Elimination of Over-the-counter Medication Coverage in the Oregon Medicaid Population: The Impact on Program Costs and Drug Utilization

by

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Certificate of Approval

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ABSTRACT

Study Purpose. In order to reduce program costs to meet budget limitations, the Oregon Medicaid program eliminated reimbursement for over-the-counter (OTC) medications effective September 1, 1993. Considering that physicians might substitute more expensive prescription-only products in situations where they had prescribed OTC therapy, this investigation evaluates the policy's impact on the program's medication costs in Oregon's Medicaid program.

Methods. This retrospective investigation examines pharmacy claims between March 1, 1992 and February 28, 1994 using an interrupted time-series analysis. Subjects included all adults (greater than 20 years) eligible for drug benefits under the Oregon Medicaid program during the 2-year study period. The policy's impact on program costs and on the number of submitted claims (mean dollars paid and mean number of claims per 1000 eligibles per week) was evaluated separately for prescription-only and total prescribing in each of nine therapeutic categories in which significant OTC prescribing occurred: anti-ulcer and gastrointestinal preparations, antidiarrheals, laxatives, antihistamines, antitussives-expectorants, multivitamins, hematinics, and fungicides.

Results. In the 18 month pre-intervention period, OTC products comprised 36% (213,516 of 592,672) of drug claims and 9% ($1.36 million of $14.58 million) of medication costs in the nine selected therapeutic categories. Of these categories,

decreased program costs were noted in five and no significant change was found in four others. In only one category, hematinics, a small, but significant increase in prescription-only prescribing was associated with the elimination of OTC products (after excluding erythropoietin products for which a change in therapeutic category coincided with the implementation of this policy). The net effect on total prescribing even in the hematinics category, however, demonstrated a significant decrease in program expenditures. Overall, medication costs in these selected therapeutic categories decreased from $7.86 to $7.39 per eligible per month after the policy's implementation.

Conclusions. The results of this investigation suggest that the OTC elimination policy was successful in reducing program drug costs in five out of nine therapeutic categories and evidence suggesting a significant increase in prescription-only costs was noted in only one, hematinics. Before such a policy could be advocated, however, further study is needed determine the policy's impact on the subgroup of patients who regularly received OTC medications and to evaluate secondary effects of this policy on outpatient visits, hospitalization, and clinical outcomes.

INTRODUCTION

Medicaid pharmaceutical expenditures have grown tremendously; national expenditures doubled between 1985 and 1990, reaching $4.42 billion annually in 1990.[1] To constrain these rapidly increasing costs, many states have implemented administrative policies restricting the reimbursement for medications: restrictive formularies, exclusion of drugs within certain categories, prior authorization programs, or copayment requirements. In 1991, for example, 11 states used restrictive formularies, 38 had implemented prior authorization programs, and 36 limited reimbursement for over-the-counter (OTC) medications, medications which are available without a prescription.[2]

Facing a large state budget deficit, Oregon's governor mandated a 20% reduction in the state's Medicaid budget in 1993. To comply with this mandate, the Office of Medical Assistance Programs (OMAP) eliminated reimbursement for OTC medications for Oregon Medicaid recipients after approval by the Oregon legislature, and this administrative policy was estimated to save $2.4 million annually.[3] The actual impact on expenses and on the program's recipients of such an administrative policy is difficult to predict, however. Anecdotally, pharmacists report that physicians frequently substitute covered medications for those for which coverage was eliminated. For example, many antacid medications (such as Mylanta and Maalox), analgesic and anti-pyretic medications (such as acetaminophen, 200mg ibuprofen, aspirin), and anti-fungal

agents (such as clotrimazole) are available in Oregon without a physician's prescription. For each of these classes of medications, physicians may prescribe prescription-only alternatives: either different medications (ketorolac instead of ibuprofen) or prescription-strength formulations of the same medication (600 mg versus 200 mg ibuprofen).

What are the possible effects of the new policy? Ideally, from the state's perspective, recipients would purchase necessary medications with their own resources, and the program's substantial cost savings would not affect the use of needed medications or patients' health outcomes. Another possibility, however, is that physicians may substitute prescription-only medications (which are covered by the program) for patients who cannot afford to purchase the OTC products. Because these prescription alternatives may be more expensive, substitution of these products would increase the program's medication costs. In addition, prescription alternatives may have more toxic side effects than their OTC alternatives, potentially resulting in poorer health outcomes or increasing utilization of physician or hospital services. Alternatively, patients who discontinue essential OTC therapy could also have poorer health outcomes, more frequent outpatient visits, and increased hospitalizations. In short, the introduction of OTC elimination policy may have both first-order (the effects of drug substitution on medication expenditures) and second-order effects (effects on clinical outcomes and on the utilization of more intensive and expensive health services).[2]

Several investigations have demonstrated that financial barriers to pharmacy services (such as the implementation of a copayment system) reduce drug utilization.[4,5,6,7,8,9,10] Several of these investigations suggest that the impact of these measures vary by therapeutic category, having the greatest impact on 'discretionary' drug classes.[4,8,9,10] Soumerai examined the impact of the implementation of a three-prescription cap on prescribing to an at-risk cohort of 860 continuously enrolled New Hampshire Medicaid recipients who were receiving multiple prescriptions each month.[9] Overall, the number of prescriptions per person per month fell from 5.2 to 2.8 in this cohort. While larger reductions were seen for 'ineffective' medications such as propoxyphene (58%), substantial reductions in 'essential' medications such as furosemide (30%) and insulin (28%) were seen as well. Furthermore, specific patient subgroups within these studies appear to be most vulnerable to these policy changes, especially the elderly and chronically ill.[7,9,11] Although few studies have considered second order effects on health status and non-pharmaceutical services, Soumerai demonstrated that a Medicaid prescription limit in New Hampshire resulted in increased admissions to nursing homes,[9] and Cromwell reported a significant increase in hospitalization for gastrointestinal disorders after Florida restricted reimbursement of medications for peptic ulcer disease.[12]

With respect to categorical exclusion of certain medications such as the elimination of OTC medication reimbursement, several studies suggest that providers substitute alternative medications for those eliminated, and widespread substitution can overcome

any cost savings which would have been realized as a result of the policy.[13,14,15] In Ireland, an investigation reported observable increases in more costly and toxic prescription alternatives when OTC coverage was eliminated.[16] In addition, Soumerai reported the effect of eliminating 12 categories of ineffective or irrationally prescribed medications in the New Jersey Medicaid program using a time-series approach with a comparison group.[15] Even though the withdrawn drugs accounted for 7% of pre-policy expenditures, the restrictions did not produce measurable reductions in overall use because the reduced use of target medications was more than offset by increased use of substitute drugs. While these studies suggest that substitution occurs, few of the reported studies are of sound methodological quality; only one of twelve investigations examined in a thorough review by Soumerai used the strongest available research design (time-series analysis with control group), and only two others were partially controlled.[2] In short, preliminary studies suggest that significant medication substitution may occur in response to administrative restrictions on medication reimbursement, probably with varying impact on different medication categories and patient populations. Little empirical evidence to support or refute this assertion, however, is currently available.

Despite this lack of empirical evidence that such policies reduce expenditures without adversely affecting health outcomes, most states currently restrict reimbursement of OTC therapy in their Medicaid programs. In a 1993 survey of Medicaid drug utilization review program coordinators, 29 out of 32 states responding

reported that they restrict coverage of OTC products for their recipients. None of the respondents had measured the actual impact on expenditures or health outcomes for these restrictions.[17] The existing Oregon Medicaid pharmacy claims database and the recent policy change in OTC coverage provided a unique opportunity to assess the impact of the elimination of OTC coverage on medication costs in the Oregon Medicaid population.

METHODS

Overview.

This investigation evaluates the impact of the elimination of OTC coverage in the Oregon Medicaid program on prescribing practices and program medication costs by examining pharmacy claims filled under the Oregon Medicaid program between March 1, 1992 and February 28, 1994, 18 months before the policy implementation and 6 months afterward. Based on limited published evidence[15] and anecdotal reports from Oregon pharmacists, we hypothesized that substitution of more expensive prescription-only medications in certain therapeutic classes would offset some or all of the cost savings from the elimination of OTC drugs.

Oregon Medicaid & the OTC Elimination Policy.

Oregon Medicaid Program. The Office of Medical Assistance Programs provides medical and pharmaceutical coverage for over 240,000 low-income Oregonians who are medically needy, disabled, elderly, minors, or pregnant. Approximately 61% of these patients are women. In order to receive reimbursement from OMAP for dispensed medications, pharmacists must submit a claim for each prescription dispensed under Medicaid funding. In 1991, approximately 2.5 million prescriptions were filled under this program in the state of Oregon.

With the introduction of the Oregon Health Plan (OHP) on February 1, 1994, 'traditional' (fee for service) Medicaid patients began to be enrolled in managed care

plans. In February, 1994, approximately 13% of the Medicaid population was shifted into the OHP, and pharmacy claims for these patients are not available. Therefore, for the final month of the post-policy period, these OHP participants were excluded from analysis. All Oregon Medicaid recipients over 20 years old who were eligible for medication benefits at any time during the 24 month study period were included in this investigation. There were no copayment requirements for pharmacy benefits under the Oregon Medicaid program during the time of this investigation.

OTC Elimination Policy. Until the policy's implementation on September 1, 1993, OMAP provided unrestricted coverage of OTC medications for its Medicaid recipients, although to receive payment for OTC medications, a physician's prescription was required. The estimated savings from eliminating OTC coverage was $2.35 million annually by eliminating reimbursement for most OTC prescriptions. The policy restricted prescribing only to recipients over 20 years of age at the time of the claim. In addition, OTC family planning products, insulin, and diabetic supplies were excluded from the policy.

Data & Statistical Issues.

Study Population. This investigation included all adults eligible for pharmacy benefits at any time during the 24-month study period. In order to detect global changes in the study population during the investigation which might impact prescribing, demographic data for the total Medicaid population were examined over the course of the study period. Because demographic data for the total Medicaid population (including both

adults and eligibles 20 years of age and younger) were readily available, these data were used for this purpose. While small changes within the adult population alone would not be detected using this approach, assessing the total population is probably sufficient to evaluate the stability of the population demographics with respect to global changes likely to produce significant changes in drug utilization. Furthermore, assessment of the total population allows direct comparison with readily available data of other state Medicaid populations.

Because the OTC elimination policy did not apply to recipients < 21 years of age at the time of the claim, this investigation included pharmacy claims for only Medicaid eligibles over 20 years of age. Aside from graphing the paid claims by month as a visual check on the expected policy's impact on both adults and eligibles 20 years of age and younger, the analysis of submitted pharmacy claims was restricted to eligibles over 20 years old.

While evaluating the policy's impact on prescribing only for patients at highest risk for a change in therapy (continuously eligible adults routinely receiving OTC therapy) would be a more sensitive design to demonstrate a small impact, we chose to study the entire population of eligibles in order to understand the impact from the program's perspective. This is an important distinction, because from a patient's perspective, the impact on an individual's therapy may be the most important consideration; from the perspective of policy makers and program administrators, although the impact on the subgroup at greatest risk cannot be

ignored, the overall program costs are a key focus. We chose the program's perspective for this investigation, recognizing that evaluating the impact on the subgroup at greatest risk merits further study.

Identifying Therapeutic Categories. The policy's impact on prescribing is analyzed by therapeutic category, a grouping of medications used for a common clinical purpose. Oregon Medicaid uses the therapeutic class assigned by First DataBank's drug information file, and the therapeutic category assigned by Oregon Medicaid at the time the claim is filed was used in this analysis.

Selecting Therapeutic Categories for Investigation. Therapeutic categories were selected in order to identify all categories which were affected by the elimination policy in which significant OTC prescribing occurred. To select appropriate categories, prescribing in all categories (as denoted by First Databank's drug information file) was examined for one month during the pre-implementation period (January, 1993). Firstly, all categories in which paid claims for OTC medications comprised less than one percent of prescribing were eliminated. These included categories such as anti-depressants, antibiotics, anti-epileptic agents, diuretics, and other similar categories which included prescription-only medications. Non-steroidal anti-inflammatory drugs were also eliminated by this criterion, since there were very few prescriptions for OTC non-steroidal anti-inflammatory drugs. Secondly, all categories which were specifically excluded from the policy (such as family planning

products and insulin) were eliminated. Thirdly, categories which included a broad array of agents for widely varying clinical indications were eliminated. This criterion eliminated classes such as surgical supplies & bandages and ophthalmic preparations, which include OTC products (such as artificial tears) that are often used for dramatically different clinical indications than the prescription-only products in this class (such as pilocarpine eye drops). In addition, antipyretics and non-narcotic analgesics were eliminated as well by this criterion; because daily aspirin use for anti-platelet therapy is much different from antipyretic or analgesic use of acetaminophen or aspirin, and because patients could be switched to other non-narcotic analgesics outside of this class, this therapeutic category was eliminated. While this category of agents may be one in which therapeutic substitution could be significant, such an analysis would require an approach which identified individual OTC agents, the probable clinical indication, and prescription-only agents potentially substituted. In short, the analysis by therapeutic category used in this investigation was not appropriate for this class. Among the remaining categories, those in which prescribing was very limited (< $3000 per month in paid claims) were eliminated since they contribute little to the potential overall reduction in medication expenditures. This process of selection resulted in the nine categories illustrated in **Table 1**.

Outcome Measures. The objective of this investigation was to assess the impact of the OTC elimination policy on overall prescribing. Therefore, the primary outcome measures were the number of claims submitted and the dollars spent before and after

policy implementation. Thus, for the selected therapeutic categories, the mean amount paid and mean number of claims per 1000 eligibles per week were calculated. These measures were assessed in both the total prescribing (OTC and prescription medications) and prescription-only prescribing.

Data Sources. Data were obtained using the Oregon Medicaid paid pharmacy claims database. In order to receive reimbursement under the Oregon Medicaid program, pharmacists must submit a claim for each medication dispensed. All pharmacy claims are stored in a database maintained by OMAP in a relational database. Pharmacists and physicians have up to one year to submit claims under Oregon Medicaid, but approximately 90% are submitted within one week.[18] To improve complete identification of claims for the selected study period, claims files were examined five months beyond the end date of the study period, ensuring identification of claims submitted up to five months after the dispensing date. Claims which are not submitted to Medicaid (prescriptions not filled, purchased with cash, or covered by another third party payer) are not recorded in these data sets.

OTC status. The policy affected the reimbursement for prescriptions for OTC medications. To determine the OTC versus prescription status of a medication for each NDC (National Drug Code), the Oregon Medicaid program uses First Databank's drug information file. For this analysis, the OTC status recorded by OMAP at the time of the pharmacy claim was used.

Data Management. Analyses were conducted on pharmacy claims files and enrollment files (monthly files listing Medicaid benefit recipients). Monthly pharmacy claims data files were obtained from the Oregon Medicaid program as raw claims data. These data were examined, cleaned, and transferred to a research database (Microsoft SQL Server) on a pentium-class PC server. The total claims database consisted of 8.3 million records over the 29 months of data files (includes 5 months of claims files after the study period to capture claims submitted up to 5 months after the dispensing date). A subset of these claims within the selected therapeutic classes was selected and stored in a separate SQL Server database for analysis. The process of data management for these claims data is illustrated graphically in Appendix F: Data Management Process. Enrollment files were similarly obtained from OMAP and analyzed to determine the demographic characteristics of Oregon Medicaid recipients. Data analysis was performed using Microsoft Access version 2.0 and statistical analyses were performed using SPSS for Windows (version 6.0 with Trends module).

Statistical Issues. This investigation used an interrupted time-series approach to examine the policy's impact on Medicaid prescribing. The outcome measures were determined for each week of the study period, and an ARIMA (Autoregressive Integrated Moving Average) model was used to fit the resulting time-series. Using $\alpha = 0.05$ for statistical significance, the Bonferroni correction was applied to account for multiple comparisons ($\alpha = 0.0014$, number of comparisons = 36).

Time-series Analysis. 1) Preparation of dataset for analysis by time-series analysis: the database of pharmacy claims was analyzed to prepare a dataset suitable for time-series analysis including the sum paid and total number of claims for each of the selected therapeutic classes by week of the study. These figures were normalized using the total number of adults (age > 20 years) eligible for pharmacy benefits during that week of the study, yielding the mean dollars paid and mean number of claims which were submitted in each therapeutic class per 1000 eligibles for each week of the investigation. 2) Building ARIMA models: Using summary data by week as described above for only the pre-intervention period, an ARIMA model was identified, estimated, and evaluated in an iterative process until a suitable model was identified in a standard fashion as described by McDowall, et al.[19] Firstly, the autocorrelation (ACF) and partial autocorrelation (PACF) functions were examined to determine the orders the autoregression (AR), integration (I), and moving average (MA) processes for an appropriate ARIMA model. Applying these parameters, an ARIMA model was used to estimate the time-series process for the pre-intervention period. The parameters were then adjusted to maximize the model's fit (using the Schwartz Bayesian criterion estimator which assesses fit but gives higher value to simpler, more parsimonious models) and minimize the autocorrelation of the model's residual errors (using the ACF plots and the Box-Ljung statistic). Model identification, estimation, and diagnosis continued in an iterative fashion until changes in the orders of the AR, I, and MA processes resulted in no further improvement in fit and the autocorrelation of errors was

not statistically significant. The resulting model's residual errors were examined to ensure they were normally distributed (normal probability plot) and appeared to have random pattern with equal variance throughout the pre-intervention period (assessment of sequence graph of residual errors). Models were examined to make sure that they did not violate bounds of invertibility or bounds of stationarity.[19] Appropriate ARIMA models were fit in this manner for each primary outcome measure (mean number of claims per 1000 eligibles per week and mean dollars paid per 1000 eligibles per week) for both prescription-only and total (prescription and OTC) prescribing for each of the nine therapeutic classes chosen for study (Table 1). No seasonal variations were considered. 3) Application of interrupted time-series analysis: The ARIMA models fit to the pre-intervention prescribing as above, were then applied to the entire study period adding a variable indicating pre- versus post- periods as an independent variable.[19]

Ethical Considerations. This investigation did not any include patient identifying information (name, social security number, address) in any database or communication, did not alter the care provided to study subjects, and study subjects were not contacted at any time. This investigation was considered exempt from Human Subjects Committee review at Oregon Health Sciences University and was approved by OMAP. To assure patient confidentiality, patients' pharmacy profiles and claims data were encoded with a patient-specific unique identifier to allow investigators to link appropriate claims data but will prevent identification of the study subjects. All electronic data were stored in password-protected, encrypted computer files.

RESULTS

Population Characteristics. The pre- and post-intervention demographics for the total Oregon Medicaid population are presented in Table 2. The proportion of females in the population steadily decreased over the course of the study from 60.9% in the pre-period to 60.1% in the post-period. The mean age and proportions of eligibles in each of the OMAP program categories (which demonstrate varying eligibility requirements) remained stable throughout the study period as illustrated in Figure 1. During the final month of the post-intervention period, 13.6% of the eligible OMAP recipients were entered into the OHP and excluded from analysis, accounting for 2.5% of the post-intervention eligible-months.

OTC and Prescription-only Pre-Policy Prescribing. Graphs of the dollars paid per week (Figure 2) and the number of pharmacy claims per week (Figure 3) in the selected therapeutic classes are illustrated. As these graphs demonstrate, there were steady increases in both the number of claims and in the sum paid in the largest area of prescribing, prescription-only medications for adults. The anticipated elimination of OTC claims in adults was also noted. Although these data are not included in the time-series analysis, the corresponding levels of prescribing in eligibles 20 years of age and younger are depicted for comparison, and these data demonstrate no obvious change in prescribing pattern during the course of the study. The number of claims and the amount paid for OTC and prescription-only medications during the pre-intervention period are

shown in Table 3. This table also shows the proportion of prescribing comprised by OTC medications for each of the nine selected therapeutic categories. In these therapeutic categories, OTC medications accounted for 36% of the overall claims and 9.3% of the medication costs during the pre-intervention period. The total program cost for OTC medications in these therapeutic classes was $1,362,560 and the corresponding prescription-only costs were $13,221,103 during the 18 month pre-intervention period. Figure 4 illustrates the mean cost per pharmacy claim throughout the study period, demonstrating an increase at the time of the policy's implementation in addition to the noted decrease in total number of claims associated with the policy.

Total Pre- and Post-Policy Prescribing. The total number of prescriptions and total expenditures for dispensed medications for Medicaid eligibles over 20 in the nine selected therapeutic categories are shown in Table 4. After eliminating the confounding effect of a categorization change for erythropoietin products, the dollars paid per eligible per month decreased from $7.86 to $7.39, and the number of prescriptions per eligible per month fell from 0.320 to 0.202 in these categories. A small number of OTC claims appear in the post-policy period because the program allowed some claims to be reimbursed on a very limited basis (75 claims totally $492 during the six-month post-policy period).

Time-series Analysis - ARIMA Model Fitting. ARIMA models were fit to pre-intervention series for the total dollars paid and the number of claims submitted (per

1000 eligibles per week) in each of the nine therapeutic categories for both the prescription-only and total prescribing. The parameters of these models are shown in Table 5 and Table 6, respectively. Some of the data series required relatively high order autoregression models to sufficiently account for the autocorrelation in the series. For example, several models demonstrated significant autocorrelated errors at a lag of four, which may represent a periodic 4-week pattern to prescription dispensing. Such a pattern makes intuitive sense in refill prescriptions and may account in part for this phenomenon. In addition, in some series, alternative ARIMA models fit the series nearly as well as the best-fit model, which may suggest that the time-series patterns were somewhat difficult to model with these techniques in some cases. In cases where model fitting appeared to be limited, the robustness of the results was evaluated by examining the results of alternative models, and they were determined to be robust with respect to the magnitude, direction, and statistical significance of the intervention effects.

Time-series Analysis - Program Costs for Prescription-only and Total Prescribing. Identified ARIMA models were applied to the entire study period, and the results are shown in Table 5. On initial evaluation, only the hematinics therapeutic category demonstrated a significant increase in prescription-only and total prescribing costs (an increase which is accounted for by a confounding effect of a change in classification of expensive erythropoietin products). Significant decreases in total prescribing costs were found for the following therapeutic categories without significant changes in

prescription-only prescribing: antidiarrheals, laxatives, multivitamins, and fungicides. The fitted models are provided for program costs in prescription-only and total prescribing in Appendix A and B, respectively.

Time-series Analysis - Number of Claims for Prescription-only and Total Prescribing. Results from the application of fitted ARIMA models are shown in Table 6. No significant changes in the number of prescription-only claims submitted were found when significance levels were corrected for multiple comparisons. Significant decreases in total claims were noted in the following therapeutic categories: Anti-ulcer and GI preparations, antidiarrheals, laxatives, multivitamins, hematinics, and fungicides. These fitted models are provided for number of submitted claims in prescription-only and total prescribing in Appendix C and D, respectively.

Hematinics. During the course of the analysis, a change in therapeutic classification of erythropoietin products from "unclassified medications" (not included in this investigation) to "hematinics" (included in this investigation) was identified (Figure 5). Because this change in classification occurred coincidentally with the OTC elimination policy, it introduces a confounding effect, giving the appearance that erythropoietin use increased following the policy's implementation. To correct for this effect, the analysis affected by this therapeutic class was repeated (Table 4, Table 7, and Appendix E: Time-series Graphs: Reanalysis Excluding Erythropoietin Claims) after excluding erythropoietin products. After excluding erythropoietin products from the analysis, a statistically significant increase in prescription-only hematinic medications is associated

with the policy's implementation (Table 7). In total prescribing (OTC and prescription only products), however, a significant decrease in mean paid per 1000 eligibles per week was noted along with a significant net decrease in total number of claims.

DISCUSSION

Population Stability. Although there were gradual trends towards a slightly lower proportion of females in the Oregon Medicaid population and slightly higher proportion of eligibles qualifying for poverty level medical coverage, no significant demographic changes occurred in the total population during the course of this investigation. In the final month of the study period, eligibles began to be entered into Oregon Health Plan (OHP) programs (13.6% of the February, 1994 eligibles), and these eligibles were excluded from the analysis because no pharmacy claims data were available. Because this represents only 2.5% of the post-intervention eligible-months, the effect of this population change should be negligible. Although these data represent the total population of Oregon Medicaid (rather than focusing on only eligibles over 20 years), there appear to be no significant demographic changes which would likely impact prescribing to Oregon Medicaid eligibles during this investigation.

Application of ARIMA models. Although the best-fit ARIMA models were easily identified for each time-series, several of the resulting models were relatively high-order autoregression models. In addition, a variety of different models were required to fit the time-series patterns of the selected therapeutic categories, and in some cases, the best-fit model provided only limited improvement in fit over competing models. While these findings may suggest limited fit in some models, they are more likely a reflection of the complexity of the underlying time-series processes. In order to

provide an adequate number of data points to apply a time-series analysis, we focused on prescribing by *week*, and this approach may have introduced complexity into the model. Chronically prescribed medications are likely to be refilled monthly which would introduce a periodicity of approximately 4 weeks. That is, the number of prescriptions filled in a given week may be related to the number dispensed 4 weeks ago. Indeed, this pattern was reflected in the autocorrelation graphs for several therapeutic categories. This may explain in part the tendency towards higher order ARIMA models. For the analysis of the therapeutic categories which were clearly seasonal (antihistamines, antitussives-expectorants, and cough and cold preparations), application of a seasonal model would be likely to provide a better fit to the data. However, two years of data (18 months pre-intervention and 6 months post) is insufficient to model accurately seasonal factors with a periodicity of one year using time-series analysis.

If these factors compromise the fit of some models, the confidence intervals around the estimation of the intervention effect would be larger. Thus, these models' ability to detect small but statistically significant differences would be impaired. The best-fit ARIMA models were compared to closely competing models to determine the impact of alternative models on the intervention effect, and the estimates of intervention effect were robust. That is, while the coefficients varied somewhat, its magnitude, direction, and significance remained robust across closely competing models. Therefore, the complexity of the identified ARIMA models probably reflects

the complexity of the underlying data series, and while it is possible that model fit is limited in some series, the models appear to be robust. In short, it may be possible to identify more sensitive models using alternative techniques, but the reported results appear to reliably evaluate the impact of the policy's impact.

Total Adult Prescribing Results. During the 18 month pre-intervention period, Oregon Medicaid spent $1.36 million for 213,516 OTC medication claims in the nine therapeutic categories selected for study. Thus, OTC prescribing comprised 9.3% of the pre-intervention prescribing costs and 36% of prescriptions in these categories. The OTC elimination policy demonstrated its expected elimination of OTC prescribing in adults as illustrated in Figure 2 and Figure 3. These figures depict the clear elimination of OTC medications while adult, prescription-only prescribing and prescribing in recipients less than 21 years continue without apparent changes. As anticipated, the mean cost per claim in adults increased associated with the elimination of inexpensive OTC medications (Figure 4). Overall, the mean dollars paid per eligible per month for prescribing in these categories decreased from $7.86 to $7.39 after the OTC elimination policy, and the mean number of claims decreased from 0.320 to 0.202 per eligible per month (excluding erythropoietin products).

The OTC elimination policy demonstrated significant decreases in both total program costs and total claims submitted in the following therapeutic categories: anti-diarrheals, laxatives, multivitamins, and fungicides (Table 5 and Table 6). In addition, there were significantly fewer claims for anti-ulcer and GI medications which was not

associated with decreased total costs. Only one therapeutic category, hematinics, initially demonstrated a significant increase in program costs (despite a significant reduction in submitted claims), but a change in therapeutic classification of erythropoietin accounts for the increase. The remaining therapeutic categories (antihistamines, antitussives and expectorants, and cough and cold preparations) demonstrated no significant change in total prescribing. Over-the-counter medications comprised 36% (range 8 to 91%) of pre-intervention prescribing in the nine selected categories, and the greatest reductions in submitted claims were seen in categories with the greatest proportion of OTC prescribing: laxatives, 91%, and multivitamins, 82%. In addition, the program experienced a significant decrease in anti-ulcer claims (18% of claims were OTC in the pre-intervention period) without an associated change in program costs (only 2.6% of costs were as a result of OTC medications). Interestingly, none of the therapeutic categories which demonstrated seasonal patterns (antihistamines, antitussives and expectorants, and cough and cold preparations) showed significant changes in claims or costs. Small changes in these categories may be more difficult to identify without applying seasonal models. In summary, on initial evaluation of the nine therapeutic categories, program costs were decreased in four, remained unchanged in four others, and increased in one, but a coincidental change in classification of erythropoietin products accounts for this increase. Overall, there was a net decrease in overall program costs which coincides with the policy implementation.

Evidence for substitution of prescription-only medications. The substitution of prescription-only medications for the OTC products eliminated by the policy would be expected to produce an increase in prescription-only prescribing associated with the policy's implementation: significant increases in the mean number of claims and (assuming prescription-only products are more costly) in the mean dollars paid (per 1000 eligibles per week). Contrary to our working hypothesis, this analysis identified such a pattern in only one of the nine therapeutic categories evaluated, hematinics (Table 7).

One would expect that prescription-only substitution would be most likely to occur in patients who are treated regularly with an OTC medication considered medically essential by their physicians. Treatment of iron-deficiency anemia with supplemental iron might represent such a clinical situation. That is, if a patient who requires iron replacement could not afford to assume the expense of this treatment, a physician might feel compelled to provide a covered therapy in order to assure compliance. For more discretionary treatments, physicians might feel less compelled to substitute covered alternatives. This differential impact on discretionary medications has been observed in previously reported studies.[4,8,10] In addition, patients might be more likely to be treated *regularly* with iron replacement. In contrast, the prescription of the other therapeutic categories such as cough and cold preparations or laxatives to a particular patient would tend to be more episodic. Physicians might be more compelled to substitute covered alternatives to patients which have received the treatment monthly

for the past year and face the prospect of assuming the expense of this treatment. While further study is needed, the differential impact of the OTC elimination policy raises significant issues with respect to the factors which influence a physician's response to such an administrative policy.

Hematinics was the only therapeutic category in which a statistically significant *increase* in total prescription costs was initially associated with the policy implementation. This therapeutic category includes primarily iron replacement therapy. This category was analyzed in greater detail to identify potential reasons for this phenomenon. Assessment of the greatest cost medications in this category revealed that an increased number of claims for erythropoietin products (tradenames Epogen and Procrit) corresponded to the timing of the OTC elimination policy. These products are very unlikely to be substituted for OTC medications such as iron replacement therapy. Indeed, iron replacement agents should be continued during erythropoietin therapy. Instead, if any substitution occurs, one would expect that physicians would substitute prescription iron supplements for their patients maintained on OTC iron therapy. Because substitution of erythropoietin for iron supplements seems like such an unlikely occurrence, several potential confounders were assessed. No labeling changes, changes in therapeutic indications, or OMAP reimbursement policy changes could be identified to coincide with the OTC elimination policy. However, after searching the entire database of Medicaid drug claims for this time period, erythropoietin products were identified in another therapeutic category. Indeed, prior to May, 1993, all erythropoietin

products were classified in therapeutic category 99, "unclassified medications," which was not included in this investigation. After September, 1993, all such products were classified in therapeutic category 88, "hematinics," which was selected for study by this investigation. It appears that the First DataBank classification for erythropoietin products coincidentally changed near the time of the OTC policy implementation, acting as a significant confounder for the hematinics therapeutic category (Figure 5). Therefore, the figures for total prescribing were recalculated after exclusion of erythropoietin products in order to avoid this confounding effect (Table 4). Using the same methods outlined, ARIMA models were identified and the impact of the OTC elimination policy was reevaluated in this modified dataset. As shown in Table 7, the initial apparent increase in total program costs is eliminated when these products are excluded from analysis. Indeed, with the exclusion of erythropoietin products, there is a marked *decrease* in total program costs for this therapeutic category. The graphs in Appendix E and the ARIMA analysis (shown in Table 7) demonstrate increased prescription-only prescribing in conjunction with OTC elimination, suggesting that some substitution of prescription products may have occurred.

The policy's impact on program costs. Contrary to our working hypothesis, from the perspective of overall program costs, the OTC elimination policy appears to have been effective in reducing expenditures resulting from drug claims. As shown in Table 4, the program costs for prescribing in the nine selected therapeutic categories decreased from $7.86 to $7.39 per eligible per month after the OTC elimination

policy. In five of the nine categories, significantly decreased total prescribing costs were identified by time-series models. Furthermore, with the exception of hematinics, there appears to be no evidence to suggest significant substitution of prescription products in any of the therapeutic categories studied. In the hematinics category, despite a significant increase in prescription-only prescribing coinciding with the policy's implementation (after controlling for the confounding effect of a change in classification of erythropoietin products), total prescribing costs were reduced after the policy's implementation. The impact of this policy on patients who would have otherwise received OTC medications is unknown. Further study is needed to evaluate whether patients went without treatment or paid for the medications themselves. In addition, this investigation offers no information regarding the secondary effects of this policy on outpatient visits, hospitalizations, or clinical outcomes.

Comparison with previously published results. Our results fail to demonstrate evidence of cost-shifting that other authors have reported. After a formulary change in Ireland which eliminated many OTC and prescription-only medications provided by the state-run healthcare service (General Medical Service, GMS), Ferrando reported an increase in potentially substituted products.[16] Associated with the policy eliminating acetaminophen, propoxyphene, triprolidine and aluminum hydroxide, these authors noted an increase in mefenamic acid, carbocysteine, and H2-receptor blockers in GMS prescriptions and in Ireland national drug utilization. In addition to the limited evidence for use of these agents as appropriate substitute medications, the investigation was based

on summary data from GMS annual reports, included no statistical analysis, and included no comparison group. Furthermore, Ferrando's investigation included both prescription-only and OTC products. Thus, these significant limitations make meaningful comparisons with our investigation difficult.

Examining the effects of eliminating propoxyphene napsylate from the formulary of reimbursable medications in the Wisconsin Medicaid program, Kreling[13] et al reported the apparent substitution of propoxyphene hydrochloride (the intended effect) as well as more expensive non-steroidal anti-inflammatory drugs (unintended). Although the overall program expenditures decreased after the policy's implementation, after adjusting for drug price and reimbursement policy changes, the overall program expenditures for the analgesic preparations studied increased. The design of the study (pre-post comparison of 3-month time periods one year apart without a comparison group) and the assumptions inherent in the cost adjustments limit the confidence in these findings somewhat, but these results are widely referenced as evidence for significant substitution. In contrast to the products eliminated in Oregon Medicaid, propoxyphene is a prescription only medication; purchasing it without a physician's prescription is not an option, and paying for the continued prescription might present a substantial financial barrier to patients on Medicaid. Furthermore, propoxyphene is frequently prescribed chronically and regularly which may increase the pressure on a physician to provide a substitute agent when the prescribed drug is no longer available.

Using a time-series analysis, Soumerai[15] reported the strongest evidence available for significant substitution resulting in increased expenditures. Analyzing 42 months of pharmacy claims in the New Jersey Medicaid program, Soumerai reported a significant increase in net prescribing costs associated with the elimination of 12 categories of questionably effective medications. Although these medications accounted for 7% of Medicaid prescribing prior to the policy change, the authors noted a non-significant increase in total program expenditures after its implementation. By examining selected subgroups of patients receiving the eliminated medications, the authors suggested that substitution of more expensive medications may account for the increase in program expenditures. Of note, Soumerai et al examined the elimination of prescription medications in the following categories: vasodilators, combination bronchodilator/sedatives, combination GI antispasmodics/sedatives, combination analgesic/sedatives, steroid or antibiotic creams, antiemetics, and psychoactive agents. In contrast to our investigation, these medications were available only with a physician's prescription, and many are chronically prescribed agents. Similar to Krelig's study, the elimination of regularly prescribed, prescription-only medications may impact prescribing quite differently from the elimination of OTC drugs prescribed on an intermittent basis, even if the prescription-only medications were considered by some to be ineffective. In addition, while our investigation focused on prescribing within broad therapeutic categories, Soumerai examined a pre-selected set of potential therapeutic substitutes for each eliminated category, increasing the sensitivity for detecting

substitution. In short, Soumerai's investigation is methodologically sound and presents evidence that substitution occurs which can reduce or eliminate potential savings of administrative policies. Such policies, however, probably have variable impact on prescribing based on availability of therapeutic alternatives, patients' access to alternative medications, and the perceived need for the prescribed therapy by physicians and patients.

LIMITATIONS AND FUTURE DIRECTIONS

Generalizability. Because this study includes only Medicaid patients, its results may not be generalizable beyond other similar low-income populations. However, financial barriers to drug utilization are likely to have their greatest impact on low-income patients, and these results may be applicable to other Medicaid and pre-paid health care programs.

Claims data. The pharmacy claims data do not necessarily represent prescribing practices, but rather dispensing practices. Prescriptions which are written but never dispensed or prescriptions purchased with cash are not included in the claims database. Claims data are intended for administrative use rather than for research investigations, and these limitations must be recognized.

Functional and clinical outcomes. This investigation does not assess the potential secondary effects of the OTC elimination policy on the hospitalization and outpatient visit rates of the population. Furthermore, this investigation does not assess the potential effects of the elimination of OTC products on the patients' functional or clinical outcomes. Such a study would require extensive resources to survey patients or review medical records. Further study is needed to examine these potential secondary effects.

Expected lag-time after policy implementation. After any such policy is implemented, a lag in measurable effect is possible. Theoretically, Oregon prescribers may demonstrate

a delayed response to the change in policy or patients may stockpile OTC medications before the policy goes into effect, delaying their need for alternative therapy. In this investigation, however, the impact on prescribing appeared to be immediate and lasting. Therefore our models were designed to identify an intervention effect of this type. If the impact on some therapeutic categories was delayed or more gradual, more complicated models might be more sensitive in detecting the intervention's effect.

Population at risk. While this investigation focused on the overall program costs and considered all Medicaid eligibles to be potentially at risk for the policy's impact, those patients who regularly receive OTC medications are most likely to be affected. That is, the subset of patients regularly managed using OTC medications may be impacted differently than the overall Medicaid population. From the perspective of program costs, the broad approach of this investigation is appropriate, but a more focused evaluation of the impact on those patients at greatest risk of impact merits further study to fully understand such a policy's effects before application of these results to other programs.

Analysis of Therapeutic Categories. This investigation does not analyze in detail the prescribing within each therapeutic category studied. Within each therapeutic class in which no significant impact was noted, there may have been significant substitution of prescription-only medications in a small proportion of the overall prescribing which was not detected. From the perspective of program costs, this may hold less importance than from an individual patient's perspective. In short, this investigation highlights potential

categories of prescribing which merit more in depth study to fully appreciate the impact on prescribing behaviors.

Potential Confounders. In a population-based natural experiment such as this investigation, controlling for all significant confounders is difficult. As demonstrated within the class of hematinics, changes in classification of medications may have significant impact on the study results. According to publishers of the dataset used for this classification, no other significant changes in therapeutic classification into or out of the nine therapeutic categories studied occurred during the study period.[20] In addition, new drugs which became available during the study period could impact prescribing practices and the cost of medication treatment. However, newer prescription medications tend to be more expensive, and would therefore minimize the cost savings noted in this investigation. Thus, controlling for the introduction of new medications would tend to increase a reduction in post-intervention medication costs. Finally, if medications were switched from prescription-only to OTC status during the study period, prescription-only prescribing would be reduced. Within the selected therapeutic categories, only three products were switched from prescription-only to OTC status during the study period according to the Nonprescription Drug Manufacturers Association: clemastine fumarate (tradename Tavist-T) was changed August, 1992; clemastine fumarate in combination with phenylpropanolamine (tradename Tavist-D)) was changed August, 1992; and dexchlorpheniramine maleate was changed December, 1992.[21] While elimination of these prescription medications may have reduced

prescription-only claims, because these changes were implemented 9 to 12 months before the OTC elimination policy, the effect would be seen primarily in the pre-policy period and would be unlikely to produce a confounding effect. Furthermore, the OTC preparations of these products accounted for very little prescribing (total of $75 over the pre-policy period), suggesting that substitution of prescription-only alternatives would be extremely limited.

Time-series analysis. The time-series approach is best suited for interventions which have an immediate and lasting effect. As noted above, an intervention with a significant lag-time between implementation and measurable effect or with a gradual impact can be more difficult to detect. Ideally, 12 or more months of post-policy data would be available to enhance the analysis and allow for the assessment of seasonal effects. However, under the current data constraints and given the immediate effect in some therapeutic categories, six months should provide sufficient data to assess the policy's impact using an interrupted time-series.

CONCLUSIONS

On the whole, the OTC elimination policy appears to have reduced total Medicaid prescribing costs in five out of nine therapeutic categories examined, and no significant change was noted in the other four categories. Although the impact on the subgroup of patients who routinely received OTC therapy and potential secondary effects on outpatient visits, hospitalizations, or clinical outcomes were not assessed, these preliminary results suggest that the OTC elimination policy successfully reduced the program's medication costs with prescribing in the nine selected therapeutic classes (decreasing from $7.86 to $7.39 per eligible per month).

With the exception of hematinics, no evidence for significant substitution of prescription-only medications was noted. In the hematinics category, a significant increase in prescription-only prescribing was associated with the implementation of the OTC elimination policy, but the impact on total costs for this therapeutic category still resulted in a net decrease in medication expenditures. This differential impact on hematinics versus other therapeutic categories may suggest that physicians are most likely to substitute prescription-only drugs in cases where patients are *regularly* treated with less discretionary medications. These findings have implications important to any programs considering such administrative, cost-saving policies.

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TABLES

Table 1. Therapeutic classes selected for study which include OTC and prescription-only prescribing.

TClass Code	Therapeutic Class Description
1	Anti-Ulcer and GI Preps
3	Anti-Diarrheals
6	Laxatives
14	Antihistamines
16	Antitussives-Expectorants
17	Cough and Cold Preps
82	Multivitamins
88	Hematinics
94	Fungicides

Table 2. Demographic data for the total Oregon Medicaid population during the study period.

	Total Medicaid Population	
	Pre	Post
Mean Eligibles/Month	243,234	264,319
Mean Age (yrs)	22.90	22.83
% Female	60.9%	60.1%
Program Coverage		
General Assistance	0.9%	0.9%
Aid to Dependent Children	57.3%	53.5%
Medically Needy	2.2%	1.9%
Old Age Assistance	8.9%	8.6%
Blind and Disability	12.9%	13.3%
Poverty Level Medical	16.4%	17.7%
Oregon Health Plan	0.0%	2.5%
Other	1.5%	1.5%

Table 3. Total claims and paid claims for adults in Oregon Medicaid during the pre-intervention period.

Therapeutic Categories	Sum Paid OTC	Sum Paid Prescription-Only	Claims OTC	Claims Prescription-Only	% Paid OTC	% Claims OTC
Anti-Ulcer and GI Preps	$ 225,459	$ 8,324,616	27,830	129,812	2.6%	17.7%
Anti-Diarrheals	$ 30,429	$191,993	3,160	14,939	13.7%	17.5%
Laxatives	$ 407,563	$167,988	57,155	5,390	70.8%	91.4%
Antihistamines	$ 15,157	$ 1,433,627	2,395	68,534	1.0%	3.4%
Antitussives-Expectorants	$ 85,951	$417,287	13,675	33,982	17.1%	28.7%
Cough and Cold Preps	$ 25,818	$ 247,657	4,263	24,755	9.4%	14.7%
Multivitamins	$ 291,122	$ 275,146	62,342	23,580	51.4%	72.6%
Hematinics	$ 188,346	$ 128,061	36,379	7,930	59.5%	82.1%
Fungicides	$ 92,715	$ 2,034,728	6,317	70,234	4.4%	8.3%
Total	**$ 1,362,560**	**$ 13,221,103**	**213,516**	**379,156**	**9.3%**	**36.0%**

Table 4. Total prescribing pre- and post-implementation of the OTC elimination policy

	Prescription-Only		OTC		Total	
	Pre	Post	Pre	Post	Pre	Post
All Claims in Selected Therapeutic Categories						
Total Paid	$ 13,221,103	$ 4,937,287	$ 1,362,560	$ 492	$ 14,583,663	$ 4,937,778
Total Claims	379,156	132,248	213,516	75	592,672	132,323
Paid/Eligible/Month	$ 7.13	$ 7.56	$ 0.73	$ 0.00	$ 7.86	$ 7.56
Claims/Eligible/Month	0.204	0.203	0.115	0.000	0.320	0.203
All Claims Except Erythropoietin Products						
Total Paid	$ 13,206,345	$ 4,821,368	$ 1,362,560	$ 492	$ 14,568,905	$ 4,821,859
Total Claims	379,116	131,971	213,516	75	592,632	132,046
Paid/Eligible/Month	$ 7.12	$ 7.39	$ 0.73	$ 0.00	$ 7.86	$ 7.39
Claims/Eligible/Month	0.204	0.202	0.115	0.000	0.320	0.202

Table 5. Time-series analyses* - Mean $ paid per 1000 adult eligibles per week.

TClass	Prescription-Only					Total Prescribing				
	AR	I	MA	Post	Sig	AR	I	MA	Post	Sig
Anti-Ulcer and GI Preps	3	1	0	9.066	0.822	3	1	0	-13.913	0.732
Anti-Diarrheals	0	1	1	-1.9	0.002	0	1	1	-5.610	**< 0.001**
Laxatives	1	1	1	0.1	0.928	4	1	0	-44.9	**< 0.001**
Antihistamines	0	1	1	6.086	0.752	0	1	1	4.123	0.832
Antitussives-Expectorants	1	1	0	1.620	0.810	1	1	0	-2.7	0.716
Cough and Cold Preps	4	1	0	-0.6	0.890	4	1	0	-2.0	0.676
Multivitamins	0	1	2	-0.076	0.953	3	1	0	-26.8	**< 0.001**
Hematinics	0	1	1	48	**< 0.001**	0	1	1	25.4	**< 0.001**
Fungicides	0	1	1	-6.204	0.201	0	1	1	-17.349	**0.001**

* For each of the following components of ARIMA time-series analysis, the order of each of the model's underlying ARIMA processes is given: AR = Autoregression, I = Integration, MA = Moving Average.

Table 6. Time-series analyses* - Mean claims per 1000 adult eligibles per week.

TClass	Prescription Only					Total Prescribing				
	AR	I	MA	Post	Sig	AR	I	MA	Post	Sig
Anti-Ulcer and GI Preps	2	1	1	-0.254	0.456	4	1	0	-2.997	**< 0.001**
Anti-Diarrheals	0	1	1	-0.087	0.024	0	1	1	-0.472	**< 0.001**
Laxatives	0	1	1	-0.028	0.524	4	1	0	-6.243	**< 0.001**
Antihistamines	0	1	1	-0.215	0.730	0	1	1	-0.549	0.392
Antitussives-Expectorants	0	1	1	0.237	0.686	0	1	1	-0.441	0.532
Cough and Cold Preps	4	1	0	0.009	0.984	4	1	0	-0.158	0.742
Multivitamins	0	1	1	0.088	0.123	4	1	0	-6.215	**< 0.001**
Hematinics	0	1	1	0.405	0.041	4	1	0	-3.470	**< 0.001**
Fungicides	0	1	1	-0.483	0.030	0	1	1	-1.321	**< 0.001**

* For each of the following components of ARIMA time-series analysis, the order of each of the model's underlying ARIMA processes is given: AR = Autoregression, I = Integration, MA = Moving Average.

Table 7. Hematinics reanalyzed after exclusion of erythropoietin products.*

Model	AR	I	MA	Post	Sig
Prescription-only - Paid Claims	0	1	1	7.642	**0.001**
Total Prescribing - Paid Claims	3	1	0	-13.79	**<0.001**
Prescription-only - Number of Claims	0	1	1	0.38	0.053
Total Prescribing - Number of Claims	3	1	0	-3.70	**<0.001**

* For each of the following components of ARIMA time-series analysis, the order of each of the model's underlying ARIMA processes is given: AR = Autoregression, I = Integration, MA = Moving Average.

FIGURES

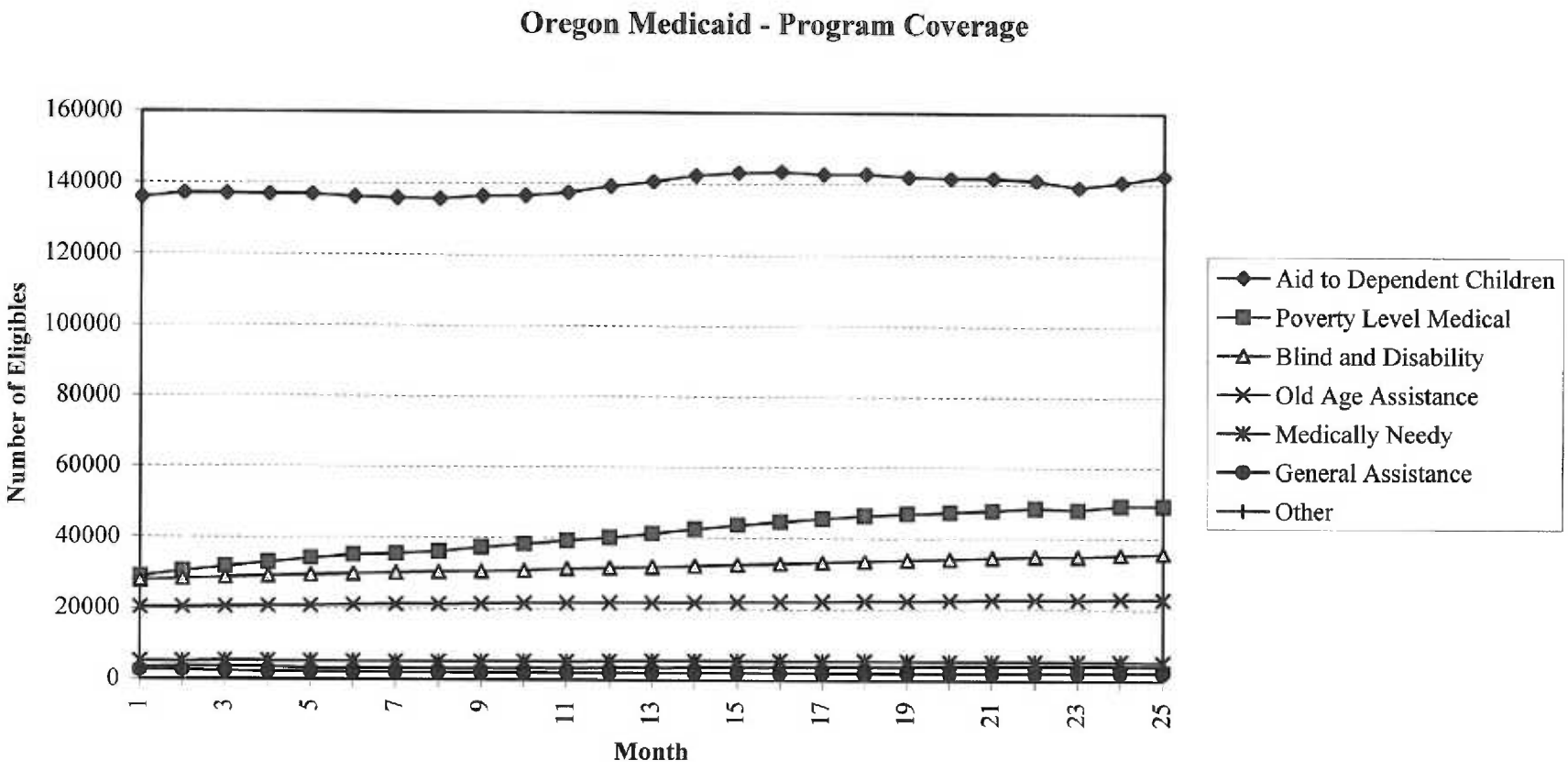

Figure 1. Demographics of OMAP eligibles during the 104-week study.

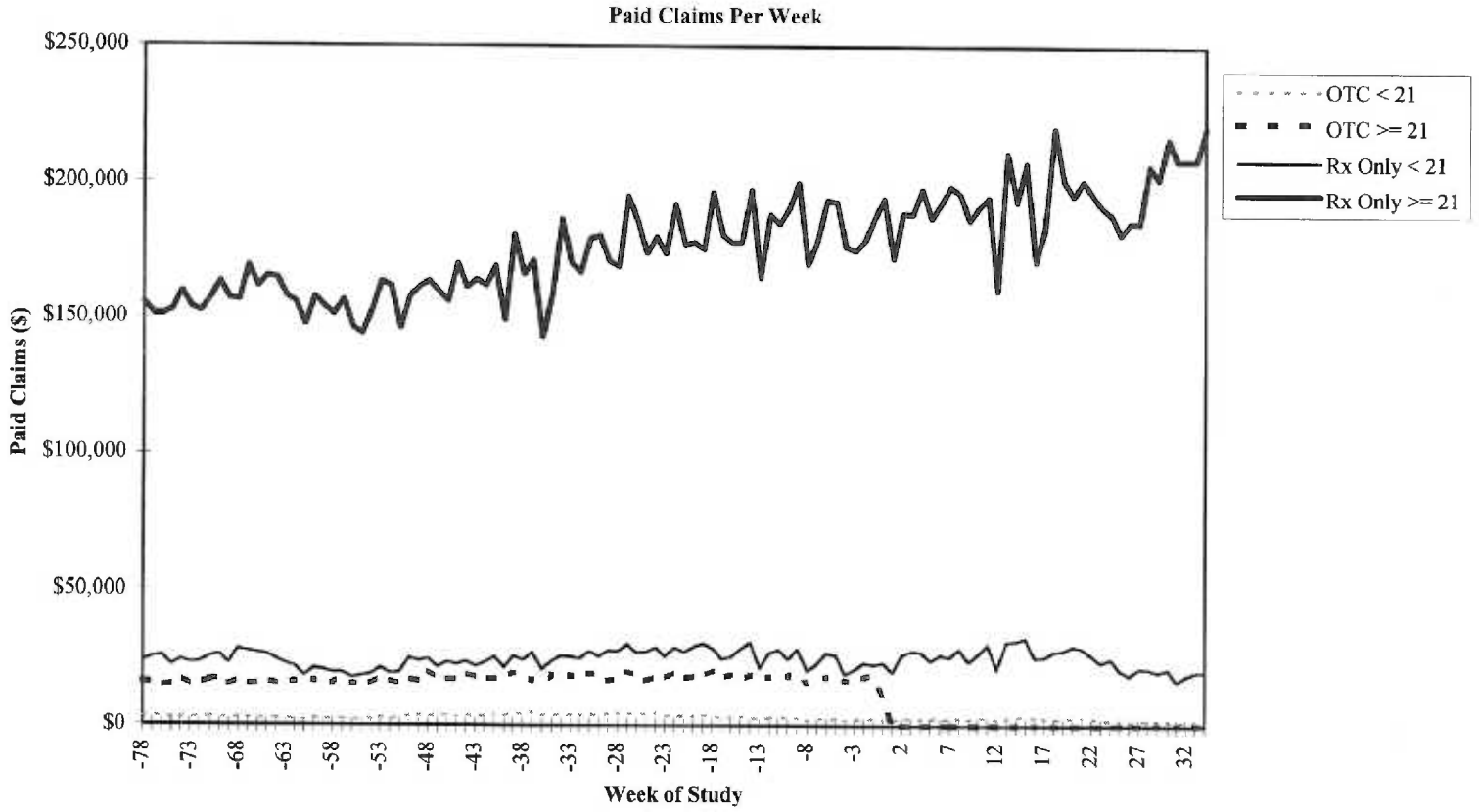

Figure 2. Paid claims ($) per week in the 9 selected therapeutic classes during the 104 week study period. (Policy implementation at Week 0)

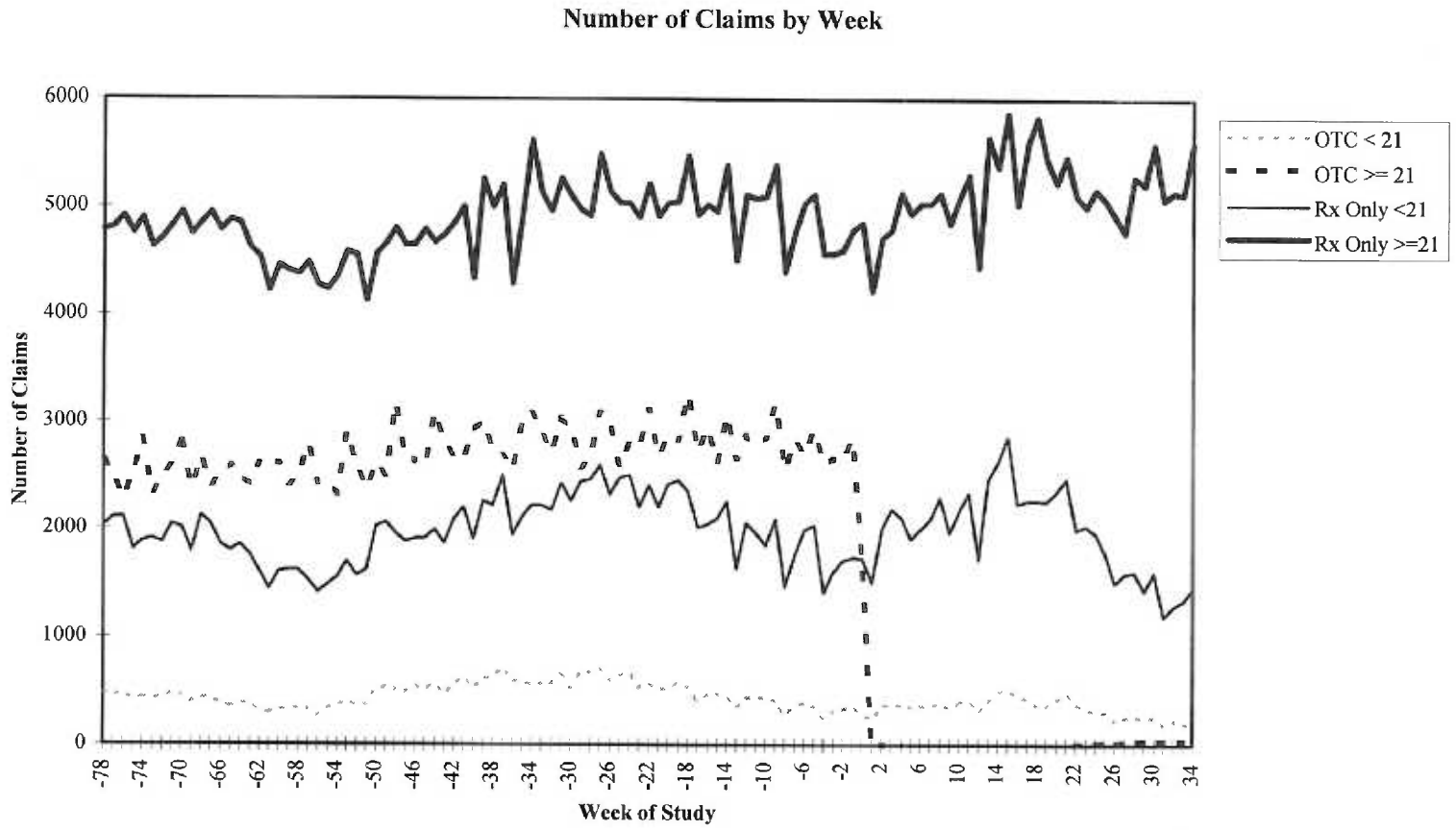

Figure 3. Number of submitted claims in the 9 selected therapeutic classes during the 104 week study period. (Policy implementation at Week 0)

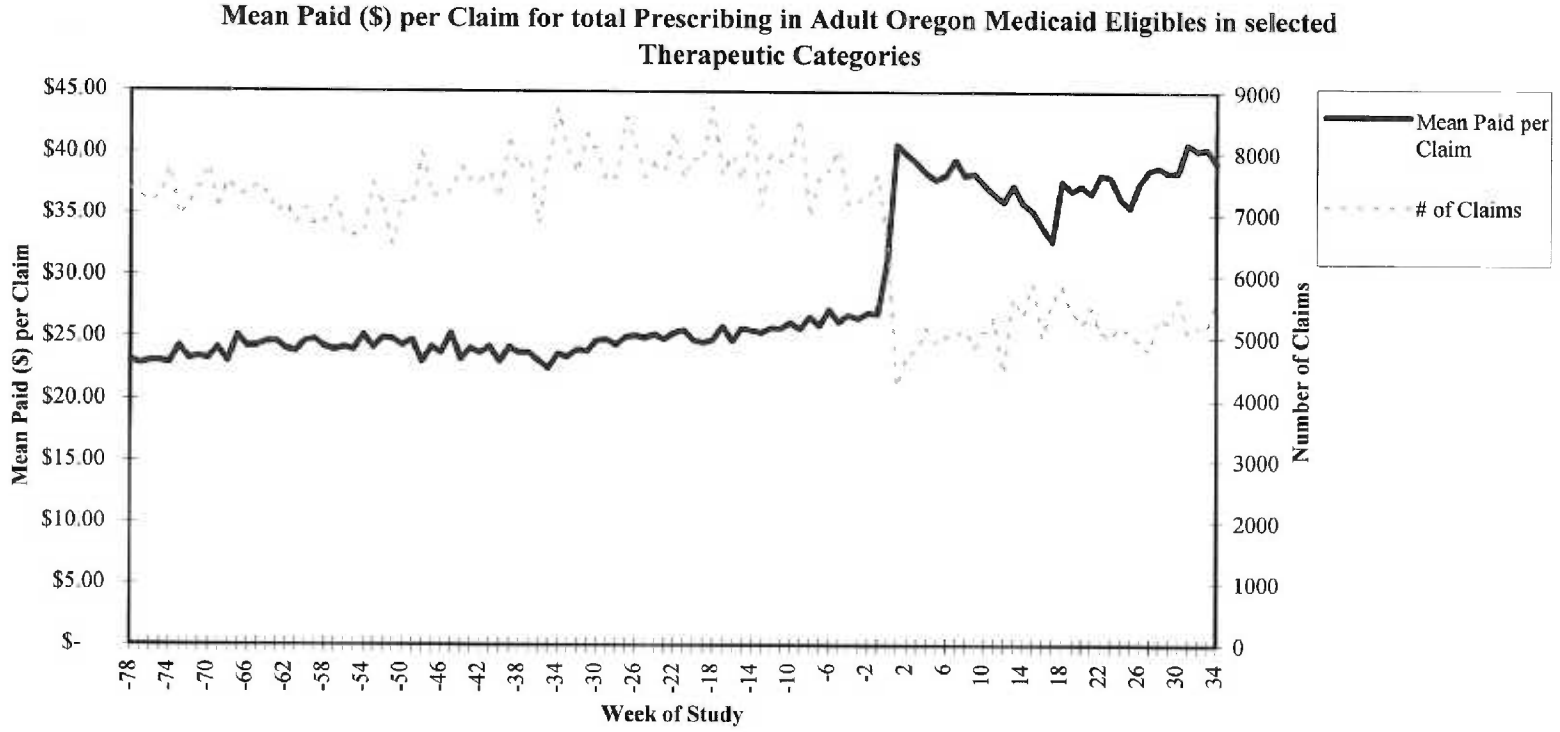

Figure 4. Cost per claim in the 9 selected therapeutic classes during the 104 week study period.

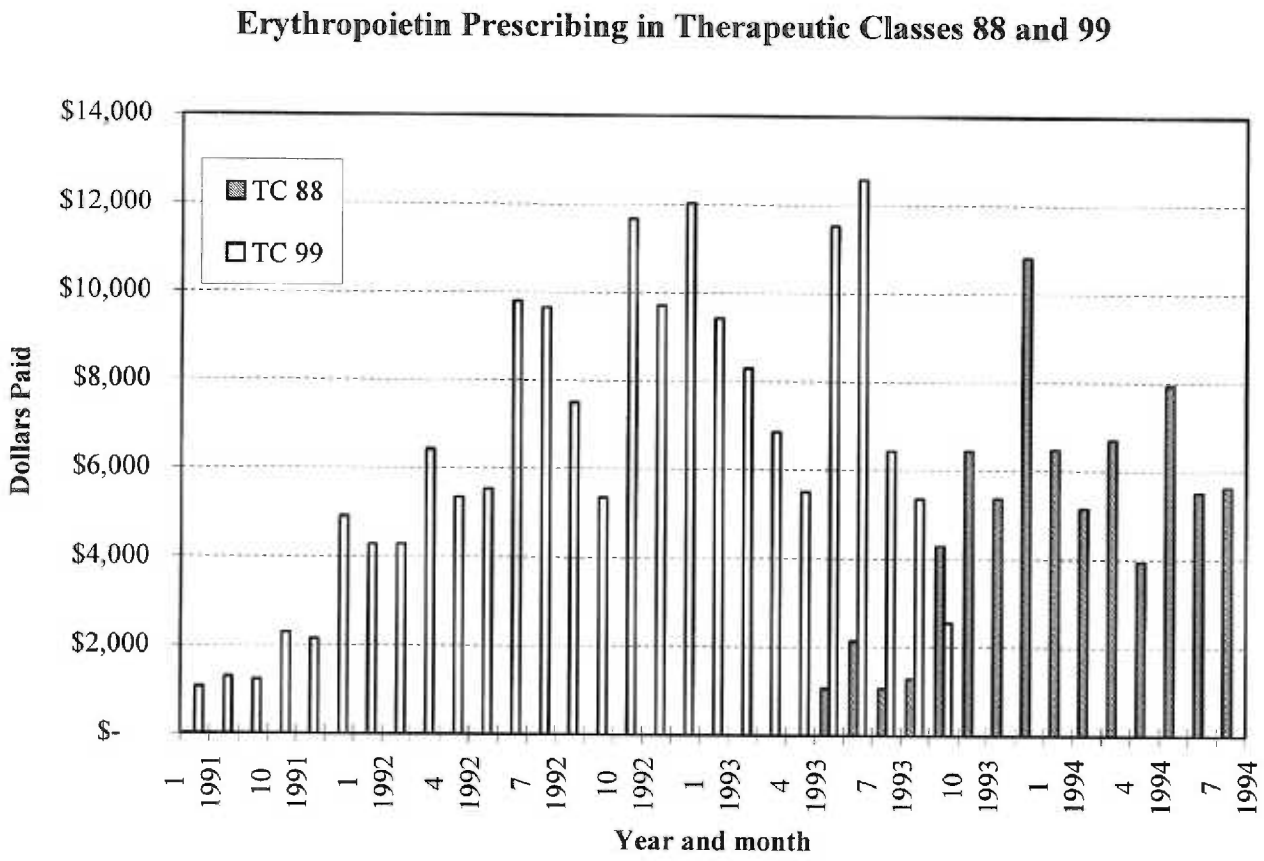

Figure 5. Erythropoietin prescribing - therapeutic classes 88 and 99.

APPENDIX A: TIME-SERIES GRAPHS: PRESCRIPTION-ONLY PRESCRIBING - MEAN PAID CLAIMS ($) PER 1000 ADULT MEDICAID ELIGIBLES

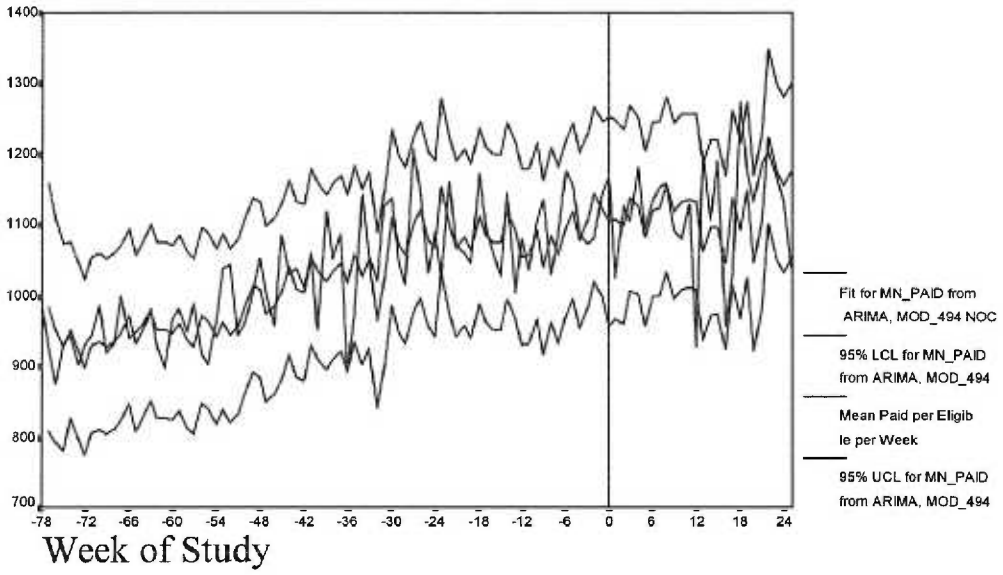

Figure 1. Therapeutic Class 1 - Anti-Ulcer and GI Preps.

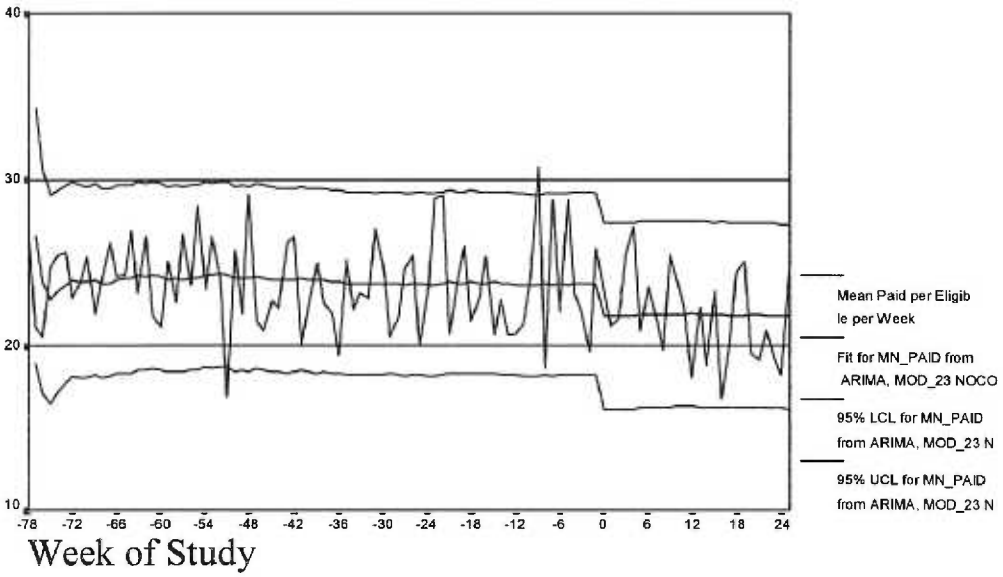

Figure 2. Therapeutic Class 3 - Anti-Diarrheals.

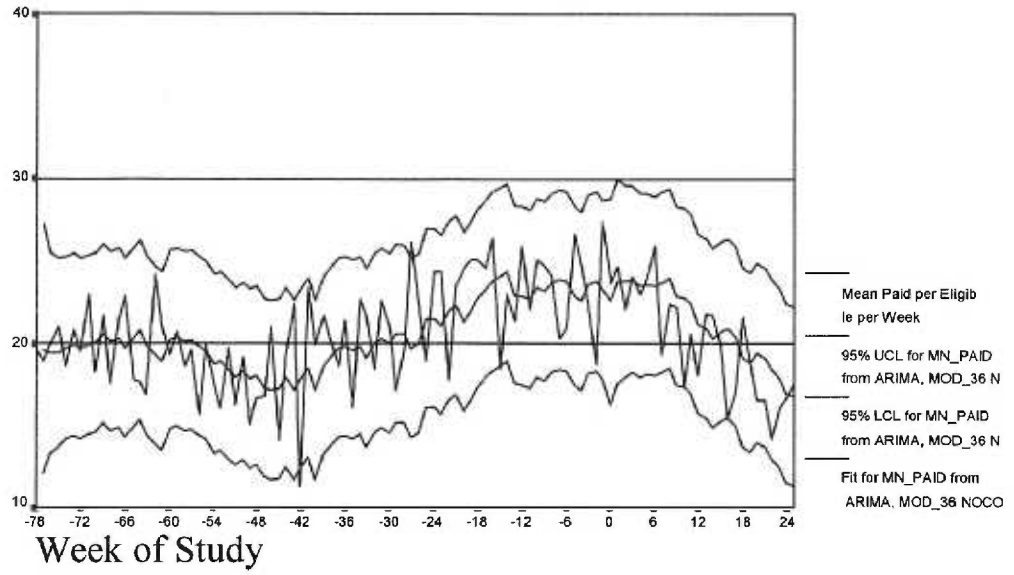

Figure 3. Therapeutic Class 6 - Laxatives.

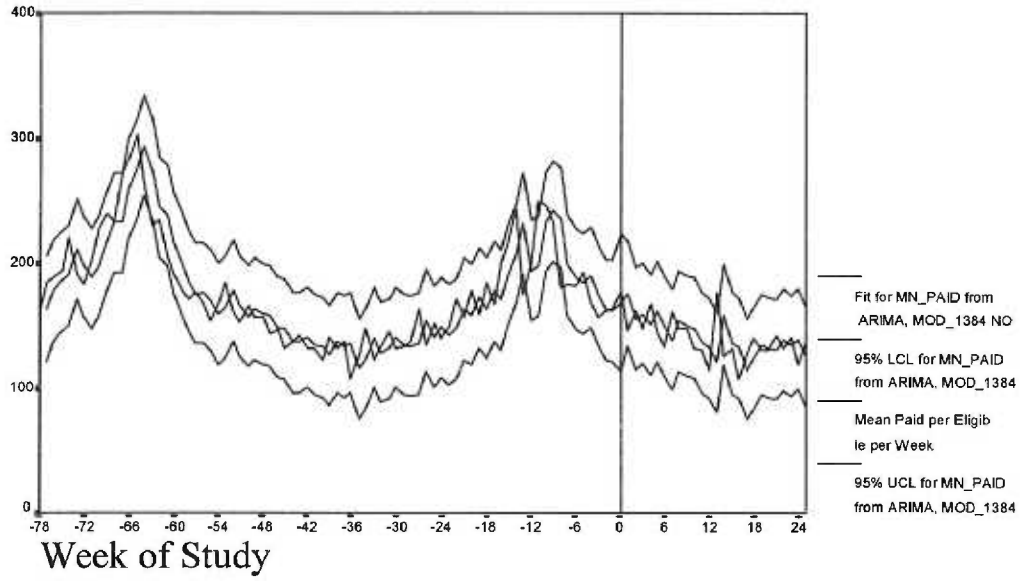

Figure 4. Therapeutic Class 14 - Antihistamines.

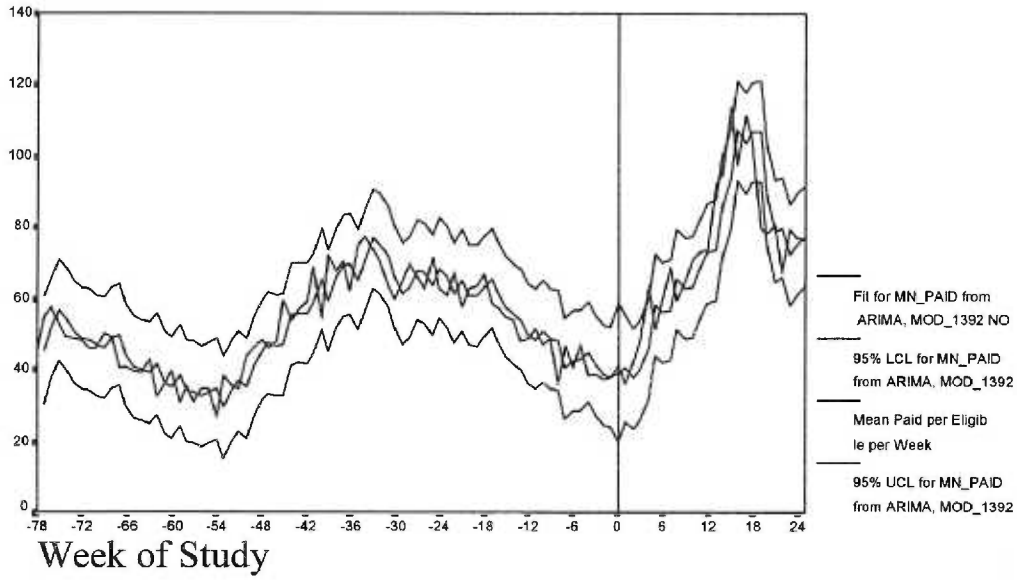

Figure 5. Therapeutic Class 16 - Antitussives-Expectorants.

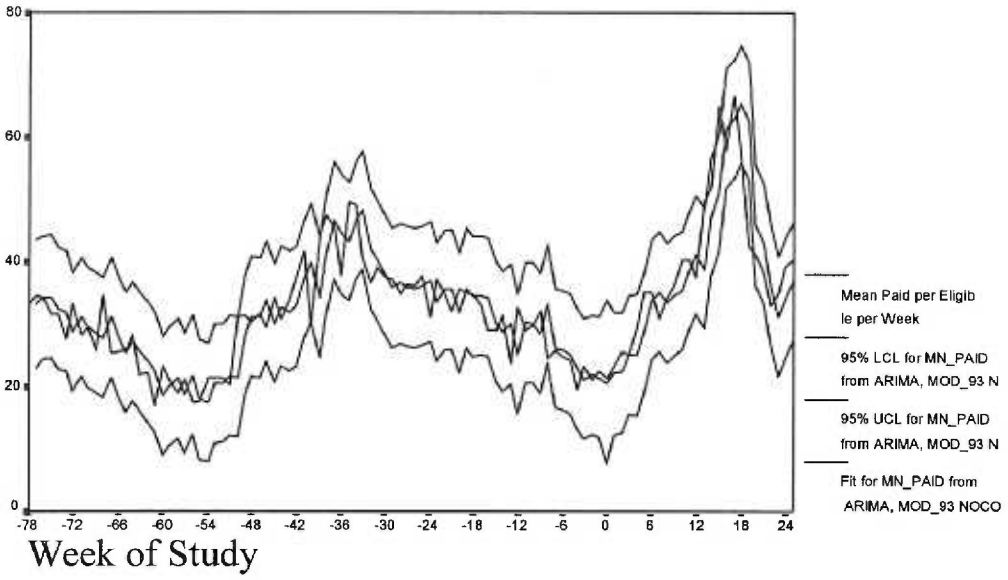

Figure 6. Therapeutic Class 17 - Cough and Cold Preps.

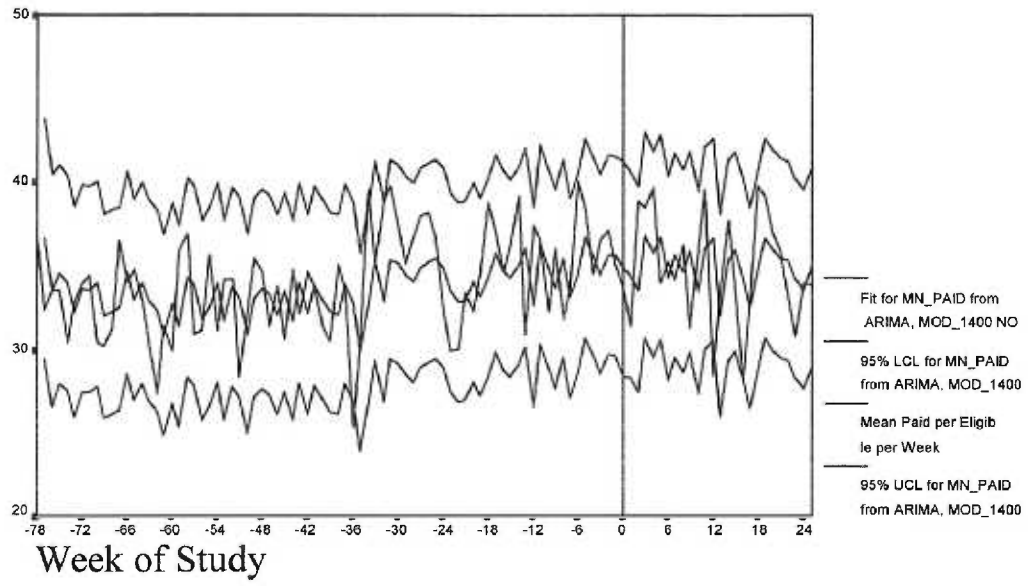

Figure 7. Therapeutic Class 82 - Multivitamins.

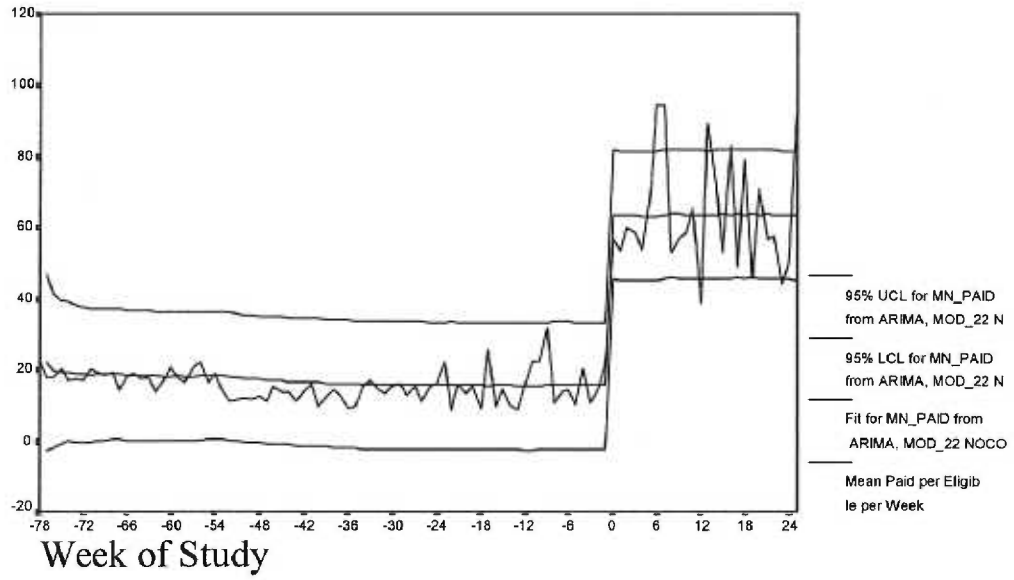

Figure 8. Therapeutic Class 88 - Hematinics. (Intervention effect significant*)

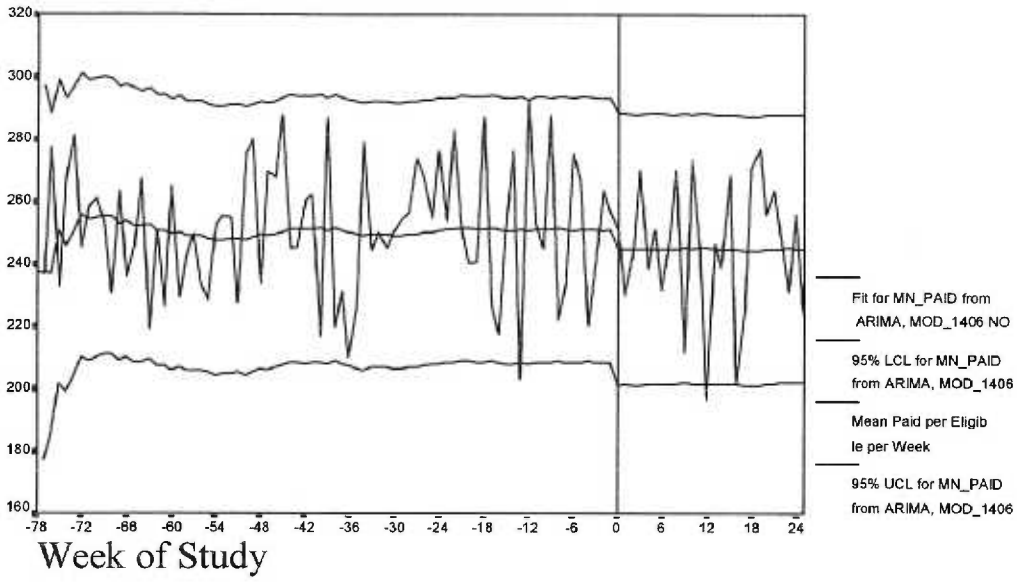

Figure 9. Therapeutic Class 94 - Fungicides.

APPENDIX B: TIME-SERIES GRAPHS: TOTAL PRESCRIBING -MEAN PAID CLAIMS ($) PER 1000 ADULT MEDICAID ELIGIBLES

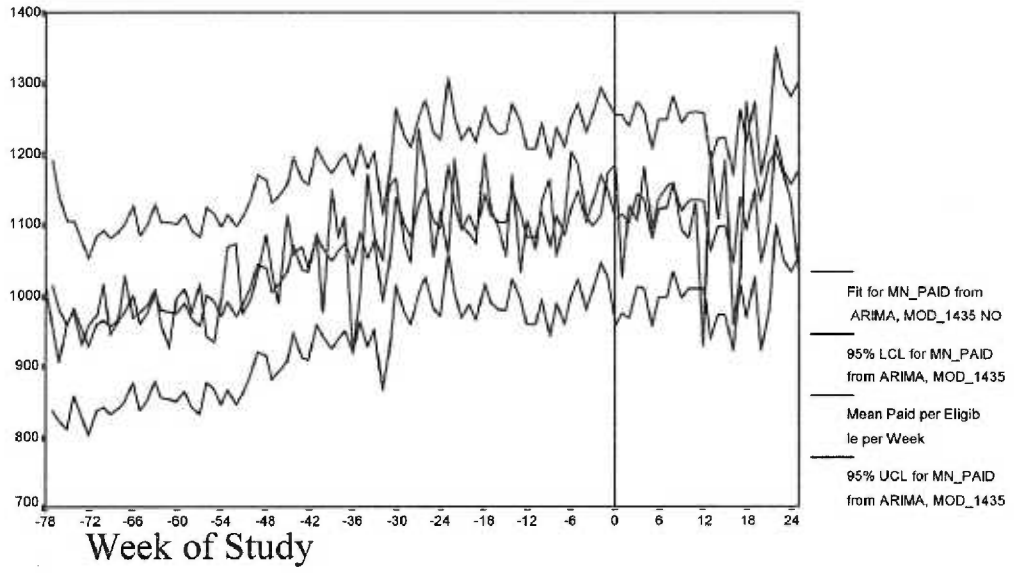

Figure 1. Therapeutic Class 1 - Anti-Ulcer and GI Preps.

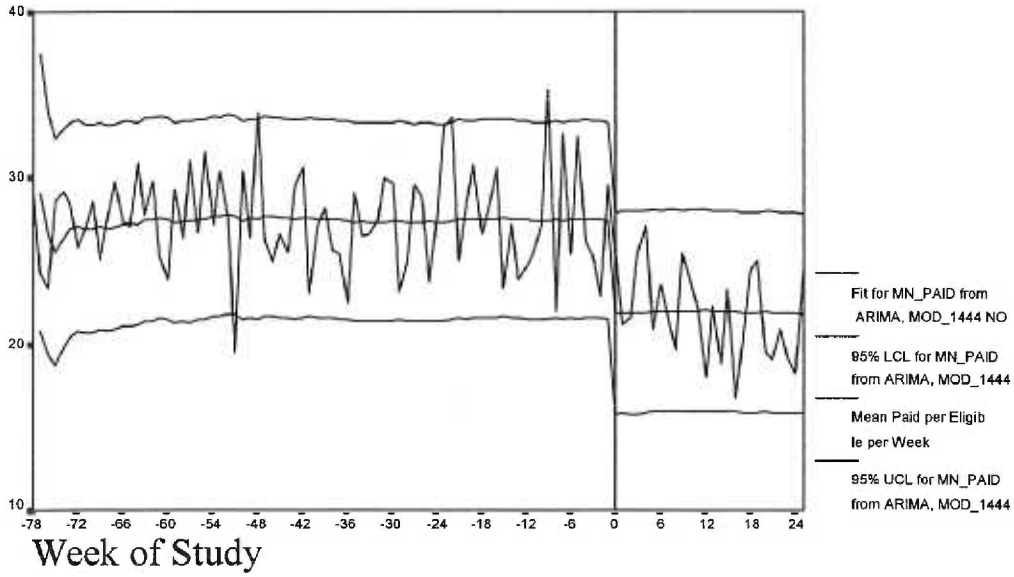

Figure 2. Therapeutic Class 3 - Anti-Diarrheals. (Intervention effect significant*)

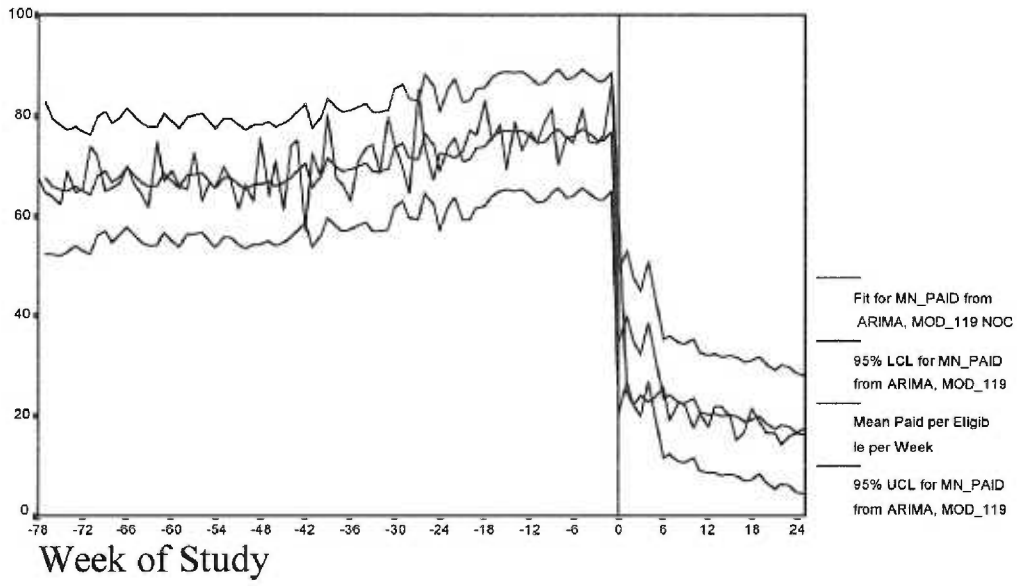

Figure 3. Therapeutic Class 6 - Laxatives. (Intervention effect significant*)

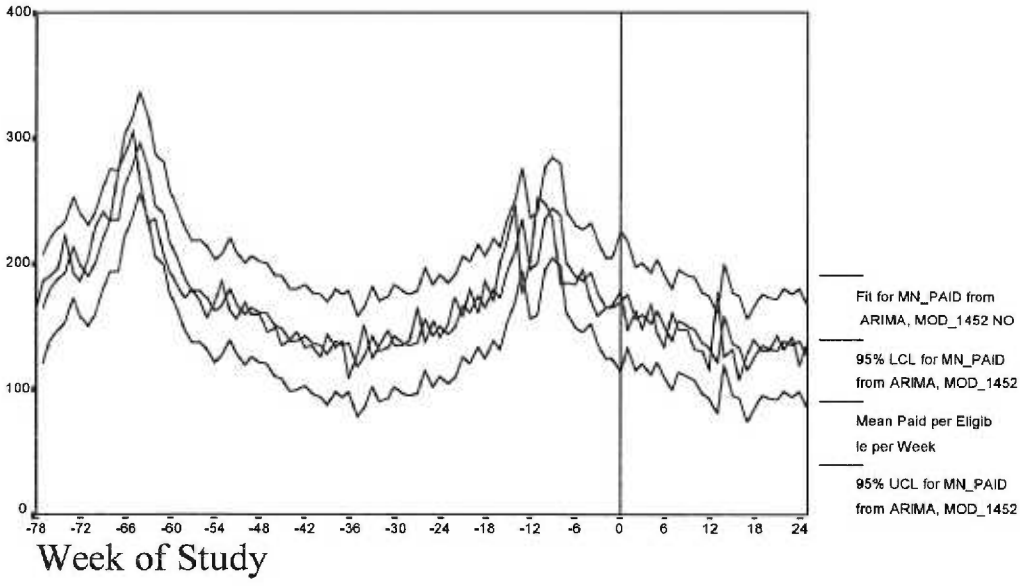

Figure 4. Therapeutic Class 14 - Antihistamines.

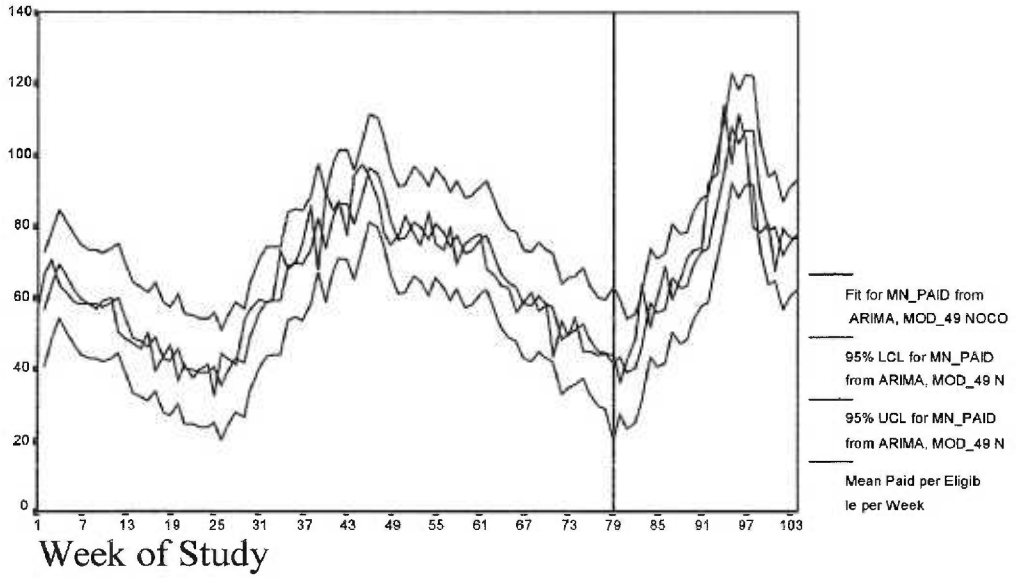

Figure 5. Therapeutic Class 16 - Antitussives-Expectorants.

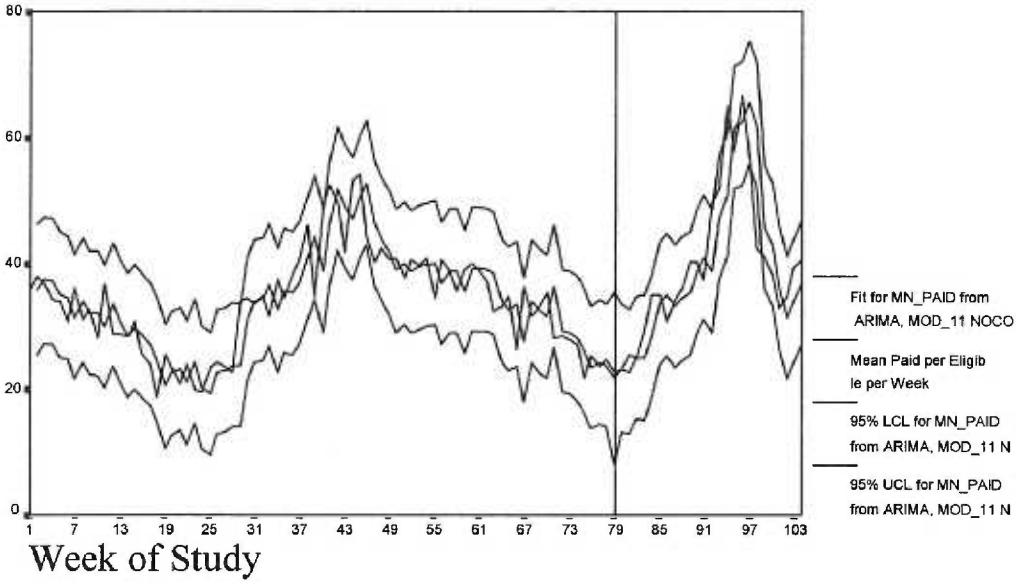

Figure 6. Therapeutic Class 17 - Cough and Cold Preps.

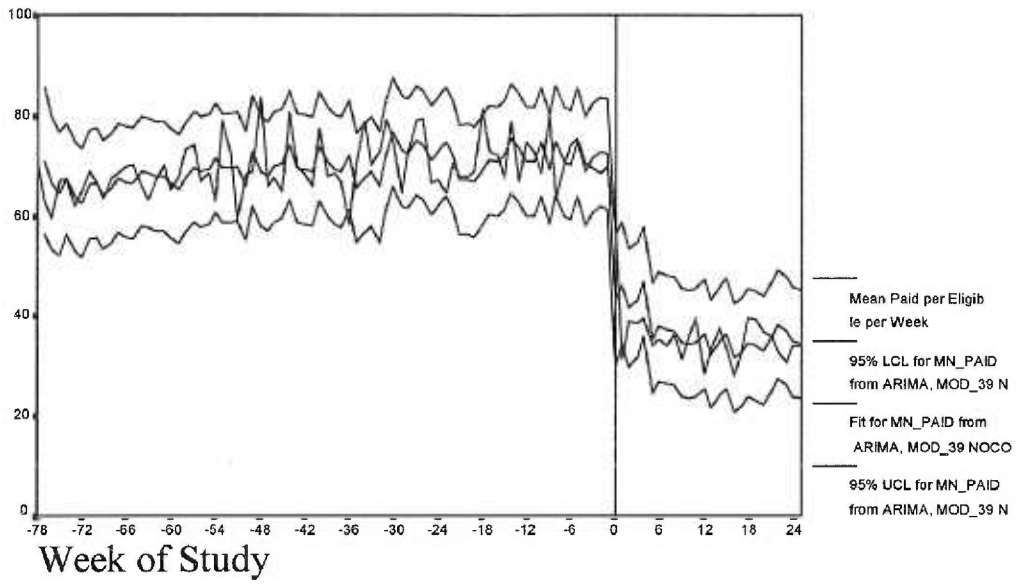

Figure 7. Therapeutic Class 82 - Multivitamins. (Intervention effect significant*)

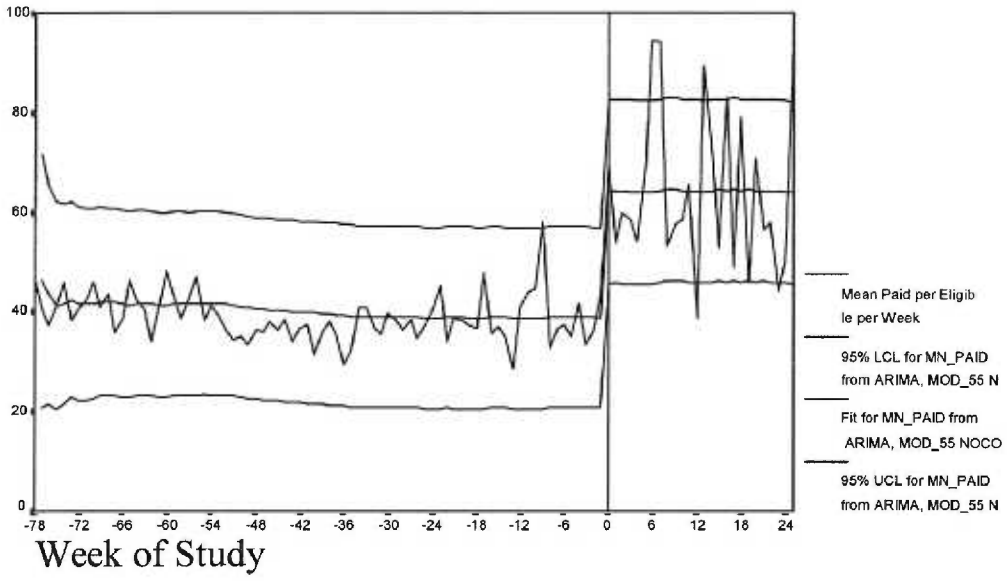

Figure 8. Therapeutic Class 88 - Hematinics. (Intervention effect significant*)

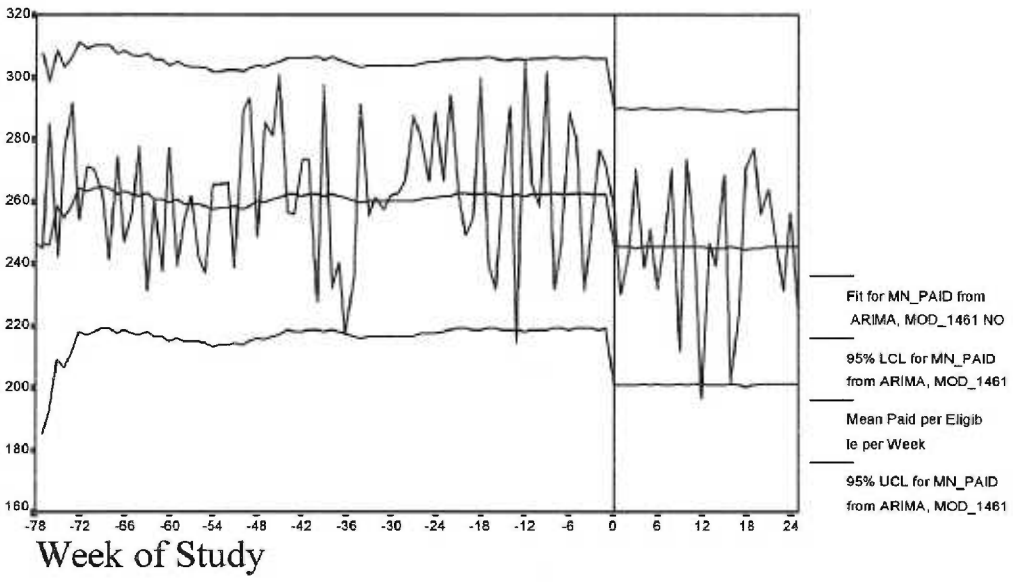

Figure 9. Therapeutic Class 94 - Fungicides. (Intervention effect significant*)

APPENDIX C: TIME-SERIES GRAPHS: PRESCRIPTION-ONLY PRESCRIBING - MEAN NUMBER OF CLAIMS PER 1000 ADULT MEDICAID ELIGIBLES

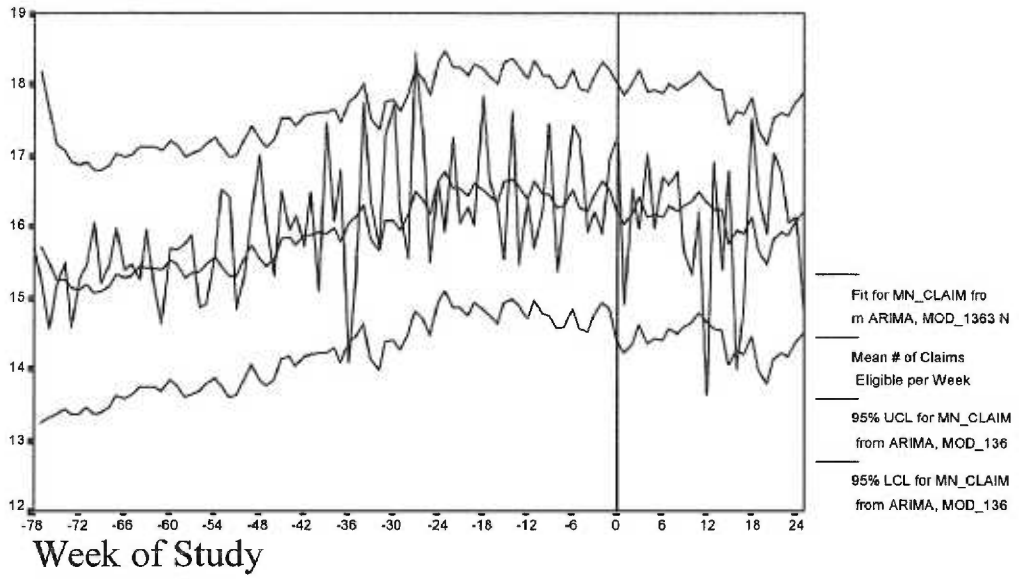

Figure 1. Therapeutic Class 1 - Anti-Ulcer and GI Preps.

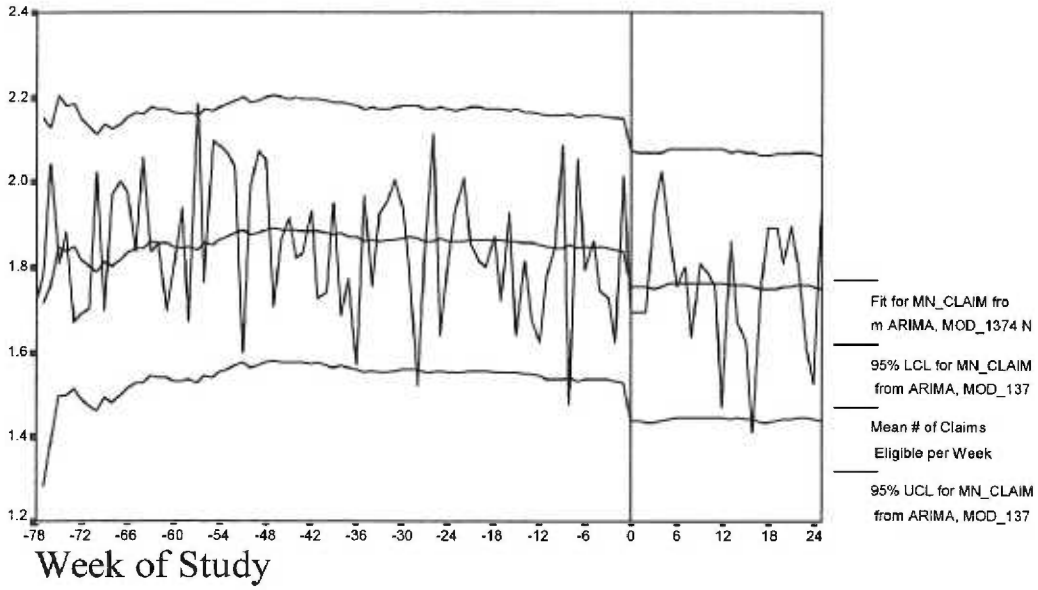

Figure 2. Therapeutic Class 3 - Anti-Diarrheals.

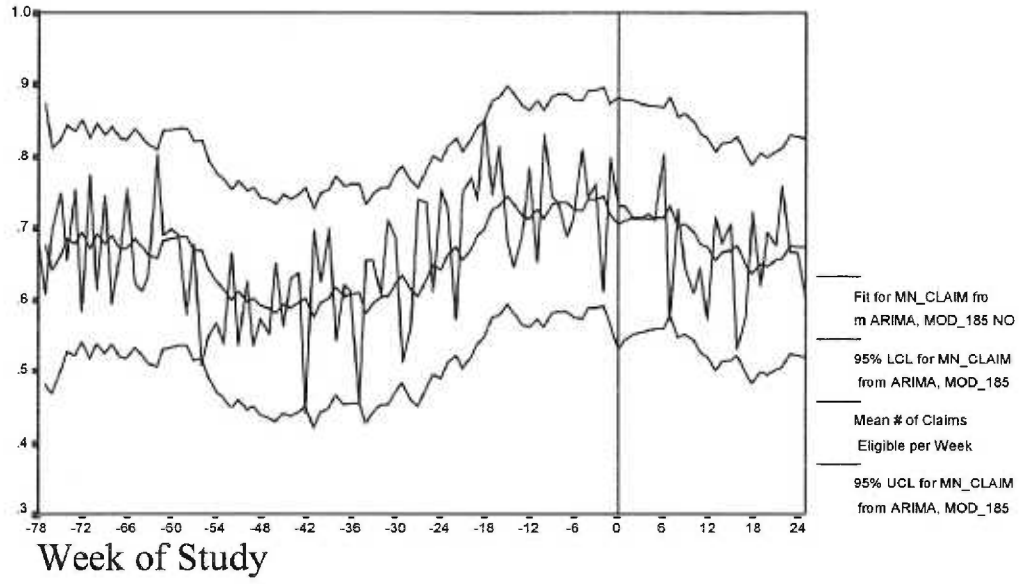

Figure 3. Therapeutic Class 6 - Laxatives.

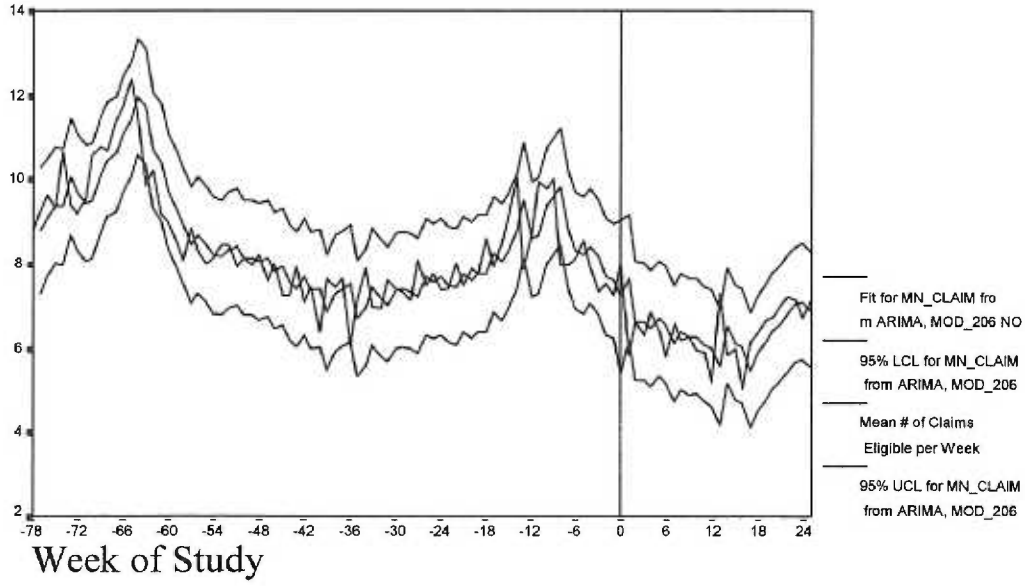

Figure 4. Therapeutic Class 14 - Antihistamines.

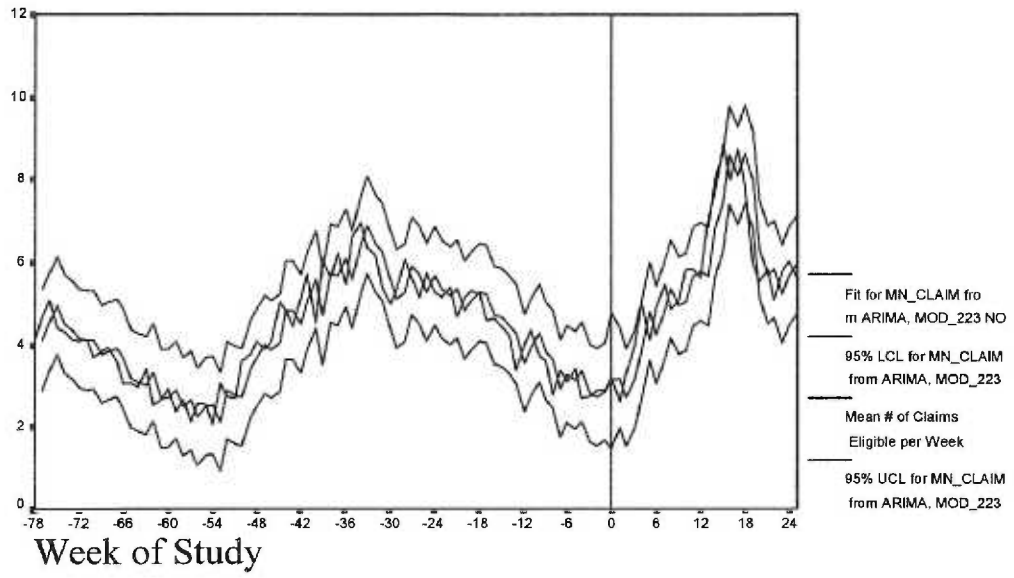

Figure 5. Therapeutic Class 16 - Antitussives-Expectorants.

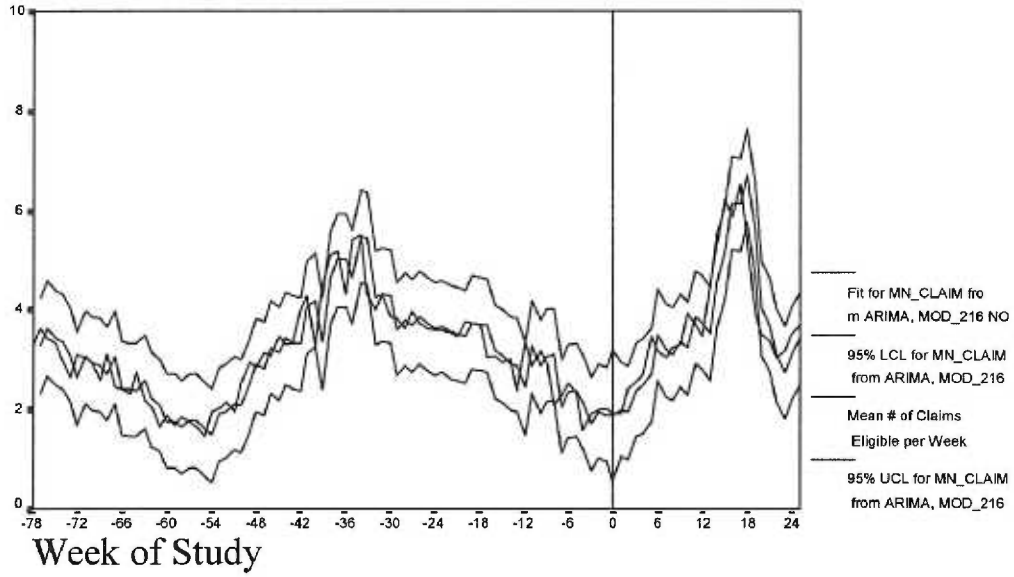

Figure 6. Therapeutic Class 17 - Cough and Cold Preps.

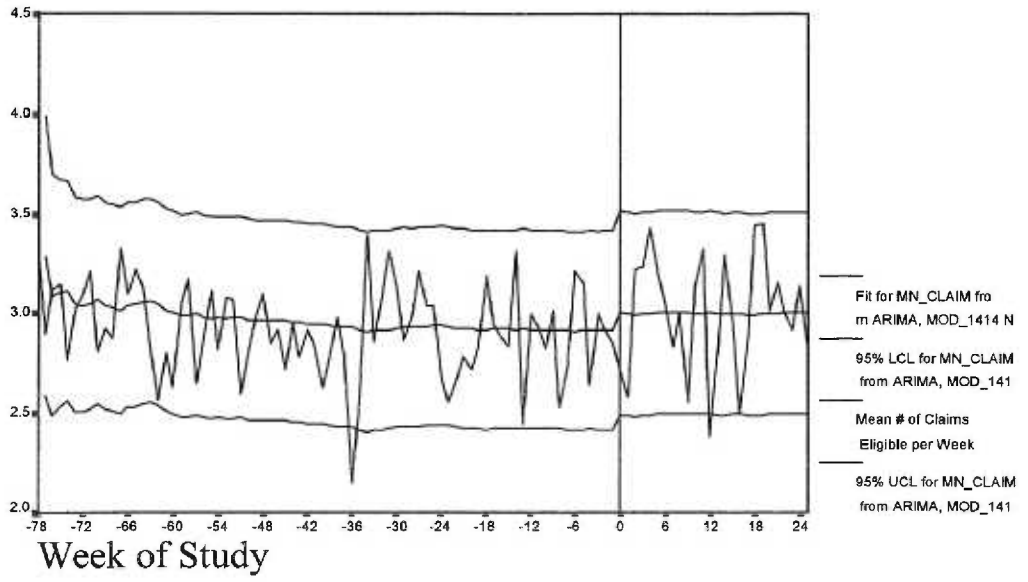

Figure 7. Therapeutic Class 82 - Multivitamins.

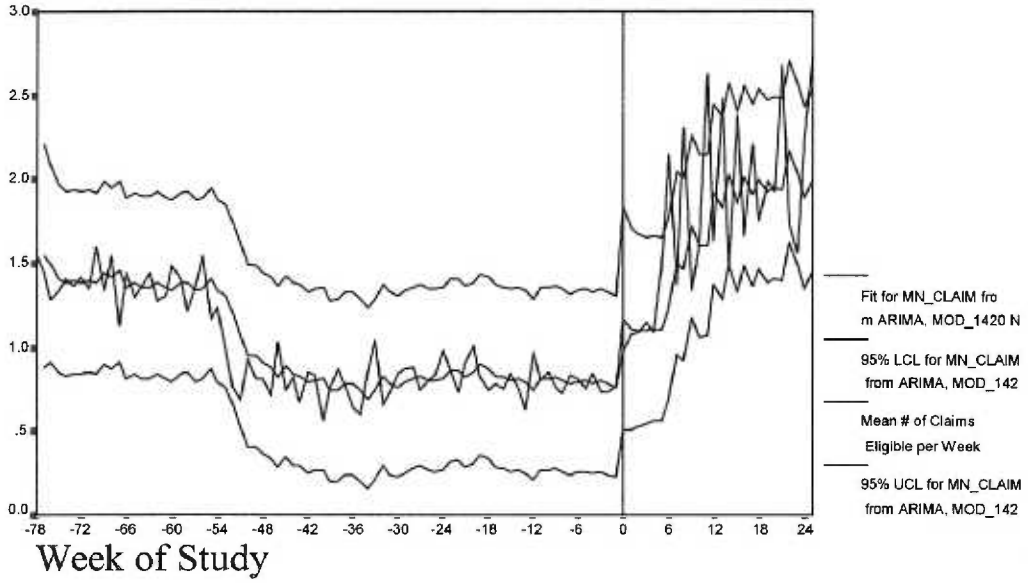

Figure 8. Therapeutic Class 88 - Hematinics.

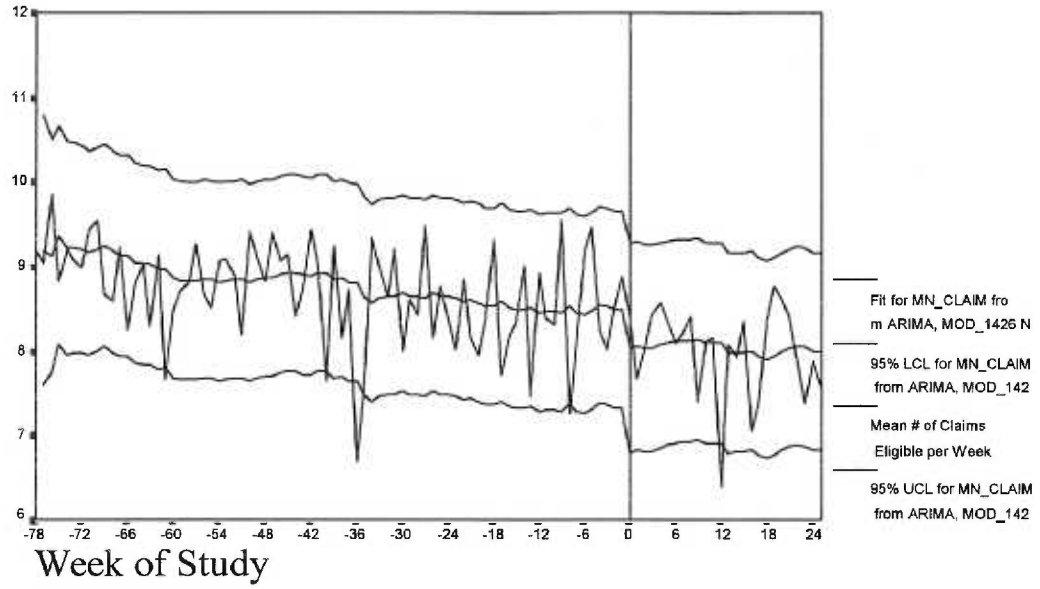

Figure 9. Therapeutic Class 94 - Fungicides.

APPENDIX D: TIME-SERIES GRAPHS: TOTAL PRESCRIBING - MEAN NUMBER OF CLAIMS PER 1000 ADULT MEDICAID ELIGIBLES

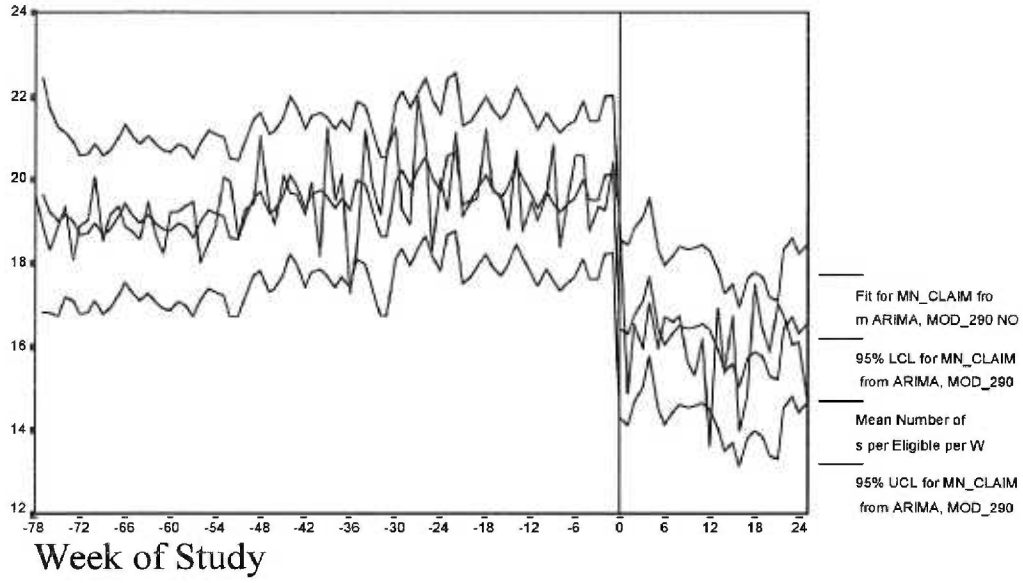

Figure 1. Therapeutic Class 1 - Anti-Ulcer and GI Preps. (Intervention effect significant*)

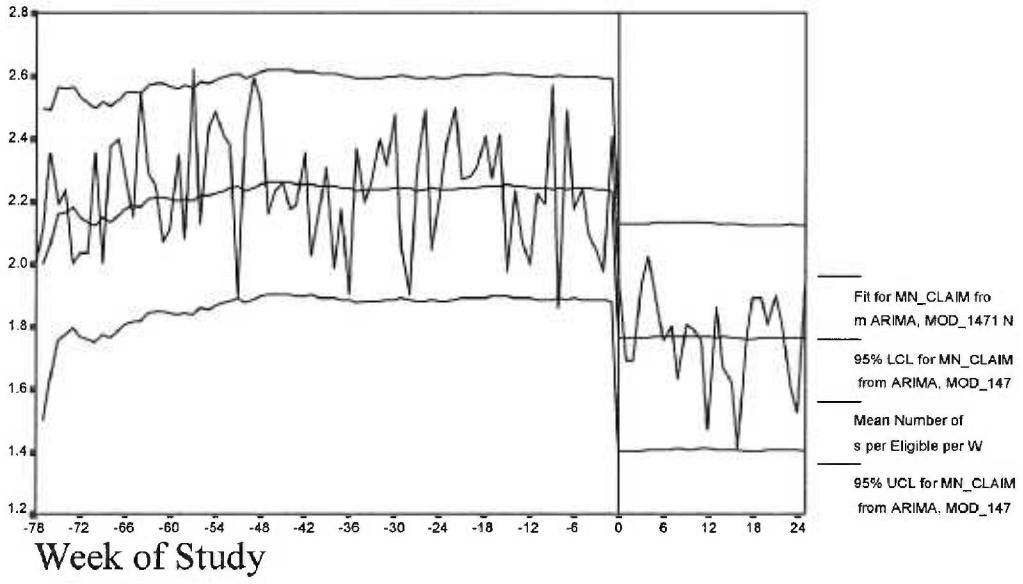

Figure 2. Therapeutic Class 3 - Anti-Diarrheals. (Intervention effect significant*)

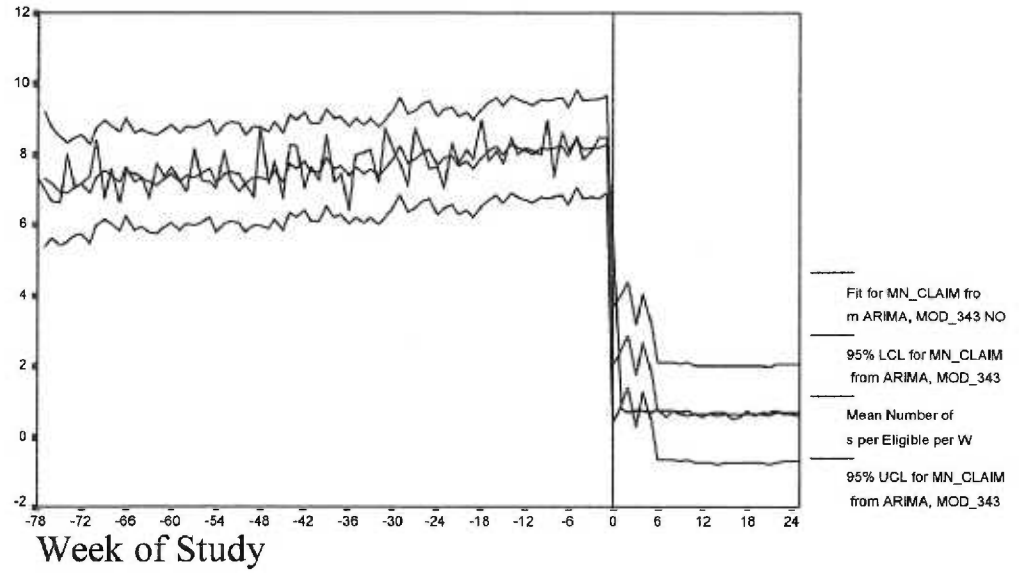

Figure 3. Therapeutic Class 6 - Laxatives. (Intervention effect significant*)

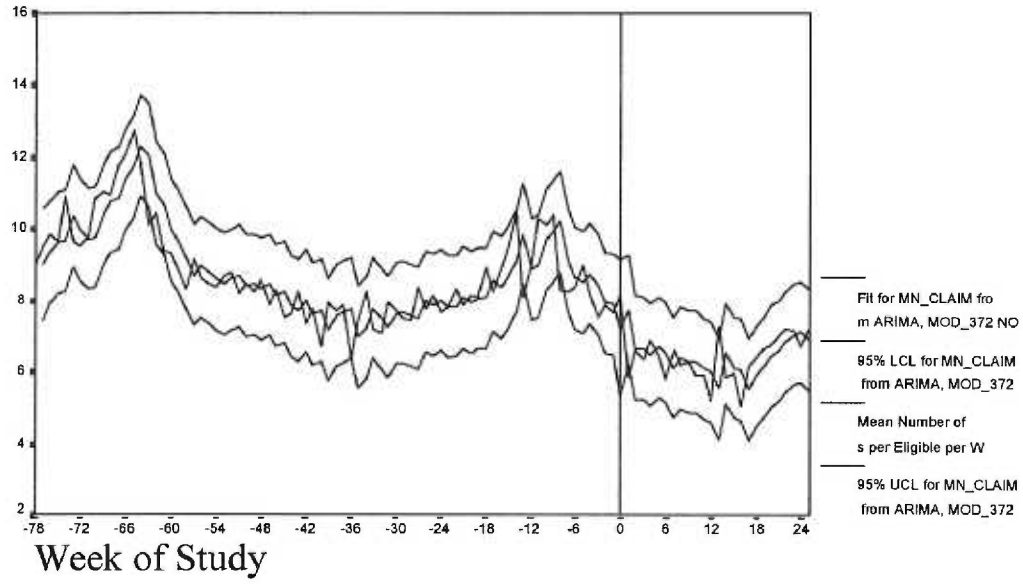

Figure 4. Therapeutic Class 14 - Antihistamines.

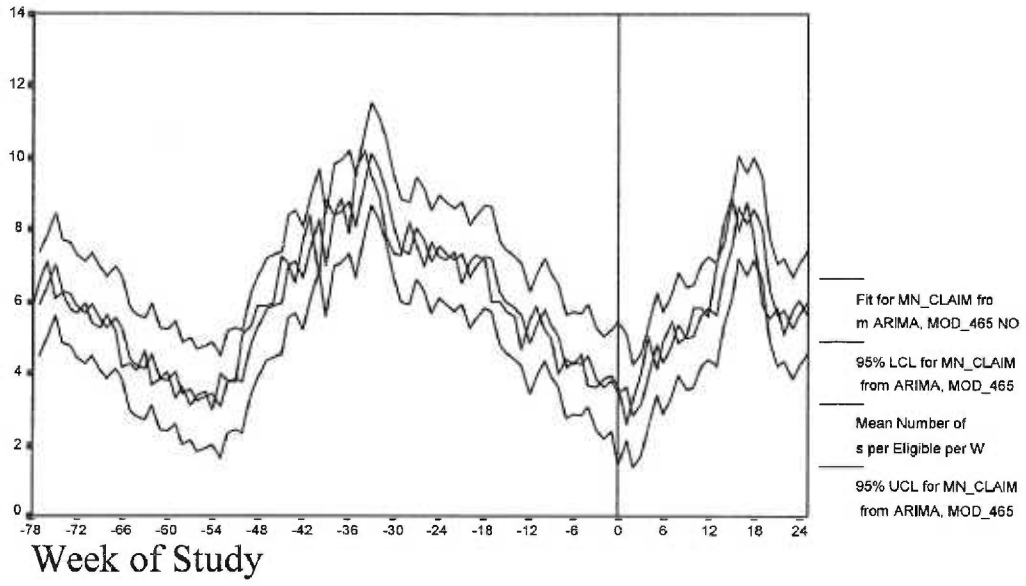

Figure 5. Therapeutic Class 16 - Antitussives-Expectorants.

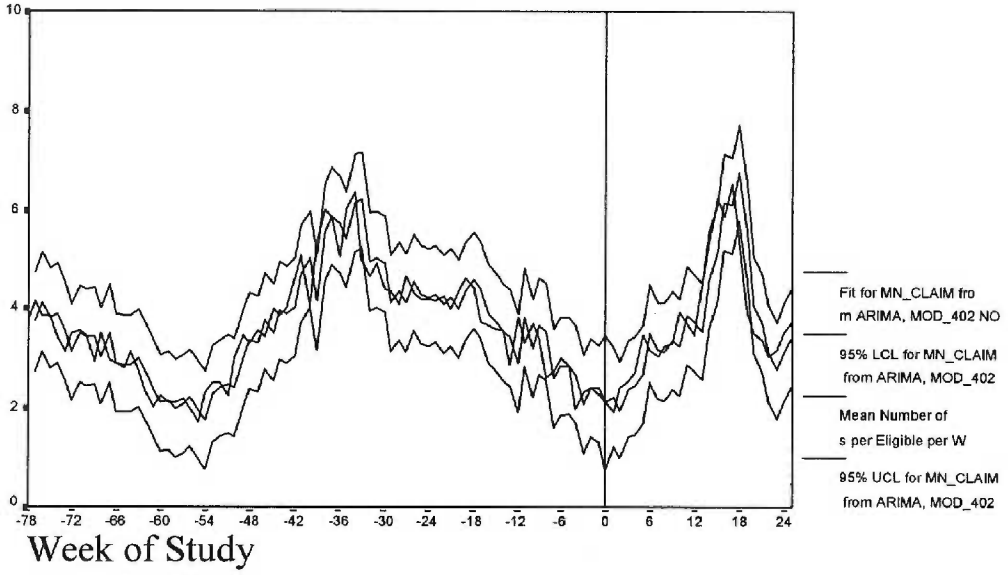

Figure 6. Therapeutic Class 17 - Cough and Cold Preps.

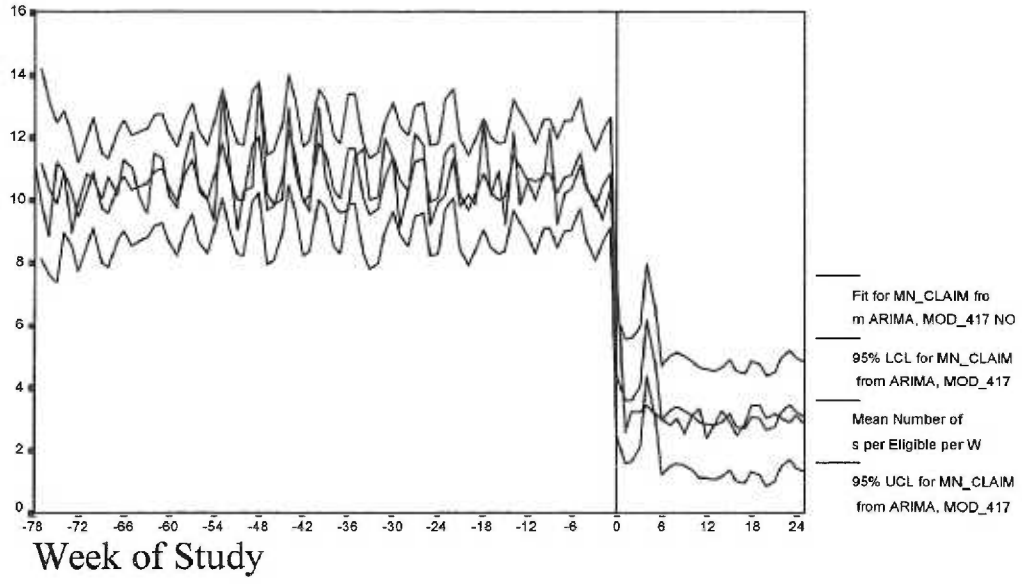

Figure 7. Therapeutic Class 82 - Multivitamins. (Intervention effect significant*)

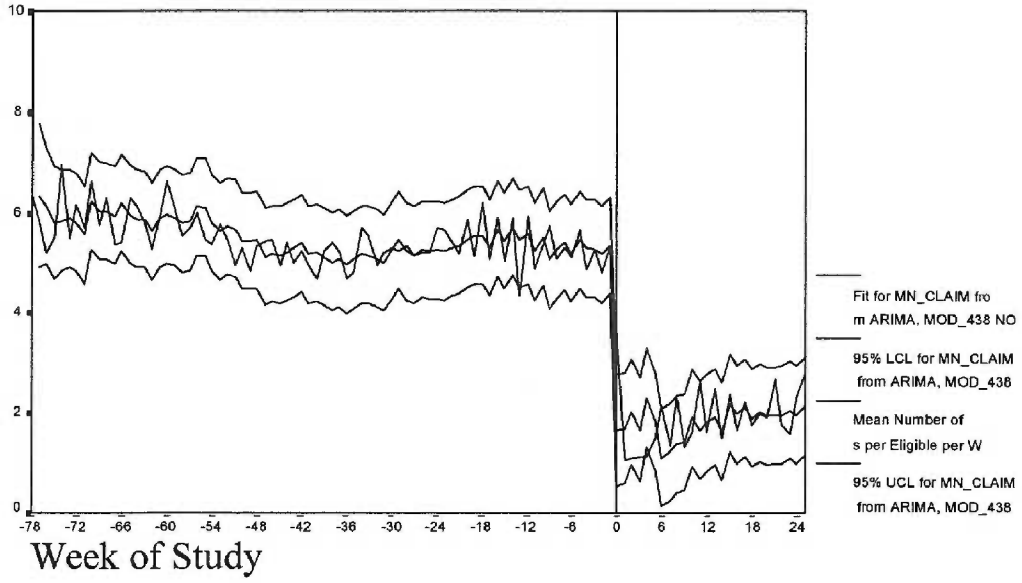

Figure 8. Therapeutic Class 88 - Hematinics. (Intervention effect significant*)

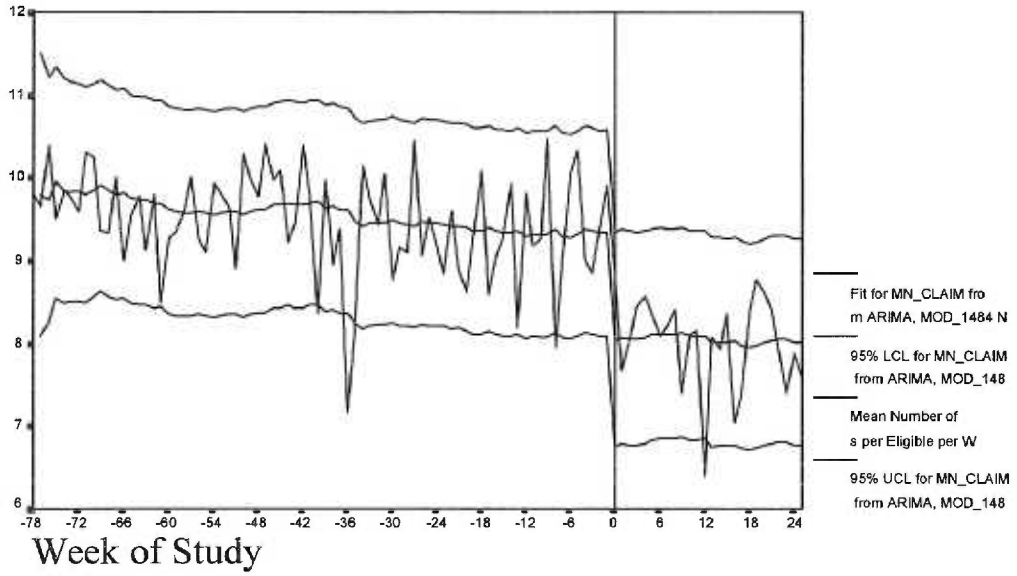

Figure 9. Therapeutic Class 94 - Fungicides.
(Intervention effect significant*)

APPENDIX E: TIME-SERIES GRAPHS: REANALYSIS EXCLUDING ERYTHROPOIETIN CLAIMS

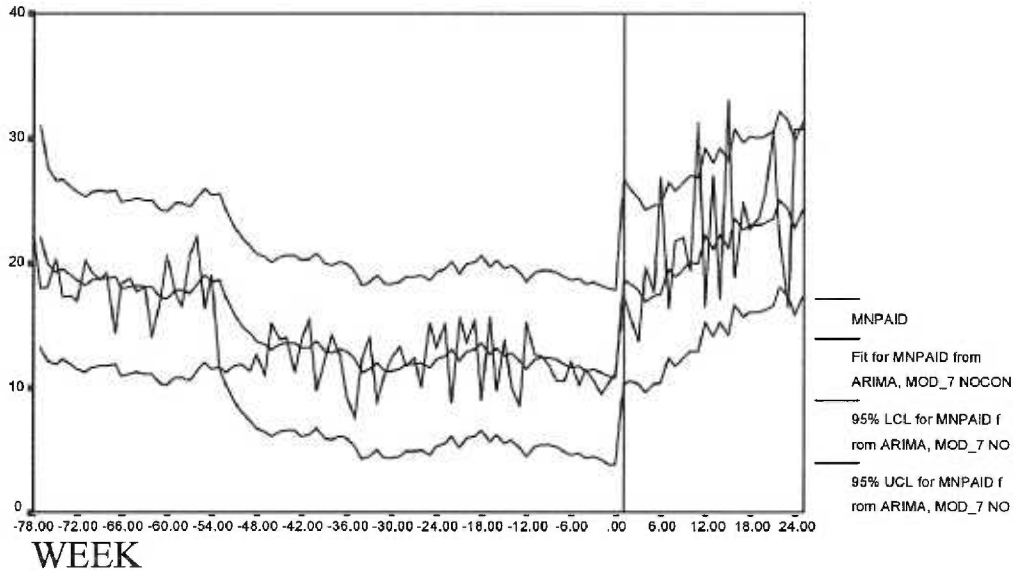

Figure 1. Time-series analysis after exclusion of erythropoietin: amount paid ($) per 1000 eligibles per week for prescription-only prescribing.

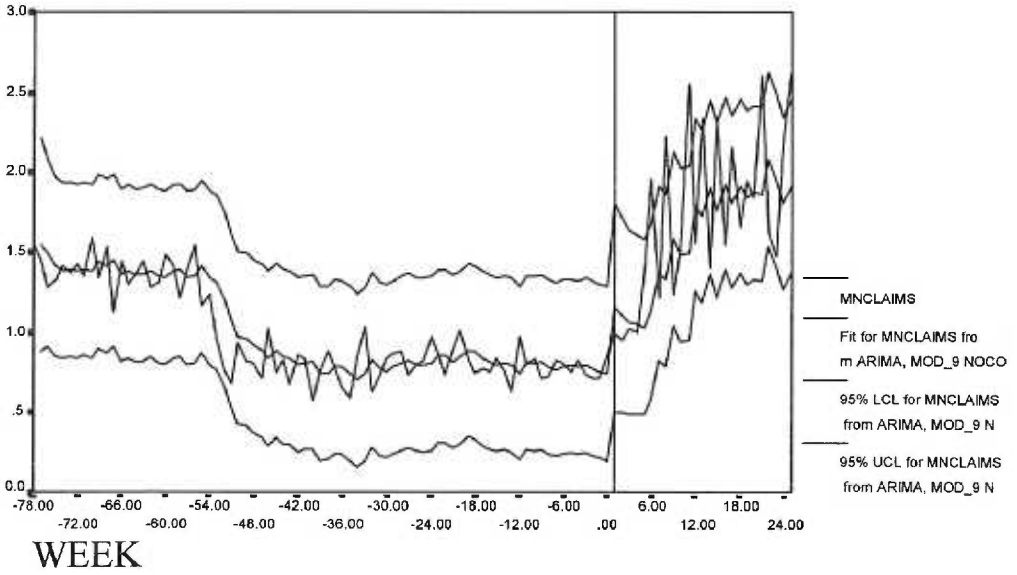

Figure 2. Time-series analysis after exclusion of erythropoietin: Number of claims per 1000 eligibles per week for prescription-only prescribing.

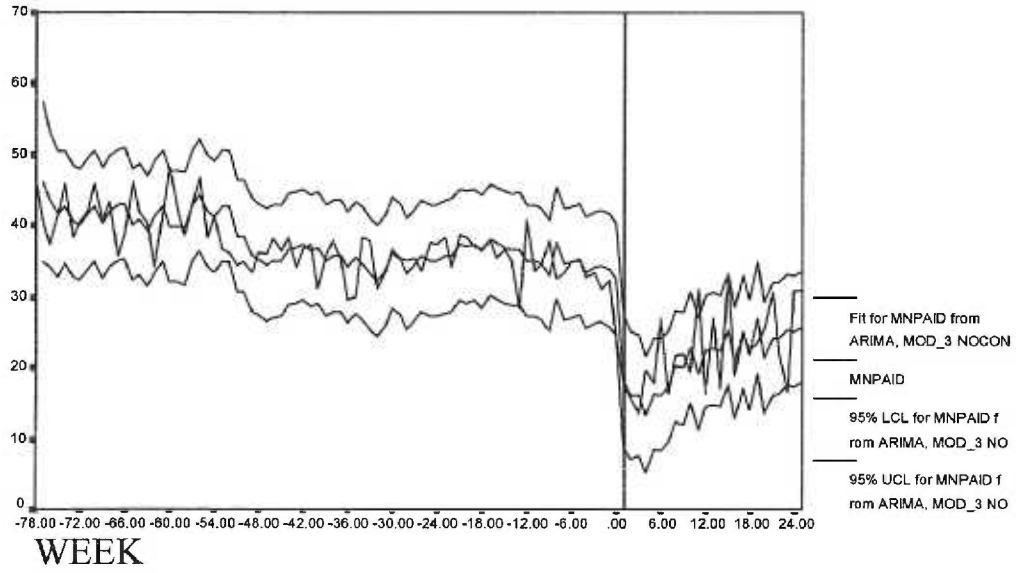

Figure 3. Time-series analysis after exclusion of erythropoietin: amount paid ($) per 1000 eligibles per week for total prescribing.

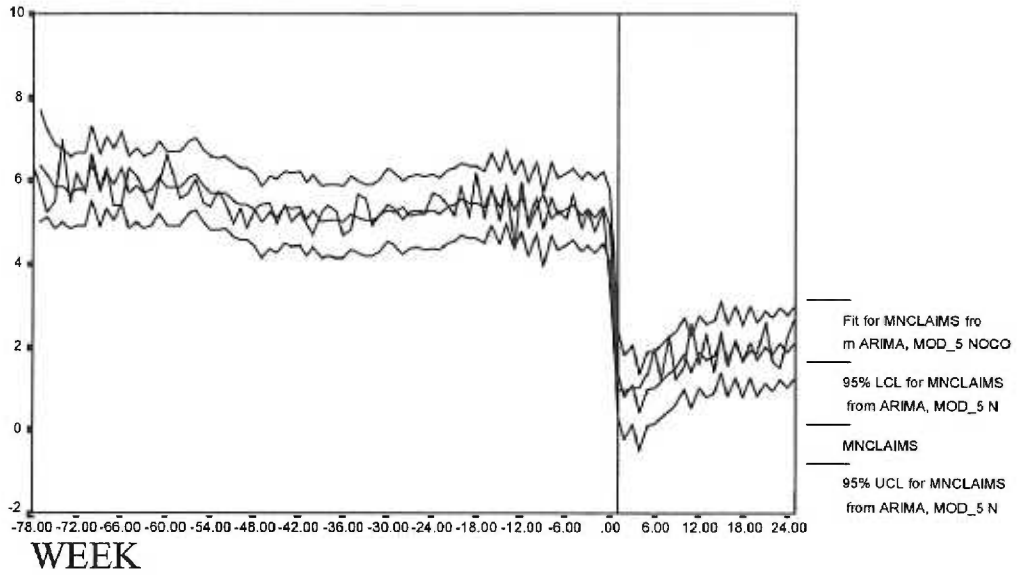

Figure 4. Time-series analysis after exclusion of erythropoietin: Number of claims per 1000 eligibles per week for total prescribing

APPENDIX F: DATA MANAGEMENT PROCESS