

The Potential of Pill Splitting to Achieve Cost Savings

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Objectives: To present a methodology for identifying specific medications for which pill splitting is clinically appropriate and cost saving, to present data from a commercial managed care population on current pill-splitting practices, and to estimate additional cost savings from extended use of this strategy.

Study Design: Retrospective pharmacy claims analysis.

Methods: Pharmacy claims data from a commercial managed care health plan covering 19,000 lives and national drug data were used to compile a list of frequently prescribed medications. Excluding medications in which packaging, formulation, and potential adverse pharmacologic outcomes prohibited splitting, we performed a cost analysis of medications amenable to splitting.

Results: Eleven medications amenable to pill splitting were identified based on potential cost savings and clinical appropriateness: clonazepam, doxazosin, atorvastatin, pravastatin, citalopram, sertraline, paroxetine, lisinopril, nefazadone, olanzapine, and sildenafil. For these medications, pill splitting is currently infrequent, accounting for annual savings of \$6200 (or \$0.03 per member per month), just 2% of the potential \$259,500 (or \$1.14 per member per month) that more comprehensive pill-splitting practices could save annually.

Conclusions: Pill splitting can be a cost-saving practice when implemented judiciously using drug- and patient-specific criteria aimed at clinical safety, although this strategy is used infrequently.

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In recent years, the cost of prescription drugs has accelerated drastically. Patients, insurers, and provider networks continue to bear the burden of prescription drug costs, which have increased nearly 60% since 1991 and tripled since 1980.¹

To alleviate rising prescription drug costs, physicians and providers have used various cost-saving strategies, including the use of generic medications, selection of more cost-effective medications, tiered systems of drug copayments, and formulary restrictions.

One cost-saving strategy that may not have yet reached its potential is pill splitting. Many prescription drugs are available at increased dosages for the same or similar costs as smaller dosages. By prescribing half as many higher strength pills and splitting them to achieve the desired dosage, patients and physician systems can save as much as 50% on the cost of selected medications. As a cost-saving approach, pill splitting has great potential. For example, a patient being treated with 10 mg lisinopril (Zestril; AstraZeneca Pharmaceuticals, Wilmington, DE) will have annual medication costs of \$340. By prescribing half the number of 20-mg tablets to be split, medication costs will drop to \$180 annually, savings of \$160 (47%).² Similarly, a recent study focusing on splitting psychotropic medications suggests the potential for annual national savings of \$1.4 billion.³

Pill splitting is a well-established medical practice,⁴ not uncommon in prescribing pediatric⁵ or geriatric dosages.⁶ However, fears of inaccurate dosing, noncompliance, and physical inability to split tablets have discouraged physicians and patients from adopting this practice. Opponents of pill splitting have cited unpredictable effects on the stability of the drug, loss of drug due to powdering, creation of uneven doses, lack of physical strength and dexterity, poor eyesight, reduced cognitive ability, and

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lack of instruction as arguments against pill splitting.⁴ However, prior studies suggest that most patients are able to accurately split pills with minimal loss of tablet content.^{4,7} With some notable exceptions, the chemical stability of most tablet formulations is not substantially altered by pill splitting.⁵ Concerns also have been expressed over patient adherence. There is a fear that prescribing higher dosages that require tablets to be halved will lower adherence: patients may not be willing to take the time to split a pill before taking it or may be unable to split a pill. Objectively, however, 1 study found that splitting tablets had no effect on adherence.⁸ It was further suggested that tablet splitting might increase adherence by reducing the cost barrier faced by some patients.⁸

Pill splitting is safer and easier when drug- and patient-specific criteria have been met. Medications should not be considered when packaging and pricing structure do not make splitting cost effective or even possible. Medications should not be split if splitting could result in adverse pharmacologic outcomes. Such medications include those with enteric coatings, extended-release formulations, a narrow therapeutic window, or a short half-life-to-dosing ratio. The use of pill-splitting devices can make splitting tablets easier for patients and often yields more accurate doses,⁹ and some physical properties of medications such as scoring, shape, and size affect the ease and accuracy of splitting.⁷

Patients should be instructed by pharmacists how to accurately split tablets manually or how to use a pill-splitting device. In most cases, patients should be comfortable with splitting their own medication, and they should be free from physical impairments, including poor eyesight, loss of a limb, tremors, debilitating arthritis, or any other condition that might hinder accurate pill splitting. Pill splitting by pharmacists may still be a viable option for impaired patients in selected states.⁴ Although consideration of these many factors suggests that pill splitting can be undertaken without compromising patient safety, explicit evaluation of this question has not been undertaken.

Pill splitting also has the advantages of making newer and expensive medications available to more people who might not otherwise be able to afford them, allowing physicians to individualize a patient's dosage when the medication is not available in the desired dosage, and offering cost savings without risking a withholding of needed services. Pill splitting for pediatric patients may have specific advantages regarding dosage, but may also require special caution.

Though a recent study suggests that pill splitting may be frequent in long-term care facilities,⁶ little is known about actual patterns of tablet splitting, particularly in ambulatory settings. This report describes a methodology for identifying medications amenable to pill splitting based on specific criteria, and uses pharmacy claims data to gauge current pill-splitting practices and the potential for additional cost savings.

METHODS

We investigated pill splitting within a commercial managed care population of 19,000 covered lives served by primary care physicians affiliated with the Massachusetts General Hospital (MGH). This population consisted of working-age beneficiaries receiving employer-based health insurance in the Boston metropolitan area.

We sought to identify specific medications for which pill splitting would be appropriate and cost saving in 2:1 splitting ratios; to determine current patterns of pill splitting among MGH physicians, to estimate the potential cost savings that would result from pill splitting; and to recommend guidelines for safe pill-splitting prescribing practices.

Pharmacy claims data from January 1, 2000, through August 30, 2000, were available for managed care members with MGH primary care providers. We compiled a list of the 265 most frequently prescribed proprietary and generic medications, both nationally² and within the MGH population. To determine medications amenable to splitting, we evaluated each medication using cost- and pharmacologic-specific criteria. Included were cost savings per dosage increase, based on the average wholesale price and actual costs to the health plan, pharmacokinetic interactions and therapeutic window, packaging, and formulation. Physical properties such as scoring and tablet size also were considered, although they were not necessarily determining factors for inclusion in this study.

Preliminary review of the 265 most frequently prescribed medications allowed us to eliminate 125 medications because pill splitting was not feasible. Among the most common reasons were that medications were available in only one dosage, that the medication was administered non-orally, that a capsule or other nonsplittable form was used, and that the tablets were prepackaged. Commonly prescribed medications available in a single dose

COST CONTROL

included fexofenadine (Allegra; Aventis Pharmaceuticals, Parsippany, NJ), oxaprozin (Daypro; G. D. Searle & Co., Chicago, IL), raloxifene (Evista; Eli Lilly and Company, Indianapolis, IN), and tramadol (Ultram; Ortho-McNeil Pharmaceutical, Raritan, NJ). Common nonoral medications included corticosteroid and β -agonist inhalers. Capsule formulations among frequently prescribed drugs include terazosin (Hytrin; Abbott Laboratories, Inc, North Chicago, IL), fluvastatin (Lescol; Novartis Pharmaceuticals Corporation, East Hanover, NJ), valsartan (Diovan; Novartis Pharmaceuticals Corporation, East Hanover, NJ), fluoxetine (Prozac; Eli Lilly and Company, Indianapolis, IN), and omeprazole (Prilosec; AstraZeneca Pharmaceuticals, Wilmington, DE). Oral contraceptives are the most common examples of prepackaged medications.

The remaining 140 medications were evaluated based on potential cost savings on a per-dosage basis. For continued consideration, a medication was required to have cost savings through splitting that exceeded 25% and/or \$0.40 per dosage (\$0.20 for generic medications) based on average wholesale price.² Of these 140 medications, 61 were eliminated because splitting offered no or minimal cost savings. Examples of commonly used medications that were eliminated because of the lack of per-dosage cost savings through pill splitting included buspirone (BuSpar; Bristol-Myers Squibb Company, Princeton, NJ), metformin (Glucophage; Bristol-Myers Squibb Company, Princeton, NJ), and famotidine (Pepcid; Johnson & Johnson/Merck, Fort Washington, PA).

Using the 1999 and 2001 *American Hospital Formulary Service Drug Information* indices,¹⁰ the 79 remaining medications were evaluated for potential adverse pharmacologic effects. Each medication was screened based on toxicity, rate of absorption, elimination half-life, and therapeutic window. Nine medications with a potential for adverse consequences from splitting were excluded based on manufacturer warning against pill breakage (eg, nitroglycerin [Nitrostat; Parke-Davis, Morris Plains, NJ]), nonproportional combination medications (amoxicillin-clavulanic acid [Augmentin; SmithKline Beecham, Philadelphia, PA]), narrow therapeutic window (eg, warfarin), or rapid half-life-to-dosing ratio (eg, tolterodine [Detrol; Pharmacia & Upjohn, Peapack, NJ]). The latter criteria refers to medications with elimination half-lives short enough relative to the dosing frequency to raise potential concerns about fluctuations in serum concentrations should splitting be inaccurate. Once-daily sertraline, with a half-life of 25 to 26 hours,¹⁰ is an

example of a medication with a substantial pharmacokinetic buffer against inaccurate pill splitting. Olanzapine was included because splitting is feasible as long as the split tablet is used within a week of splitting.

Twenty-two additional medications with extended-release formulations were excluded, as altering these medications' physical properties by splitting could negatively impact their pharmacokinetics. Examples of extended-release formulations included felodipine (Plendil; AstraZeneca Pharmaceuticals, Wilmington, DE), extended-release bupropion (Wellbutrin SR; Glaxo Wellcome, Inc, Research Triangle Park, NC), extended-release nifedipine (Procardia XL; Pfizer Inc, New York, NY; Adalat CC; Bayer Corporation, West Haven, CT), and isosorbide mononitrate (Imdur; Key Pharmaceuticals, Inc, Kenilworth, NJ).

A detailed cost analysis of the 48 remaining medications using data from the available pharmacy claims records allowed us to determine actual cost, current rates of pill splitting among MGH physicians, and potential savings from extended use of this strategy. Eliminating those medications with minimal usage in the MGH population, we identified 11 recommended medications for which pill splitting is clinically appropriate and cost saving. Enalapril (Vasotec; Merck & Co. West Point, PA), nefazadone (Serzone; Bristol-Myers Squibb Company, Princeton, NJ), mirtazapine (Remeron; Organon, Inc, West Orange, NJ), zafirlukast (Accolate; AstraZeneca Pharmaceuticals, Wilmington, DE), and clarithromycin (Biaxin; Merck & Co. West Point, PA) were examples of medications that could have been associated with cost savings if they were used more frequently in the MGH system.

To calculate current rates of pill splitting for these medications, we used the following methods: for each daily dose of each medication, we calculated the proportion of prescriptions for which 2-to-1 splitting was implied by the number of pills provided and the days of therapy supplied by the prescription. For example, for all patients prescribed lisinopril 10 mg per day, we compared the number achieving this dose via 10-mg tablets (30 tablets provided for 30 days) with the number achieving this dose via 20-mg tablets split 2-to-1 (15 tablets provided for 30 days). For each medication, we reported the aggregate rate of pill splitting across all possible 2-to-1 splitting possibilities. During our investigation, no organizational efforts were in place to promote pill splitting.

Pill Splitting in a Managed Care Plan

Our cost analysis was based on usage volume and the actual cost of select medications in a commercial HMO population. Our unit of analysis was the prescribed daily dose (mg/day) for each of the selected medications, whereas our outcome measures were the cost savings realized from halving higher-strength tablets to achieve the desired dosage. To estimate current costs and potential savings, we extracted the total number of days of therapy prescribed for each medication at each dosage for all

patients as well as the total number of days of therapy for each medication if higher-strength pills were split to achieve the desired dosage. We annualized our 8 months of data to represent expected utilization and costs for a full year. An annualized cost analysis indicated those medications for which sizable current or future cost savings could be expected from pill splitting.

Observed and potential cost savings were calculated using the following equations:

Table. Potential Cost Savings from Pill Splitting in a Commercial HMO Health Plan

Drug and Daily Dose (mg)	Cost in Health Plan Contract		Annual No. of Prescriptions	Observed Occurrences		
	Per Pill (\$)	If Higher-Strength Pill Is Split (\$)		No. of Prescriptions From Splitting	Observed Annual Savings (\$)	Potential Annual Savings (\$)
Clonazepam	0.5	0.40	380	-	0	1456
	1	0.47	79	-	0	510
Doxazosin (Cardura)	1	0.97	58	-	0	1207
	2	0.95	105	11	224	2320
	4	1.00	76	-	0	146
Citalopram (Celexa)	20	1.90	890	66	2409	25,758
Atorvastatin (Lipitor)	10	1.77	2184	3	120	44,746
	20	2.68	1121	-	0	62,465
Paroxetine (Paxil)	10	2.19	281	17	712	11,176
	20	2.19	468	-	0	15,202
Pravastatin (Pravachol)	10	2.03	88	-	0	4056
	20	2.17	481	-	0	11,209
Nefazodone (Serzone)	50	1.16	12	-	0	242
	100	1.19	33	-	0	565
Sildenafil (Viagra)	25	8.54	37	-	0	610
	50	8.52	513	-	0	8461
Lisinopril (Zestril)	2.5	0.55	85	20	123	415
	5	0.85	566	9	99	8265
	10	0.88	1214	-	0	23,754
	20	0.93	716	-	0	9708
Sertraline (Zoloft)	25	2.11	87	12	526	2656
	50	2.12	616	75	1669	20,535
Olanzapine (Zyprexa)	2.5	4.26	38	3	263	2302
	5	5.09	52	2	57	1752
Total cost savings					\$6202	\$259,516

Daily dosages reported here can be achieved as a whole tablet or from splitting a higher strength tablet in half. The highest reported daily dosage for each drug can be achieved from splitting a higher strength tablet not shown in the table.

COST CONTROL

Observed annual savings = (savings per day of therapy) × (# of observed annual days of therapy achieved from pill splitting)

Potential annual savings = (savings per day of therapy) × (total annual days of therapy)

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RESULTS

Top Drugs for Splitting

We identified 11 medications for which pill splitting was clinically appropriate and could result in significant cost savings (Table). Of these medications, many are used for treatment of psychiatric disorders: clonazepam, citalopram (Celexa; Forest Pharmaceuticals, Inc, St. Louis, MO), paroxetine (Paxil; SmithKline Beecham, Philadelphia, PA), nefazadone, sertraline (Zoloft; Pfizer, Inc, New York, NY), and olanzapine (Zyprexa; Eli Lilly and Company, Indianapolis, IN). Also common were medications for lipid lowering: atorvastatin (Lipitor; Pfizer, Inc, New York, NY) and pravastatin (Pravachol; Bristol-Meyers Squibb Company, Princeton, NJ); and for hypertension: doxazosin (Cardura; Pfizer, Inc, New York, NY) and lisinopril. In addition, sildenafil (Viagra; Pfizer, Inc, New York, NY), a drug for erectile dysfunction, was included.

Of the 11 medications, 7 (70%) are scored: clonazepam, doxazosin, citalopram, paroxetine, nefazadone, lisinopril, and sertraline. The potential average cost savings from splitting was 36%. Cost savings ranged from 18% for lisinopril (2.5 mg dose) to 50% for doxazosin (1 mg), nefazadone (100 mg), and sildenafil (25 and 50 mg). Seventy-five percent (18 of 24) of the possible prescribed daily dosages for these medications could yield cost savings of at least 40% per pill.

Pill Splitting Is Currently Infrequent

Although pill splitting was used for a sizable number of HMO members, this practice was relatively infrequent. Splitting was most frequent for sertraline at a dose of 50 mg/day, for which 75 (12%) prescriptions were made from 100-mg tablets to be taken one half per day, compared with 616 (88%) receiving one 50-mg tablet once per day. Other medications for which splitting occurred were citalopram (8%), doxazosin (4%), and paroxetine (2%). Pill splitting was either negligible or not observed for the other selected medications.

Current and Potential Cost Savings

Among the selected 11 medications, we calculated that current pill-splitting practices saved \$6200

on an annualized basis, an equivalent of only \$0.03 per member per month. The largest contributor was citalopram (\$2400). Current cost savings, however, represent only 2.4% of the potential savings that could result from pill splitting among these 11 medications. Full use of tablet splitting for these drugs would generate \$259,500 in savings annually (or \$1.14 per member per month). The largest potential contributors to cost savings were atorvastatin (\$107,200), lisinopril (\$42,100), paroxetine (\$26,400), citalopram (\$25,700), sertraline (\$23,200), and pravastatin (\$15,300). Because not all patients should be considered for pill splitting, achievable savings would be less than these projections, although this report does offer a useful gauge of cost savings using this strategy.

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DISCUSSION

Based on specific criteria focused on safety and frequency, we have identified 11 medications in which extended use of pill splitting could be cost saving for a commercial HMO plan. Of these medications, a preponderance were used to treat psychiatric disorders, hypertension, and hyperlipidemia. The selected medications shared relatively wide therapeutic windows, long half-life-to-dosing ratios, and substantial potential for cost savings. Pill splitting is currently infrequent among MGH physicians, accounting for only \$6200 in savings annually, just 2.4% of the potential \$259,500 that could be saved from extended use of this cost-reduction strategy for the selected medications. This represents overall savings of 36% off the costs of these selected medications.

A recent lawsuit alleging that a mandatory pill-splitting program adopted by one of the nation's largest health maintenance organizations jeopardized patient safety¹¹ highlights an important point about appropriate pill splitting: although the practice can save money, pill splitting should be considered only in the context of specific patient-physician assessment and discussion. Review of these legal issues suggests that physicians can reduce the liability risks associated with pill splitting by judiciously limiting pill splitting to those medications and patients for whom it is medically appropriate and by engaging in a candid discussion of the requirements, costs, and benefits of a pill-splitting regimen.

Pill splitting can be expected to be relatively safe when drug- and patient-specific criteria have been met. In addition to appropriate dialog between the

physician and the patient, the following medication characteristics should be considered in selecting medications for splitting:

- Wide therapeutic windows ensure a buffer against potential fluctuations in dosing that could occur because of inaccurate tablet splitting. This includes medications with a relatively large ratio of drug concentrations producing significant undesired effects to those producing desired effects.
- Fluctuations from misdosing also can be minimized by medications that have a long half-life relative to the frequency of dosing because steady-state drug levels are less sensitive to potential variation in individual doses.
- Drugs that have enteric coatings or that are formulated as extended release should not be split.
- Drugs that are prepackaged, such as oral contraceptives, should not be split.
- Medications that do not have a pricing structure that makes splitting cost effective should not be considered.
- Physical properties of medications affect the ease and accuracy of splitting. For example, tablets that are deeply scored or scored on both sides are easier to split than unscored tablets.⁷

Our list of medications incorporated these characteristics, as well as several others that were specific to our setting, including frequency of prescribing and pricing considerations. Whereas other systems may derive somewhat different lists of medications, the foundation for these decisions should always begin with drug characteristics.

Patient-specific characteristics are also vital to consider in tablet splitting. Patients should be willing and able to be instructed by pharmacists on how to accurately split tablets or in the use of a pill-splitting device and they should be comfortable with splitting their own medication. Additionally, patients should have no physical or cognitive impairments that could impede accurate pill splitting or reliable dosing once pills are split. While some states prohibit pharmacists from splitting tablets,⁴ pill splitting may still be a viable option for some impaired patients in selected states. For example, regulations controlling pharmacists do not include such a prohibition in Massachusetts, California, Oregon, and New York, among other states. Even where legal, however, lack of reimbursement to pharmacies for pill splitting may constrain the willingness of pharmacists to perform splitting.

The beneficiary of the cost savings generated by tablet splitting will vary depending on the system of

reimbursement. Self-pay patients or patients with capped pharmacy benefits will reduce their out-of-pocket expenses by splitting their pills. In other instances, physician systems or health insurance plans will realize the cost savings, as was the case with the population that we analyzed. For patients who would not otherwise benefit, it would be ideal if they could be offered an incentive to use split dosages (eg, a reduction in their copayment).

Out of convenience, we have used data from a commercial health plan, although data from other types of plans could augment our analysis. For example, information on a Medicare population would be appropriate given that elderly patients have greater medication use and experience greater out-of-pocket costs that could be diminished through pill splitting.

Limitations

Although we lack the information needed to estimate precisely the proportion of patients who are unwilling or unable to split pills, this proportion is likely to be smaller within an employed population compared with other populations. In our population, we estimated that approximately 10% to 30% of patients would be unable or unwilling to make use of prescriptions that require pill splitting. Our results, from a large academic medical center and its physicians, may not reflect current practices and potential cost savings in other practice settings. We focused only on medications that were preferred in the MGH managed care plan. This tactic excluded several drugs for which significant savings could be realized in other settings (ie, lisinopril as Prinivil was included, but not Zestril). We focused only on 2-to-1 splitting ratios, although savings may be significant with other dosing ratios (eg, prescribing 75 mg sertraline from splitting three 50-mg tablets over 2 days rather than three 25-mg tablets in one day).

We recognize that the potential cost savings as reported here might not be fully achievable, as pill splitting will not be appropriate for every patient. A number of factors may cause actual savings to fall below those potentially achievable, including a patient's unwillingness to accept split-dosing prescriptions, patient inability to split pills (either through self-splitting or through a pharmacist), and lack of familiarity by prescribers. Although we lack information needed to estimate the proportion of patients that fall into these categories, this proportion is likely smaller within a employed population compared with other populations.

Although many factors suggest that more widespread pill-splitting practices could be adopted without compromising patient safety, it was beyond the scope of this study to evaluate the safety of pill splitting in our population either currently or for our projections of increased splitting. A long-term consideration may be that consistent and widespread adoption of tablet splitting might result in pharmaceutical pricing strategies that eventually eliminate the advantages of splitting. More likely, however, is that some segments of the market for pharmaceuticals (eg, managed care or self-pay) may adopt pill splitting more than others.

Implications

Our analysis has indicated that significant cost savings are possible through tablet splitting for a set of medications selected using explicit criteria. We recommend that physicians talk with patients, review their medications, work with them to assess whether pill splitting is a viable option, and use this strategy when it can be carried out safely. The cost savings from this underused practice are significant and, if implemented judiciously, this strategy presents an opportunity to reduce healthcare costs without compromising quality.

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