0.03
Menthol 7.5 mg	Halls Cough Drops	14	$0.07	Equate Honey Lemon Cough Drops	160	$0.02
Vitamin A (as retinyl acetate) 600 mcg, Vitamin C (as ascorbic acid) 500 mg, Vitamin E (as dl-alpha tocopheryl acetate) 13.5 mg, Magnesium (as magnesium oxide and magnesium sulfate) 40 mg, Zinc (as zinc oxide) 8 mg, Selenium (as selenium amino acid chelate) 15 mcg, Manganese (as manganese gluconate) 0.5 mg, Sodium (from sodium bicarbonate) 75 mg, Potassium (from potassium bicarbonate and Saccharomyces cerevisiae) 210 mg, Dried Yeast Fermentate (Saccharomyces cerevisiae) 500 mg	Airborne Vitamin C	2 Powder Packets	$0.50 per packet	Equate Immune Support Dietary Supplement (1000 mg Vitamin C)	20	$0.45 per packet
Vitamin C 106 mg	Assured Vitamin C Supplement Drops	30	$0.03	Equate Vitamin C supplement drops	80	$0.03

Table 4. Constipation, diarrhea, and gas medication products & cost comparison

Constipation, Diarrhea, and Gas; price per pill, $0.37 dollar store vs $0.46 generic, $p = 0.46$						
Active ingredient	**Dollar store product**	**Quantity**	**Price/unit**	**Equate product**	**Quantity**	**Price/unit**
Bisacodyl 5 mg	Assured Laxative	25	$0.04	Equate Gentle Laxative	100	$0.05
Magnesium Citrate 1.745 g/fl oz	Swan Magnesium Citrate	10 fl oz, 296 mL	$0.10/fl oz	Equate Saline Laxative	10 fl oz, 296 mL	$0.10 /fl oz
Magnesium Hydroxide 1200/15 mL mg	Assured Original Milk of Magnesia	12 fl oz, 355 mL	$0.08/fl oz	Equate Milk of Magnesia Magnesium Hydroxide 1200 mg	26 fl oz, 769 mL	$0.14/fl oz
Loperamide 2 mg	Assured Anti-Diarrheal	12	$0.08	Equate Anti-Diarrheal	24	$0.12
Simethicone 125 mg	Assured Extra Strength Gas Relief	15	$0.07	Equate Extra Strength Gas Relief Softgels	72	$0.05

Table 5. Sleep medication products & cost comparison

Sleep; price per pill, $0.37 dollar store vs $0.46 generic, $p = 0.46$						
Active ingredient	**Dollar store product**	**Quantity**	**Price/unit**	**Equate product**	**Quantity**	**Price/unit**
Diphenhydramine HCl 25 mg	Assured Nighttime Sleep Aid	#12	$0.08	Equate Night Time Sleep Aid	365	$0.03
Diphenhydramine HCl 25 mg	Assured Sleep Aid	#36	$0.03	Equate Night Time Sleep Aid	365	$0.03
Diphenhydramine HCl 50 mg	Assured Maximum Strength Sleep Aid	#8	$0.13	Equate Maximum Strength Sleep Aid	100	$0.10
Diphenhydramine HCl 50 mg	Guardian Nighttime Sleep Aid	4 fl oz (118 mL)	$0.25/fl oz	Equate Alcohol Free Nighttime Sleep Aid	24 fl oz (710 mL)	$0.39/fl oz
Melatonin 1.5 mg, Proprietary Blend 22 mcg • Lemon Balm (Aerial Parts) • Chamomile (Flower) • Lavender (Flower)	Nature Garden Sleep Aid	#8	$0.13	No equate equivalent	N/A	N/A

Table 6. Topical medication products & cost comparison

Topical; price per pill $1.55 dollar store vs $2.89 generic, $p = 0.56$						
Active ingredient	**Dollar store product**	**Quantity**	**Price/unit**	**Equate product**	**Quantity**	**Price/unit**
Bacitracin 400 units, Neomycin 3.5 mg, Polymyxin B 5,000 units	Natureplex Triple Antibiotic Original Ointment	0.33 oz (9.4 g)	$0.11/g	Equate Triple Antibiotic First Aid Ointment	2 oz (56 g)	$0.07/g
Benzocaine 20%	Iodent Maximum Strength Oral Analgesic	0.42 oz (11.9 g)	$0.08/g	Equate Orasol	0.33 oz (9.35 g)	$0.41/ g
Calamine 8%, Zinc Oxide 8%	Calamine Lotion	6 fl oz (177 mL)	$0.17/fl oz	Equate Calamine Lotion	6 fl oz, 177 mL	$0.2 /fl oz
Camphor 1.2%, Menthol 5.7%, Methyl Salicylate 6.3%	Coralite Pain Relief Patch	20 patches, 2.56 in × 1.65 in (4.224 sq in, 84.48 total)	$0.01/sq in.	No equate equivalent	N/A	N/A
Camphor 11%, Menthol 11%	Coralite pain relief balm	0.63 oz, 18 g	$0.06/g	No equate equivalent	N/A	N/A
Camphor 4.7%, Eucalyptus Oil 1.0%, Menthol 1.0%	Assured Vaporizing Chest Rub	4 oz, 113 g	$0.25/oz	No equate equivalent	N/A	N/A
Clotrimazole 1%	Natureplex Athlete's Foot Antifungal Cream	1.25 oz (35 g)	$0.03/g	Equate Athlete's Foot Antifungal Cream	4 oz (120 g)	$0.08/g
Diphenhydramine Hydrochloride 2%, Zinc Acetate 0.1%	Dr. Sheffield's Anti-Itch Cream	1.25 oz (35 g)	$0.03/g	Equate Extra Strength Anti-Itch & Skin Protectant Cream	1 oz (28 g)	$0.10/g
Glycerin 14.4%, Petrolatum 15%, Phenylephrine hydrochloride 0.25%, Pramoxine hydrochloride 1%	Natureplex Maximum Strength Pain Relief Hemorrhoidal Cream	0.9 oz (26 g)	$0.04/g	Equate Hemorrhoidal cream	1.8 g (51 g)	$0.06
Hydrocortisone 1%	Natureplex Maximum Strength Hydrocortisone Cream	1 oz (28 g)	$0.04/g	Equate Hydrocortisone 1% Anti-Itch Cream	4 oz (112 g)	$0.06/g
Iron	Assured Air Activate Heat Wrap	1 (43.17 sq in)	$0.02/sq in	No equate equivalent	N/A	N/A
Isopropyl Alcohol, Methyl Salicylate, Magnesium Sulfate, Capsicum	LDN Research Lab Arthritis & Sport Penetrating Heat Rub	16 fl oz (473 mL)	$0.06/fl oz	No equate equivalent	N/A	N/A
Isopropyl Alcohol, Methyl Salicylate, Magnesium Sulfate, Capsicum	LDN Research Lab Arthritis & Sport with Wintergreen	16 fl oz (473 mL)	$0.06/fl oz	No equate equivalent	N/A	N/A
Menthol 6.5%	Absorbine Jr. Plus Ultra Strength Pain Relief Patch	1, 5.5'× 4' (22 sq in)	$0.05/sq in	No equate equivalent	N/A	N/A

Menthol 6.5%	Absorbine Jr. Plus Ultra Strength Pain Relief Patch	1, 5.5'× 4' (22 sq in)	$0.05/sq in	No equate equivalent	N/A	N/A
Menthol 2.5%	Assured Extra Strength Pain Relieving Gel Muscle Rub	1.5 oz (42.5 g)	$0.02/g	No equate equivalent	N/A	N/A
Menthol 2%	Artic Ice Relieving Gel	8 oz (227 g)	$0.13/oz	No equate equivalent	N/A	N/A
Menthol 30 mg, Capsicum extract (capsaicin) 8.3 mg	Assured Pain Relief Hot Patch	14.45 sq in	$0.07/sq in.	No equate equivalent	N/A	N/A
Menthol 5.0%	Absorbine Jr. Plus Pain Relief Back Patch XL	36 sq in	$0.03/sq in.	Equate Extra Strength Cool & Heat Medicated Patch	5 patches, 153.8 sq in	$0.03/sq in.
Polyvinyl alcohol 0.5%, Povidone 0.6%	Family Care Sterile Artificial Tears	0.5 fl oz (15 mL)	$0.07/mL	No equate equivalent	N/A	N/A
Purified water, Stearic acid, Cetyl alcohol, Glyceryl stearate, Mineral oil, Triethanolamine, DMDM hydantoin, Methylparaben, Trisodium EDTA, Propylparaben, Vitamin A (as retinyl palmitate), Vitamin D (as cholecalciferol), Polysorbate 20	Natureplex Vitamin A&D Cream	1.5 oz (42.5 g)	$0.02/g	Equate Vitamins A&D ointment	4 oz, 113 g	$0.02/g
Salicylic Acid 2%	Dr. Sheffield's Psoriasis Medicated Moisturizer	1 oz (28 g)	$0.04 /g	No equate equivalent	N/A	N/A
Sodium Bicarbonate (Baking Soda) 5%	Assured Bug Bite Relief	0.5 fl oz (14 mL)	$0.07 mL	No equate equivalent	N/A	N/A

Table 7. Pain medication products & cost comparison

Pain; price per pill, $0.37 dollar store vs $0.46 generic, $p = 0.46$						
Active ingredient	**Dollar store product**	**Quantity**	**Price/unit**	**Equate product**	**Quantity**	**Price/unit**
Acetaminophen 160 mg/5 mL	Assured Children's Pain Relief	4 fl oz (118 mL)	$0.25 / fl oz	Equate Children's Pain and Fever	4 fl oz 118 mL	$0.72/ fl oz
Acetaminophen 250 mg, Aspirin 250 mg, Caffeine 65 mg	Assured Extra Strength Headache Relief	24	$0.04	Equate Extra Strength Headache Relief	200	$0.02
Acetaminophen 500 mg	Assured Extra Strength Acetaminophen	40	$0.03	Equate Extra Strength Pain Reliever	500	$0.01
Acetaminophen 500 mg	Assured Extra Strength Pain Relief	12	$0.08	Equate Extra Strength Pain Reliever	500	$0.01
Acetaminophen 500 mg	Tylenol Extra Strength	6	$0.17	Equate Extra Strength Pain Reliever	500	$0.01

Acetaminophen 500 mg, Caffeine 65 mg	Assured Tension Headache Relief	24	$0.04	No equate equivalent	N/A	N/A
Acetaminophen 500 mg, Diphenhydramine 25 mg	Assured Extra Strength Pain Relief PM	24	$0.04	Equate Extra Strength Acetaminophen PM	100	$0.05
Acetaminophen 500 mg, Diphenhydramine citrate 38 mg	Headache PM	20	$0.05	No equate equivalent	N/A	N/A
Aspirin 325 mg	Assured Aspirin	125	$0.01	Equate Aspirin Pain Reliever and Fever Reducer	1000	$0.01
Aspirin 325 mg	Bayer Aspirin	6	$0.17	Equate Aspirin Pain Reliever and Fever Reducer	1000	$0.01
Aspirin 500 mg, Caffeine 32.5 mg	Assured Extra Strength Back & Body	24	$0.04	No equate equivalent	N/A	N/A
Aspirin 81 mg	Assured Chewable Low Dose Aspirin	36	$0.03	Equate Low Dose Chewable Aspirin	216	$0.02
Aspirin 81 mg	Assured Low Dose Aspirin	60	$0.02	Equate Low Dose Aspirin Enteric Coated Tablets	500	$0.01
Diphenhydramine citrate 38mg, Ibuprofen 200 mg	Advil PM	4	$0.25	Equate Ibuprofen PM	160	$0.10
Ibuprofen 200 mg	Advil	6	$0.17	Equate Ibuprofen Tablets	500	$0.03
Ibuprofen 200 mg	Assured Ibuprofen (Caplets)	40	$0.03	Equate Ibuprofen Tablets	500	$0.03
Ibuprofen 200 mg	Assured Ibuprofen (Coated Tablets)	40	$0.03	Equate Ibuprofen Tablets	500	$0.03
Ibuprofen Solubilized equal to 200 mg Ibuprofen (present as the free acid and potassium salt)	Assured Ibuprofen (Soft-Gels)	10	$0.10	Equate Ibuprofen Capsules	300	$0.05
Naproxen Sodium 220 mg (naproxen 200 mg)	Aleve	6	$0.17	Equate All Day Pain Relief	300	$0.04
Naproxen Sodium 220 mg (naproxen 200 mg)	Assured All Day Pain Relief	15	$0.07	Equate All Day Pain Relief	300	$0.04

*Unit = pill, caplet, fluid oz, etc.

Table 8. Results of a Mann-Whitney U Test by price per unit and group

Medication Products	Dollar Median	Equate Median	W	*p*	n
Overall	0.07	0.06	2524	0.79	142
Allergic rhinitis medications	0.07	0.11	22	0.12	18
Heartburn medications	0.08	0.02	8	0.72	7
Cough and cold medications	0.08	0.17	96	0.56	30
Constipation and diarrhea medications	0.08	0.10	8.5	0.46	10
Sleep medications	0.13	0.07	12	0.71	9
Topical medications	0.06	0.07	71	0.23	31
Pain medications	0.05	0.03	251	0.013*	37

*** Indicates statistical significance at $p < .05$.**

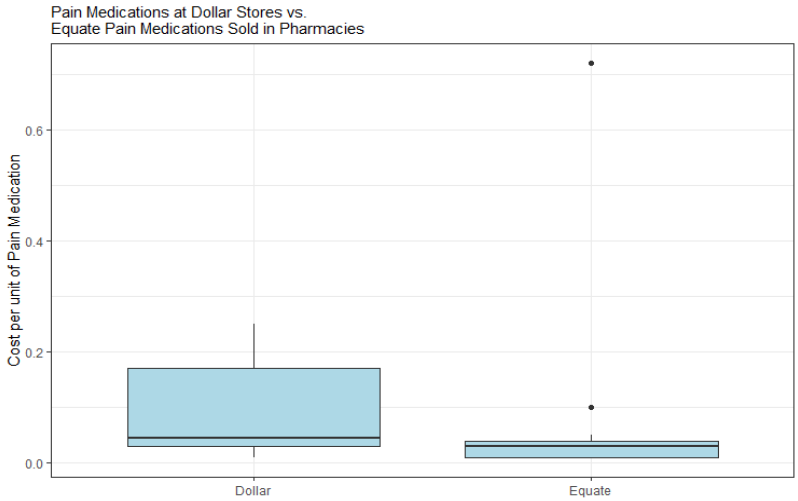

Figure 2. Pain medications at dollar stores vs. equate pain medications sold in pharmacies

Discussion

The results indicate that dollar stores do not provide a cost saving with obtaining OTC medications from this setting. Additionally, there is an actual increase in the cost of pain medication. Pain medication costs more per pill at the dollar store than the generic versions sold in pharmacies. Individuals are paying more for pain management while not attaining access to a health professional to determine if the pain medication is appropriate and/or safe based on age, comorbid conditions, and medications. The concerns associated with pain medications are discussed further below.

The majority of OTC products sold at the dollar store were found to be from a manufacturer with serious violations of the good manufacturing law. The manufacturer's violations included not testing finished drugs for quality and pathogens [9]. These findings, alone, should confirm the concern for the medications sold in this setting, but additional findings highlight that the OTC medications available in this setting are not considered first-line for the management of the conditions in which they are promoted. Many of the OTC medications identified have significant drug interactions and should be avoided in older patients and in patients with comorbidities such as cardiovascular disease and diabetes.

Allergy

The products available at the dollar store for allergies include first- and second-generation antihistamines, oral and topical decongestants. (See Table 1) The only oral decongestant available at the dollar store is phenylephrine, which has been shown to be equal to placebo in regard to efficacy, and thus causes more harm (side effects include increased blood pressure) than benefit [25,26]. Guidelines do not recommend any of these agents as a first-line therapy [13,27]. Intranasal decongestants are associated with rhinitis medicamentosa, also known as rebound congestion [28]. The rebound response to topical decongestants is not fully understood, but results in a worsening of congestion rather than relief once the topical decongestant has been used more often than recommended [28]. Furthermore, symptoms are worsened by a

preservative, benzalkonium chloride, which all of the topical decongestants sold at the dollar store contain [28].

First-generation antihistamines (diphenhydramine, doxylamine) have significant side effects including constipation and drowsiness but are of special concern for fall risks in older adults [29,30]. Long-term use of first-generation antihistamines is associated with a higher risk of dementia [31]. The first-line therapy for allergic rhinitis is monotherapy with an intranasal corticosteroid (INCSs) [12,13]. No OTC INCSs are available at the dollar store. Based on analysis of INCS therapy alone or with added second-generation antihistamines, the consensus is that INCS monotherapy provides potential cost savings as a result of patients presenting with improved adherence, and a reduction in adverse effects with INCS therapy in place of others [12]. If symptoms are not adequately controlled by INCS therapy, the next recommended step in therapy would be to add an intranasal antihistamine [12] . Intranasal antihistamines are prescription only. Based on current evidence for best standards of care in managing allergic rhinitis, patients utilizing the products available at the dollar store may experience increased cost, side effects and poorer control of their condition. An additional concern is that allergic rhinitis has been found to be an independent risk factor for asthma [12,32]. Appropriately managing allergic rhinitis is essential for preventing poor health outcomes, and improved quality of life. The dollar store does not provide appropriate medications to do so.

Cough & Cold

OTC medications for cough and cold symptoms sold at the dollar store are mainly combination products. Combination products result in patients taking more medications than indicated for the symptoms they are experiencing. Active ingredients in these products consist of a combination of the following medications: dextromethorphan (cough suppressant), acetaminophen (pain-reliever), guaifenesin (expectorant), phenylephrine (decongestant), and doxylamine succinate (1st generation antihistamine). Guidelines provided by the American College of Chest Physicians emphasize the importance of understanding the underlying cause of the cough prior to treatment [14]. Updated guidelines suggest against the use of OTC cough and cold medications [14,18]. There is growing concern with the use of OTC cough and cold products and their correlation with heart failure (HF) [33].

Of the cough and cold products sold at the dollar store, 7 contain acetaminophen. Six of these seven products documented as containing acetaminophen were not labeled for “pain.” The importance of recognizing the inclusion of acetaminophen is paramount as acetaminophen is the most common cause of acute liver failure in the United States [34,35]. Many OTC medications that contain acetaminophen are not labeled for pain relief, so patients may not expect to be consuming acetaminophen. These concerns are covered additionally in the pain/fever section.

Camphor, commonly found in many topical products, has risks in certain populations if not used appropriately. Human fatalities have occurred in individuals ingesting 1-2 grams of camphor-containing products [36,37]. Lethality has also occurred in teaspoon doses in infants [36].

Heartburn

Heartburn is a symptom that may be present in several different diagnoses, (i.e., nonerosive reflux disorder, hypersensitive esophagitis, functional heartburn, Barrett’s esophagus) [15,38]. The importance of discussing these diagnostic possibilities is that heartburn should be evaluated by a healthcare provider if it is not easily managed by lifestyle and diet modifications. This brings attention to the concern with self-treating heartburn without a formal diagnosis. An additional concern is warranted in that several studies have shown that patients with a psychiatric diagnosis are more likely to report heartburn and dysphagia [36,38-40]. When evaluating psychological comorbidities and heartburn groups, researchers found that depression was significantly more common in heartburn disorders in comparison to healthy controls, and that major depression was significantly more common in functional heartburn patients and anxiety more common in hypersensitive esophagus and erosive esophagitis [35,37,39]. When an individual has a psychological comorbidity, and they are only treating their heartburn symptoms, they are less likely to achieve complete heartburn resolution [38-40].

Additional concerns with self-treatment of heartburn are that many drug-drug interactions are possible [41]. Finally, and with the utmost importance, patients may perceive a heart attack as heartburn [42]. The bottom line is that heartburn not easily resolved should be evaluated by a provider prior to the implementation of self-treatment.

Constipation

There are many different factors that can lead to constipation, including, but not limited to, diet, medications, metabolic or neurologic disorders, and psychosocial issues [16]. Due to the complex nature surrounding the development of constipation, and the ability for acute episodes to turn into chronic episodes, it is imperative that patients be counseled appropriately when self-treating constipation with OTC medications.

The dollar store sells only three products: Milk of Magnesia (magnesium hydroxide), magnesium citrate, and bisacodyl.

Both magnesium hydroxide and magnesium citrate are saline laxatives, which should be used for acute episodes of constipation in other healthy individuals [16,17]. Dehydration is a common concern with saline laxatives as they lead to large volumes of water loss through their

mechanism [16,17]. Additionally they should be avoided in renal impairment. Bisacodyl is a stimulant laxative and is recommended only for short-term use. None of these options are first-line in the prevention or management of constipation.

Medical guidelines recommend that the first steps in managing constipation should be non-pharmacologic actions such as dietary and lifestyle modifications [16,17] . All efforts should be made to increase dietary fiber and fluid intake before initiating other interventions for the management of constipation [16]. If non-pharmacologic modifications are deemed insufficient in symptom relief, the first-line pharmacological recommendation is fiber supplementation. Fiber supplementation has been shown to resolve symptoms of constipation allowing for the discontinuation of laxatives for up to 80% of elderly patients [16]. Dietary fiber and subsequent discontinuation of laxatives in elderly patients has been shown to improve body weight and overall health [16]. Fiber supplementation provides an effective and safe option for the prevention and management of constipation [16,43,44]. Chronic symptoms of constipation not relieved by an increase in dietary fiber and fluids can also be managed with osmotic laxatives [46]. Polyethylene glycol 3350 (PEG) has been shown to be an effective and safe treatment for chronic constipation, including in the elderly [16,45] . PEG and fiber therapy are not available at the dollar store. Bisacodyl, a stimulant laxative, is considered a second-line treatment option and is only recommended for short-term use, rather than chronic [16]. A high frequency of diarrhea and abdominal pain was reported in participants in a study evaluating the long-term safety and efficacy of stimulant laxatives [46]. Updated guidelines also warn about the limited quality of data regarding the use of Milk of Magnesia in managing chronic constipation [16]. It is evident that consumers of the dollar store are at a greater disadvantage for safe and effective self-treatment of constipation.

Diarrhea

One product, loperamide, is available for sale in dollar stores. OTC loperamide has a maximum daily dose of 8 mg/day [47]. Unfortunately, loperamide is largely becoming known for its potential abuse as an opioid receptor agonist when consumed at higher than recommended doses [48]. Doses taken to achieve the opioid receptor effects (a “high”) lead to cardiotoxicity, and can result in sudden death [48]. Those that are at an increased risk for loperamide abuse/toxicity are consumers wishing to self-treat opioid withdrawal symptoms, using other illicit drugs and cardiotoxic drugs, taking concomitant medications that can inhibit the blood-brain-barrier protective efflux mechanisms, or taking other medications that inhibit the normal metabolism of loperamide [48]. Taking loperamide with other medications such as corticosteroids, quinidine, methadone, ketoconazole, protease inhibitors, antineoplastic drugs, cimetidine, grapefruit juice, or verapamil can increase blood concentration levels of loperamide and increase the body’s exposure to loperamide, resulting in central nervous effects which may include toxicity [48]. Due to the low cost and high accessibility of loperamide sold at the dollar store, there is potential for abuse and the adverse effects associated with this drug.

Pain/Fever

There are many products available for pain/fever. Acetaminophen or ibuprofen may be appropriate for short-term management of fever symptoms in children; however, it is dependent on the severity of the fever and in the absence of other symptoms that would require a provider to evaluate the patient prior to self-treatment [18]. Ideally, a child should be evaluated by a healthcare provider in order to determine if self-treatment is appropriate, and specifically which medication (acetaminophen or ibuprofen) would be appropriate for each child [18-19]. Symptoms indicative of etiologies not appropriate for self-care include the presentation of a rash with fever, severe dehydration, nausea/vomiting, and varicella infection [18].

Counseling individuals about acetaminophen is important to ensure education is provided about multi-product risk (see Cough & Cold), the relevance of liver metabolism and risks for liver injury, and avoidance of alcohol when using this drug. The National Poison Data System listed acetaminophen alone as the fourth highest cause of fatalities related to substance poisoning in 2012 [35]. Acetaminophen in combination with other medications was listed as the sixth highest cause of fatalities related to poisoning [35]. It is important to recognize that acetaminophen both alone and in combination with other drugs carry risks.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

NSAIDs (ibuprofen, naproxen) are strongly associated with an increased risk for cardiovascular disease, reduced kidney function, and bleeding risks [20,21,29,33]. The use of these medications should be minimized to prevent harm. Individuals considered ‘high risk’ include those with cardiovascular disease, diabetes, and older adults [20,21,29,33]. Some guidelines recommend the avoidance of ibuprofen use in children with asthma[18]. Although NSAIDs are effective medications to minimize pain, the risks should be considered prior to use and especially for chronic pain relief. The risks associated with NSAIDs are proportional to how much and how often they are used [20,21]. The less they are used, the safer it is for the patient.

Insomnia

Insomnia is a prevalent but complicated condition in which many times, co-morbidities are a root cause. Many individuals with insomnia also suffer from a co-morbid mental disorder [22]. Management of insomnia requires a full work-up and self-medicating is not ideal as it inhibits an individual from attaining the information needed to overcome the condition. The first line is psychological and behavioral interventions [22-24,49]. The medications available at the dollar store (diphenhydramine and melatonin) are not recommended for the treatment of chronic insomnia as a result of the lack of evidence showing improvement in health as well as the lack of safety data [22,49]. Additionally, as discussed briefly in the allergy section, chronic use of diphenhydramine has an associated risk with dementia [22,28,49]. For short-term use, diphenhydramine or melatonin may be used. Although diphenhydramine may promote an individual to sleep, it comes with risks, especially for the older adult patient population [29,30].

Limitations

This study was completed at one dollar store, with 5 other dollar stores visited to determine if the drugs sold at the selected store were consistent with others. It is difficult to determine if the stores located in Colorado are consistent with all dollar stores throughout the country. Additionally, the inventory at these stores remains variable, so what was sold during the times of this research may vary from what is currently available.

Conclusions

The majority of OTC products sold at the dollar store were found to be from a manufacturer with serious violations of the good manufacturing law. The manufacturer's violations included not testing finished drugs for quality and pathogens. When considering the underserved patient population seeking care in this setting, it is devastating to think that they attain access to OTC drugs less effective and safe than those sold in pharmacies, and they are also being subjected to drugs that may be adulterated, and/or contain pathogens.

Furthermore, OTC pain medicines were found to be significantly more expensive at dollar stores compared to equate generic pain medicines sold at pharmacies. The findings of this study also determine that OTC medications available at the dollar store are not first-line options or individuals seeking care for their symptoms. These products are less effective, more likely to have adverse side effects with minimal improvement in symptoms, fand many individuals should be cautioned from using these products if they have co-morbid conditions such as diabetes or cardiovascular disease. Consumers of dollar store products lack access to a pharmacist and these important concerns may not be addressed or fully understood based on the small print and vague warnings on product labeling.

Individuals in lower socioeconomic areas are at a higher risk for negative health outcomes. OTC medications offered at dollar stores increase the risk for harmful self-treatment, especially when utilized outside the care of a pharmacist or other healthcare providers. Author recommendations following this research are the following:

(1) Some medications are not necessarily better than no medication for the self-treatment or OTC setting. If medications are to be available, especially for chronic use (products include 30 counts or more of medication per package), they should have access to a pharmacist in the setting where these medications are sold.

(2) The dollar store is not an appropriate setting for medications that may have relevant drug-disease and drug-drug interactions.

(3) The dollar store should only sell short-term use products for acute use (packages for one-time use only) for medications with risk to patients.

(4) All products from the manufacturer in violation of GMP should be removed from stores.

Author contributions

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