RESEARCH ARTICLES

Medication Use as Evidence for Pharmacotherapeutics Curriculum Content

Stuart K. Pitman, PharmD, and Bernard Sorofman, PhD

College of Pharmacy, University of Iowa

Submitted March 26, 2009; accepted June 3, 2009; published December 17, 2009.

Objective. To analyze the most common active ingredients in ambulatory prescription and nonprescription products to provide evidence for contemporary pharmacotherapeutics curricula development.

Methods. Content analysis was performed to code commonly dispensed prescription ingredients into American Hospital Formulary Service Pharmacologic-Therapeutic categories and commonly sold nonprescription products into self-care categories. This study used data from *Drug Topics'* 2007 "top 200" lists.

Results. For prescription drugs, when tallying the ingredients assigned to the AHFS categories "Cardiovascular Drugs" and "Central Nervous Systems Agents," more than 50% of the total dispensed ingredients from the brand and generic top 200 lists were represented. For nonprescription products, over 75% of the commonly sold nonprescription products were categorized within 4 of the possible 11 self-care categories.

Conclusions. This analysis provides a method for educators to use when collecting curricula-refining evidence and specific findings for evaluating therapeutics curricula.

Keywords: curriculum, therapeutics, pharmacotherapy

INTRODUCTION

Those who design pharmacy curricula experience a problem central to the discipline of economics, namely *scarcity*; or having unlimited wants, with limited resources. One limited resource is curricular space, or, in essence, "time."¹ As courses academic content competes for curricular space, pharmacy educators must decide what to teach and how to teach it efficiently. In addition to space concerns, time-sensitive curricular areas such as pharmacotherapeutics must frequently and rapidly change to keep pace with current clinical knowledge. Following the ideals of best evidence pharmacy education (BEPE); defined as "implementation by pharmacy teachers in their practice, of methods, and approaches to pharmacy education, based on the best evidence available," this paper examines common ambulatory prescription active ingredients (from this point forth, "active ingredient(s)" will be referred to as "ingredient(s)") and nonprescription product data to help guide pharmacotherapy curricula content.² The top 200 brand, top 200 generic (as reported by units dispensed), and the top 200 nonprescription medications (as reported by sales) were analyzed, to prompt pharmacy educators to discuss whether

their present therapeutic curricula address the most common ambulatory practice ingredients/products that pharmacy graduates will encounter in practice. The paper will also aid colleges and schools in developing and updating therapeutic information in lectures, courses, and learning objectives. Examining patient use of common medications in ambulatory settings enables pharmacotherapy course designers to address how "best practice," through clinical evidence, and "common practice," through prescriber behavior, relate positively or negatively to quality therapeutic care plans. BEPE must weigh actual medication use along with whether these ingredients and products are appropriate evidence-based choices. For example, propoxyphene ranks No. 21 (in combination with acetaminophen) on *Drug Topics'* top 200 generic list, resulting in over 21 million prescriptions in 2007, but "best practice" no longer considers it a drug of choice.^{3,4}

This study categorized the most commonly dispensed prescription ingredients and nonprescription medicines sold in ambulatory settings in order to inspect where, and to what extent, pharmacotherapy curricula should include patient consumption patterns. The authors do not intend this paper to act as a comprehensive guide to curriculum development, nor to emphasize "the product." As previously mentioned, the authors recognize that an ingredient's or product's volume dispensed or rank on a particular list may not correlate with its relative

Corresponding Author: Bernard Sorofman, PhD, University of Iowa, College of Pharmacy, S115 PHAR, S. Grand Ave, Iowa City, IA 52442. Tel: 319-335-8838. Fax: 319-335-5646. E-mail: bernard-sorofman@uiowa.edu

importance, and that providers may overprescribe several top ingredients while others are underutilized.

METHODS

This study used the qualitative methodology of content analysis to categorize the most common prescription ingredients and nonprescription products, which include nonpharmaceutical pharmacy-related products (eg, diabetic testing materials, pregnancy kits). Specifically, common brand and generic products' ingredients were assigned pharmacologic/therapeutic thematic categories, while nonprescription products were sorted into self-care categories. Data originated from prescription and nonprescription "top 200 lists." Top 200 lists for 2007, the most recent year available at the time, were obtained from 2 periodicals, *Drug Topics* and *Pharmacy Times*.⁵⁻⁸ *Pharmacy Times* provided 2 lists. The first list combined brand and generic drugs into an "overall" top 200 list, based on both prescriptions dispensed as well as manufacturer. For example, furosemide appeared 3 times on this list: the Mylan product at No. 19, the Teva product at No. 88, and the Sandoz product at No. 117. The second list was similar but based on both sales as well as manufacturer. *Drug Topics* offered several top 200 lists including: brand prescriptions by unit, generic prescriptions by unit, and combined nonprescription/health and beauty brands (HBC) by sales. (This list excludes cough drops, cough syrup, and foot care product categories.⁷) The authors concluded that the *Drug Topics*' top 200 lists generated the most appropriate data for the study's purpose.

To analyze the prescription data, the *Drug Topics*' brand and generic top 200 lists were imported and combined in an Excel workbook. Generic names were identified for all brand name products. Each generic ingredient was coded according to its corresponding numeric AHFS Pharmacologic-Therapeutic Classification (On February 24, 2009, *STATRef!* ceased offering the 2008 edition of AHFS after updating to the 2009 edition. Subsequently, both editions were used at different points during the study. Efforts were made to compare the 2 versions to ensure coding accuracy. The authors determined the edition change had no significant effect on the data.) This was accomplished by using *STATRef!*'s online advanced search feature.⁹ In the advanced search options, the AHFS Drug Information (2008/2009) title and the "Heading" text-type boxes were selected and the ingredient placed in the search field. The individual ingredients in Primacare One, a brand name prenatal multivitamin/multimineral preparation with essential fatty acids, were not coded separately. This product was coded as 1 ingredient under "Vitamins." Also, for prescription oral contraceptive

products containing ferrous fumarate tablets (Loestrin 24 Fe, Estrostep Fe, and Junel Fe), the ferrous fumarate portion was not coded. Next, the search was executed, and the AHFS number(s) gleaned from the results. If the search generated only 1 hit, then the corresponding AHFS numeric code was recorded as such.^{10,11} If the search displayed zero hits (no "direct hit"), then the "Heading" text-type box was unchecked and the search performed again (now an "all text" AHFS search). New hits were then evaluated to determine the best code(s) for a given ingredient. If the original search generated 2 or more hits, then all corresponding AHFS numbers were recorded. These number codes were then compared and evaluated. Clinical decisions were guided by noting product preparations listed in AHFS, searching for name variants, evaluating the placement of similar products, and observing ingredient or product indication(s)/description. Online databases such as Micromedex Healthcare Series and Clinical Pharmacology were consulted to aid with clinical decision-making.^{12,13} After establishing all ingredients' numeric codes, each ingredient was placed into 1 of 21 AHFS first-line textual categories (Table 1).

Analysis principally focused on individual ingredients. To start, the frequency with which each ingredient occurred within a category was determined. If the same ingredient was present in multiple products, it was counted separately each time it occurred. If more than 1 ingredient was present in a single product, each ingredient in that product was counted under its respective category (even if the ingredients fell into the same category).

To determine how often patients who obtained common prescriptions received a category's ingredients as compared to ingredients from other categories, further analysis summed the number of times "list" ingredients were dispensed according to category. If a product contained more than 1 ingredient, then this product's 2007 amount dispensed was added into each of its ingredients categories even if more than 1 of its ingredients were in the same AHFS category. For example, the product Zyrtec-D contains 2 ingredients: cetirizine and pseudoephedrine. All 2.9 million prescriptions of Zyrtec were added to *both* the "Antihistamine Drugs" (AH) and the "Autonomic Drugs" (AU) category totals (to represent cetirizine being dispensed 2.9 million times and pseudoephedrine being dispensed 2.9 million times). For a product such as Endocet (oxycodone and acetaminophen) in which both ingredients fall under "Central Nervous System Agents" (CNS), the total prescriptions dispensed (3.5 million) was counted for each ingredient, so that this product counted as 7 million toward the CNS category's ingredients dispensed total. With the unit of analysis being product ingredients, the limited situations in which

Table 1. Active Ingredients Sorted by Category From Top 200 Brand and Top 200 Generic Drug Lists^a

AHFS Pharmacologic-Therapeutic Category	Abbreviation	Active Ingredients Dispensed: in 000s (%)	Active Ingredient Frequency (%)
Central Nervous System Agents	CNS	1055810 (30.0)	113 (23.3)
Cardiovascular Drugs	CV	733494 (20.8)	80 (16.5)
Hormones and Synthetic Substitutes	HM	472541 (13.4)	92 (19.0)
Anti-infective Agents	AI	329954 (9.4)	32 (6.6)
Electrolytic, Caloric, and Water Balance	ECW	224372 (6.4)	23 (4.7)
Autonomic Drugs	AU	159603 (4.5)	28 (5.8)
Gastrointestinal Drugs	GI	134677 (3.8)	17 (3.5)
Eye, Ear, Nose, and Throat (EENT) Preparations	EENT	80130 (2.3)	23 (4.7)
Miscellaneous Therapeutic Agents	MISC	64945 (1.8)	11 (2.3)
Antihistamine Drugs	AH	60957 (1.7)	12 (2.5)
Skin and Mucous Membrane Agents	SK	56110 (1.6)	22 (4.5)
Blood Formation, Coagulation, and Thrombosis	BFCT	55380 (1.6)	7 (1.4)
Respiratory Tract Agents	RT	49737 (1.4)	10 (2.1)
Vitamins	VI	16356 (0.5)	5 (1.0)
Smooth Muscle Relaxants	SM	12829 (0.4)	5 (1.0)
Antineoplastic Agents	AN	7881 (0.2)	3 (0.6)
Local Anesthetics	LA	3444 (0.1)	1 (0.2)
Serums, Toxoids, and Vaccines	STV	1768 (0.1)	1 (0.2)
Blood Derivatives	BL	0 (0.0)	0 (0.0)
Diagnostic Agents	DA	0 (0.0)	0 (0.0)
Oxytocics	OX	0 (0.0)	0 (0.0)

^a Based on 2007 data by unit.

Abbreviations from *AHFS Drug Information (2008)*

multiple ingredients in the same pharmacologic category in a single prescription product may have overemphasized certain category totals. Because the goal was to achieve a relative understanding of the use of ingredients, this was deemed acceptable.

Data analysis of nonprescription products began with transferring the complete nonprescription/HBC top 200 list into an Excel spreadsheet. This list was then consolidated to include only products with active ingredients and specific nonpharmacological items, such as diabetes monitors and pregnancy kits. Finally, products were placed into self-care categories. These categories were selected from the section headings in the *Handbook of Nonprescription Drugs: An Interactive Approach to Self-Care*, 15th ed.¹⁴

RESULTS

The number of times an individual ingredient appeared on the combined 2007 top 200 brand and top 200 generic drug lists is shown in Table 1. Since several products contain multiple ingredients, 485 ingredients were present in the “top 400” products. One hundred thirteen ingredients were categorized under “Central Nervous System” (CNS) followed in rank order by “Hormones and Synthetic Substitutes” (HM), and “Cardio-

vascular Drugs” (CV) with 92 and 80 ingredient appearances within each respective category.

The number of times a brand or generic “top 200” ingredient was dispensed is displayed in Table 1. The top 3 pharmacologic-therapeutic categories remained the same when compared by ingredient frequency and total ingredients dispensed, but when assessed by total ingredients dispensed, CV moved ahead of HM. This indicates that although products which contain an HM category ingredient occur more frequently on these lists, more CV category ingredients are dispensed. The sum of the top 2 categories’ (CNS and CV) dispensed ingredients account for more than 50% of the total number of list ingredients dispensed. Eighty percent of the dispensed ingredients were accounted for in just the top 5 categories: CNS, CV, HM, “Anti-Infective Agents” (AI), and “Electrolytic, Caloric, and Water Balance” (ECW).

Table 2 shows how frequently the specific 103 products from the top 200 OTC/HBC list occur according to self-care category. The Respiratory Disorders category contained the greatest number of products (25 or 24.3%). Further, more than 75% of the products were categorized into 1 of the top 4 categories: Respiratory Disorders, Nutrition and Nutritional Supplements, Pain and Fever Disorders, and Gastrointestinal Disorders.

Table 2. Selected Products From Top 200 Nonprescription/HBC List^a Sorted by Category (N=103)

Self-Care Category	Abbr	Product
		Frequency (%)
Respiratory Disorders	Resp	25 (24.3)
Nutrition and Nutritional Supplements	Nutr	19 (18.4)
Pain and Fever Disorders	Pain	17 (16.5)
Gastrointestinal Disorders	GI	17 (16.5)
Ophthalmic, Otic, and Oral Disorders	OOO	6 (5.8)
Other Medical Disorders	Othr	6 (5.8)
Dermatologic Disorders	Derm	5 (4.9)
Home Medical Equipment	HME	5 (4.9)
Reproductive and Genital Disorders	Repr	3 (2.9)
Complementary and Alternative Medicine	CAM	0 (0.0)

^a Based on 2007 sales data

DISCUSSION

This study observed patient consumption patterns as evidence for pharmacotherapy curricula. Fifty percent of the ingredients that patients received from the 2007 brand and generic top 200 lists from ambulatory settings were from either the CV or CNS category. This raises the question: to what degree do pharmacy curricula address both individual and subclasses of CNS ingredients during CNS-related topic instruction (eg, pain management, mental/behavioral health), or in similar fashion, individual and subclasses of CV ingredients during CV-related topic instruction (eg, hypertension, dyslipidemia)? Readers who wish to view and analyze the relative make-up and dispensing rates within particular groupings can request the detailed listing from the corresponding author. This listing displays all brand and generic top 200 list products' individual ingredients organized by category and sorted by product. The list allows determinations of which ingredients "drive" certain dispensing totals in different categories.

Regardless of whether colleges/schools of pharmacy integrate teaching nonprescription medications throughout their overall curricula or teach these agents during a dedicated course, curricular content that covers allergies and upper respiratory illnesses, nutrition and weight management, pain/fever, and gastrointestinal illnesses must include instruction regarding the nonprescription products patients frequently use.

Overall, when pharmacy educators understand how the most frequently dispensed ingredients and the best-selling nonprescription products in ambulatory settings translate into either pharmacologic-therapeutic or self-

care categories, they can globally reevaluate overall and individual therapeutics courses and critically assess existing student learning objectives.

Students frequently encounter patients who take several "list" products, both brand and generic, which contain CNS and CV ingredients, along with nonprescription products from the respiratory, nutritional, pain/fever, and gastrointestinal self-care categories. Therefore, students must acquire a high level of "common product/ingredient" expertise in order to provide adequate patient counseling and monitoring during their experiential learning programs and as practitioners. They must also be fully aware of ingredients commonly dispensed that do not represent best practices. How will students provide pharmaceutical care, or "pharmacist[s] sharing responsibility for patients' drug therapy outcomes," if they do not know what outcomes to measure or how to measure them in those patients who take common medications?¹ Also, since colleges and schools of pharmacy consider emphasis on patient education important, the curricula should cover adequately the products and ingredients which represent a high percentage of the patient's educational needs.¹

The intent of this project was to contribute to the practice of best evidence pharmacy education (BEPE). Unfortunately, when educators develop curricular content and student learning outcomes, incorporating evidence-based methods is not always considered. According to Hammer and colleagues "...as with academic research, the content of academic teaching must be continually reviewed."² Importantly, BEPE in pharmacotherapy must also integrate forms of curricular content evidence, including actual patient use of common prescription and nonprescription agents.

Limitations

Both methodological and interpretive limits exist. Inherently, content analysis can pose several methodological limitations. Notably, this evaluation introduced a sense of subjectivity as coding processes often require data interpretation (eg, clinical decisions). Within a category, the same ingredient was counted each time it appeared which may have overemphasized a category's total. Further, this study did not consider those disease states and services for which pharmacists typically take more responsibility (eg, anticoagulation services, anti-infective monitoring), nor that patients who take certain medications often require a greater degree of pharmacist counseling and monitoring.

By repeating this analysis over time, researchers could follow and monitor ingredient use trends. Also, similar studies could employ additional classification schemes or alternative categories of ingredients. The AHFS system, by

its nature, hybridizes therapeutic and pharmacologic categories; however, others could classify medications according to disease state using a clinical therapeutics text or by pharmacological category using a pharmacology text. Further, other studies might conduct sub-population analyses by examining the most common ingredients dispensed to Medicare or other insurers' beneficiaries.

CONCLUSION

Analyzing the most commonly dispensed prescription brand and generic ingredients, and the most commonly sold nonprescription products (found primarily in ambulatory settings) allows patient consumption patterns to be integrated into curricula. This study provided a small piece of evidence to guide curricular and student learning objective development, while confirming conventional teaching wisdom, and presenting a method for gathering such evidence.

ACKNOWLEDGEMENTS

The authors wish to thank Mr. Vern Duba at the University of Iowa College of Pharmacy for his assistance during manuscript preparation.

REFERENCES

1. Graber DR, Bellack JP, Lancaster C, Musham C, Nappi J, O'Neil EH. Curriculum topics in pharmacy education: current and ideal emphasis. *Am J Pharm Educ.* 1999;63(2):145-51.
2. Hammer DP, Sauer KA, Fielding DW, Skau KA. White paper on best evidence pharmacy education (BEPE). *Am J Pharm Educ.* 2004;68:Article 24.
3. Barkin RL, Barkin SJ, Barkin DS. Propoxyphene (dextropropoxyphene): a critical review of a weak opioid analgesic that should remain in antiquity. *Am J Ther.* 2006;13(6):534-542.
4. Traynor K. Close vote by FDA advisers favors propoxyphene withdrawal. *Am J Health-Syst Pharm.* 2009;66:518-520.
5. Top 200 brand name drugs by units in 2007. *Drug Topics.* <http://drugtopics.modernmedicine.com/drugtopics/data/articlestandard/drugtopics/072008/491207/article.pdf>. Accessed September 10, 2009.
6. Top 200 generic drugs by unit in 2007. *Drug Topics.* <http://drugtopics.modernmedicine.com/drugtopics/data/articlestandard/drugtopics/072008/491181/article.pdf>. Accessed September 10, 2009.
7. Top 200 OTC/HBC brands in 2007. *Drug Topics.* <http://drugtopics.modernmedicine.com/drugtopics/data/articlestandard/drugtopics/082008/492702/article.pdf>. Accessed September 10, 2009.
8. Lamb E. Top 200 Prescription Drugs of 2007. *Pharmacy Times.* May 2008. Available at: http://www.pharmacytimes.com/issues/articles/2008-05_003.asp. Accessed September 10, 2009.
9. STAT!Ref Online Electronic Medical Library [online database]. Jackson, WY: Teton Data Systems; 2009. <http://www.statref.com>. Accessed September 10, 2009.
10. McEvoy GK, ed. *AHFS Drug Information (2008)* [book online]. Bethesda, MD: American Society of Health-System Pharmacists, Inc; 2008. In STAT!Ref Online Electronic Medical Library [online database]. Jackson, WY: Teton Data Systems; 2009.
11. McEvoy GK, ed. *AHFS Drug Information (2009)* [book online]. Bethesda, MD: American Society of Health-System Pharmacists, Inc; 2009. In STAT!Ref Online Electronic Medical Library [online database]. Jackson, WY: Teton Data Systems; 2009. <http://online.statref.com/titleinfo/fixid-1.html>. Accessed September 10, 2009.
12. *Micromedex Healthcare Series* [Internet database]. Greenwood Village, Co: Thomson Micromedex. <http://www.thomsonhc.com>. Accessed September 10, 2009.
13. *Clinical Pharmacology* [database online]. Tampa, FL: Gold Standard, Inc.; 2009. <http://www.clinicalpharmacology.com>. Accessed September 10, 2009.
14. Berardi RR, ed. *Handbook of Nonprescription Drugs: An Interactive Approach to Self-Care*, 15th ed. Washington, DC: American Pharmacists Association; 2006.