

Cost Analysis of the Adolescent Transitions Program

An Honors Thesis

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by

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1. Introduction

The goal of our study is to assess the cost-effectiveness of the Adolescent Transitions Program (ATP) if implemented in Oregon middle schools. The ATP was conducted through the University of Oregon's Child and Family Center and concerns the intervention for students who appear to be at risk for youth substance use from grades six through eleventh. The ATP's objective is to reduce problem behavior in adolescents through intervention and the encouragement of positive parenting practices. Other objectives included observing changes in GPA, peer association, and parent relations. We begin our study with an overview of what the ATP study consists of and their methods used. Following that overview we address other literature and previous studies of intervention programs of this type. We will then assess the cost-effectiveness and cost-benefits using a variety of methodology.

The first round of the ATP study, Project Alliance, was conducted in Portland area middle schools with 672 participants. The study was done using both a control group (n=341) and a treatment group (n=331). Surveys were given out in the participating middle schools to the students, their parents and their teachers. The teachers' surveys were used to assess the student's risk level (no risk, at risk, and high risk). Questions dealt with the student's peer association, motivation in class, and parents' involvement in their child's education. Questions on the parent and student surveys ranged from peer association to self-reported substance use. Although all of the services provided by the ATP were voluntary, families in the treatment group that were assessed as at-risk or high-risk were pro-actively recruited for additional intervention.

The ATP consists of a three-tier intervention program. The first, and most universally available, is the Family Resource Center, which provides a home base in schools for providing intervention and information. The second, is the Family Check Up Program where at-risk students and families can be assessed and intervention programs can be designed and implemented. The third is the Family Intervention Program and is geared towards students displaying academic and/or behavioral problems. The program includes therapy sessions, a monitoring system, parent groups, case management and referral services. All hours with students or parents, whether in person or on the telephone, were logged to help assess the amount of assistance that was given to each student.

In our study, all logged therapy hours were totaled and averaged. Each student received 24.76 minutes of therapy per year. After calculating both the explicit and implicit costs of the ATP, our results show that with start-up costs, the cost per student per year is \$494.68 and then \$451.74 per year after that for a total cost of \$1849.86 per student. Our findings of effectiveness per student show a 2.28 unit substance use reduction per month in the last wave of the program for the treatment group with respect to the control group which is a 53% reduction in substance use. The total units of substance use reduction per student over all four waves of the program was 34.08 for the treatment group in comparison with the control group.

1.2 Literature Review

In this section we discuss existing evaluations of the ATP study and other youth intervention programs. These evaluations use differing methods to show the effectiveness

of the programs. While no program exactly parallels the ATP, they serve as guidelines for our own methodology and evaluation of intervention programs.

The first analysis of the ATP was conducted by Thomas Dishion, Kathryn Kavanagh, Alison Schneiger, Sarah Nelson, and Noah Kaufman in the study *Preventing Early Adolescent Substance Use: A Family-Centered Strategy for the Public Middle School*. The study ran a regression using substance use in grade 9 as the dependent variable and substance use in grades 6 through 8, the intervention condition, risk, and the correlation variable between intervention and risk as the independent variables. Students were randomly assigned into two groups, one group was to receive treatment, the other served as the control group and received no treatment. The regression showed that the treatment was associated with a reduced amount of substance use in the first year of high school, controlling for the prior use of substances in middle school. The intervention effect was statistically reliable. The typically developing youth seemed to benefit as much as the at-risk youths. The study showed that 18.6% of the typically-developed youths in the treatment group had reported using substances as opposed to 28.9% in the control group. 26.3% of the at-risk youths in the treatment group reported using substances in contrast with 42.1% in the control group. We plan to use similar estimates of the reduction of substance use in our analysis of cost-effectiveness, using a similar, but we believe more appropriate, statistical model.

Foster, Dodge, and Jones(2001) assess a study called Fast Track to analyze and support the significance of economic analysis in intervention and prevention programs. Fast Track is very similar to the ATP study we are analyzing. It involves many of the same intervention methods and similar sorts of costs. Therefore, the methodology used to

evaluate this program can serve as a guide for our evaluation of the ATP. Their work, *Issues in the Economic Evaluation of Prevention Programs*, breaks down the different types of cost analysis and highlights problems that can arise when dealing with intervention programs that span over several years. Foster, Dodge, and Jones argue that economic evaluation of this type is critical to understanding the true social costs and benefits intervention programs impose. Programs of this nature deserve this careful analysis because they have very high research and development costs that go into the program before it's implemented. Once the intervention program is in place, the benefits, if any, span the length of the program and potentially after the program has ended. Our own study attempts to analyze the ATP study using the same methods of economic evaluation as outlined in this work.

Foster, Dodge, and Jones state that such evaluations can be done using benefit-cost analysis, cost-effectiveness and cost-utility analysis. The cost-benefit analysis works by fully accounting for all the costs and benefits of an intervention program and translates these costs and benefits into dollar amounts. If the program produces more costs than benefits, it is not worthwhile to pursue. If the program's benefits outweigh its costs, it is a worthwhile intervention program. Measuring these costs and benefits is a difficult task. In our own study, calculating the costs of the program is much easier than calculating the benefits. This is seen in the Fast Track study as well. Aside from accounting for opportunity costs involved with the resources used in these studies (i.e. resource room, parents' time, teachers' time, etc...), the concrete costs such as salaries, supplies, and start-up costs are easy to measure. The benefits side becomes harder to quantify. Benefits may range from improved high-school graduation rates, avoided incarceration costs, and

overall improvement in quality of life for these students. Foster, Dodge, and Jones show that these are the most difficult results of the Fast Track study to truly quantify.

The cost-effectiveness analysis (CEA) is used in economic evaluation of intervention programs, but unlike the cost-benefit analysis, it does not convert outcomes into dollar terms. As outlined in their work, outcomes are measured in units such as a one point reduction in substance abuse or a one point increase in a student's GPA compared to the incrementally added units of costs. The program is then analyzed by a series of these ratios for different outcome measures. Our own study of the ATP will focus on using a CEA of the treatment program to assess the worth of this type of intervention. The last type of analysis mentioned by Foster, Dodge, and Jones, the cost-utility analysis, is much like the CEA, however it attempts to measure non-quantitative changes in well-being based on survey responses throughout the program. This includes changes in a student's behavior, the type of friends they hang out with, and involvement in their education. However, it should be noted that this is not the economic concept of utility. Economic utility would be measuring how much the benefits of these changes would mean to each individual, assuming the individual places value on these changes. Our own analysis will attempt to use similar measures in our CEA instead of conducting a cost-utility analysis.

The second area the Foster, Dodge, and Jones work finds important for a proper analysis of these programs is the measurement of costs. They argue that the analysis of costs should include both direct costs and indirect costs. They use Fast Track, the largest prevention study funded by NIHM, to show these cost estimation techniques. Fast Track is a clinical study designed to prevent serious conduct disorder and violent crimes among

adolescents. Much like the ATP study, the program assigns students into intervention and control groups through randomization. Fast Track is a ten year program that involves the child, teachers, parents, tutors, mentors and peers (pg.4). The program has three levels of intervention; universal prevention in the school, selective prevention support for families of children of high risk, and individual support to high risk children and families based on assessments over time. The results of the study show that children assigned to the intervention group have responded more favorably than those in the control group.

Foster, Dodge, and Jones found that looking at costs in terms of explicit and implicit costs is important in studies of this nature. The costs of a child with behavior or substance abuse problems through the child-serving sector are enormous (pg. 6). If these costs can be reduced through intervention, they argue these are “costs offset .” They discuss three ways of measuring these costs; identifying the resources involved, measuring their use, and valuing the resources used in dollar terms. In our study we will measure implicit costs such as parent time spent on intervention and the cost of donated space as well as explicit costs through therapy time-logs and other paid resources such as salaries, start-up costs and supplies.

Foster, Dodge, and Jones state that the explicit costs are easy to place a dollar value on, but can be much more extensive than solely the costs of the intervention program itself. These costs also include all of the research expenses that went into creating and implementing the program, often causing the total cost of the intervention to be extremely high. Because these costs are fixed and do not affect the costs of implementing the intervention program elsewhere, they are going to be ignored in our study.

Implicit costs are much harder to determine because they include donated time and space. Parents receive incentive payments for their time, however depending on their income, this generally does not come close to full compensation for a busy parent. Indirect cost estimates can be useful in providing a better understanding of these costs. The last step in their process of economic evaluation is to determine a measure for projecting future costs. Costs in the student's future after the program, such as incarceration or social services can provide a large drawback to the effectiveness of the program. However, the benefits such as better educated citizens can greatly improve the effectiveness of the program and the benefits to society as a whole. Our own analysis of the ATP study will address further efforts to place quantitative measurements on these future outcomes and will question how much society is willing to pay for these benefits.

Another example of a cost-effectiveness study is the RAND study, *Diverting Children from a Life of Crime* study done in California. The RAND study looks at the cost-effectiveness of early intervention in the lives of children at risk for criminal behavior. The study compares the costs-effectiveness of these intervention programs to the Three Strikes law of California, which targets youths who are repeat offenders with minimum-sentence incarcerations. The motivation behind the study is comparing programs that focus on the incarceration of youths with diversion programs that stop youths before they commit the crime. This question is very close to our own when attempting to compare the cost-effectiveness that may occur when students are involved in intervention programs.

The RAND study finds that the cost-effectiveness of most of the early intervention programs compares favorably to the Three Strikes law. They analyzed four

different types of intervention programs that targeted high-risk youths. They found that students from single mother households are most at risk for committing crimes and they target these families first. Their intervention methods include: 1) home visits by child care professionals beginning before birth and continuing through the first two years followed by four years of day care, 2) training for parents and family therapy for children who display aggressive behavior, 3) four-year cash incentives to induce high school graduation, and 4) monitoring high-school youth with already delinquent behavior. While some of these methods are much more intensive and expensive than those conducted by ATP, they show the effectiveness that intervention in general can have.

The study continues to estimate how much monetary benefit will be derived from these youths not being placed in jail and the benefit to society that results if their crimes are not committed. The costs that they noted were that of the program itself, including therapy hours and graduation incentives. The study found that the parent-training program, the graduation incentives program and the delinquent supervision program all compared favorably in their cost-effectiveness to the Three Strikes law. The Visits and Daycare program however did not. The most cost effective program seemed to be the graduation incentive program, which had a 56% prevention rate for juvenile crimes that would have been committed and a 50% prevention rate for adult crimes. A cost-effectiveness analysis is exactly what we are attempting to quantify for the ATP study, which has not yet placed any monetary value to its findings. The RAND study was used as a guide for our analysis.

2. Results of Empirical Analysis

2.1 Methodology

In our assessment of the ATP, we will conduct a cost-effectiveness analysis of the ATP, along with a cost-benefit analysis using estimated future benefits. These methods of analysis will include calculations of variable, fixed and opportunity costs. Our cost-effectiveness analysis is comprised of two parts; how effective the program is in reducing substance use in adolescents and how much the program costs per student. A cost-effectiveness analysis will allow the Child and Family Center to compare the costs of the program with its outcomes and compare this value with other programs that have similar goals. The cost-benefit analysis will go one step further and examine whether the program is worthwhile by putting the outcome measures into dollar terms, and allowing us to place a quantitative measure on future benefits.

Costs of the program will be calculated using the Child and Family Center's cost information from the ATP's Project Alliance. Our interest lies in how much the ATP would cost if implemented in other middle schools. Therefore, we only examine the program costs such as salaries of therapists, supplies, and travel expenses. This measurement will not consider the costs included in the research and analysis of the program. Furthermore, some initial costs including the research and development of the program's set up will not be considered a current cost as it is a one-time expense that has already been incurred. The opportunity cost, which equals the value of the best alternative use of time and supplies, will be factored in as a cost as well. In the ATP study, the opportunity costs are the parents' time, which will be calculated using their income and time spent with the therapist. The donated Family Resource Center is

included in opportunity costs as well. All costs are then accumulated and divided by the number of students in the treatment group. This will give us the cost per student of implementing the ATP into other middle schools.

2.2 Calculating costs of ATP

In order to properly evaluate the cost-effectiveness of the ATP study we gathered information on the general costs that went into the study. Our goal was to generate an estimate of what this program would cost if implemented in another school district. There were both implicit and explicit costs that went into implementing the ATP study. Implicit costs represent the opportunity costs involved with the program and often require making some assumptions to measure. These costs include the donated Family Resource Center (FRC) space in Portland middle schools and the parent and teacher unpaid hours dedicated to the intervention program. Explicit costs are the costs directly paid out in order to implement the program. These include program supplies, travel, equipment, and salaries of the intervention therapists and FRC employees. We gathered only the costs that were specifically used for Project Alliance so as to show what this program would cost if implemented elsewhere. With these actual program costs we were able to analyze the cost-effectiveness of the program as opposed to the cost-effectiveness of the entire study.

When calculating the costs of ATP, the most extensive and expensive were the explicit costs of the program. We calculated these costs by combining services and supplies, travel, salaries, Other Personal Expenses (OPE) and benefits, teacher time compensation, and Family Resource Center expenses. We reviewed the accounting

records and salary/OPE records of the Project Alliance grant for one year in order to obtain the best estimate of what yearly costs would be. These records reflected the costs of the intervention program from 4/30/00 to 5/01/01, giving us an example of what costs would be for a typical year of the program. These costs are displayed on Table 2.2.1. Services and supplies included only the accounting records specifically related to Project Alliance costs. These costs included all office supplies and equipment used by Project Alliance and totaled \$2,687.67. In order to obtain an estimate of services and supplies shared by the ATP and the research psychologists working on the program, we separated the shared costs and included only 50% of these costs in our calculations. These costs included telephone charges, postage, and copying and totaled \$6,261.09. Our total services and supplies costs were \$8,948.76.

Salary and OPE costs also had to be separated from those pertaining to the research aspects of the program. The ATP generally used three intervention therapists and a program secretary each year of the program. For our given year of accounting records, we calculated one therapist for the whole year, two therapists for almost the entire year, and two additional therapists who finished out the full year. Their salary costs totaled \$96,358.89 and their OPE benefits totaled \$39,747. Travel costs were also accounted for and estimated given the accounting records for one year. All travel was compensated by mileage records from the therapists who traveled between the Portland middle schools involved in the ATP. Total travel costs were \$2,212.25. The expenses for each of the three Family Resource rooms included a computer, printer, television/VCR, and a camcorder. We estimated these costs using average market prices for these three items and totaled costs at \$5850 for three rooms.

When calculating the implicit/opportunity costs such as teachers' time, parents' time and the Family Resource Center we only included teachers' time in our total program costs measure. The teachers were given \$25 for survey completion that assessed the risk of every student randomly assigned to the ATP. However, for our own study, we are only calculating the costs associated with the 326 treatment students. This compensation was far more than the hourly wage for a teacher's time, especially since the surveys were only three pages long and could be completed in less than an hour. Therefore, we have not included the hourly wage that teachers give up to complete the survey, but have included the compensation they were given at \$25 a survey for 326 students. This totaled \$8,150.

Parent time was calculated by taking an average of all the logged treatment minutes of the intervention students. The average of the time spent per year for each student was 2.86 min. for mailing, 5.09 min. for telephone contact, and 16.80 min. for therapy contact. This totaled 24.76 minutes per student per year. To determine the value of this time we estimated the parent compensation by averaging the annual income reported by the parents, \$29,000 a year. We then used this average to estimate an hourly wage by assuming that on average there would be a full-time workload for each family, totaling 40hrs. a week for a whole year. This accounts for single parent families or families where one or both parents only work part-time. We then divided the average income by the hours worked to get an hourly wage of \$13.74 per family. This hourly wage concluded that after the average 24.76 minutes of parent time, the compensation would need to be \$5.75 per family per year.

Since this estimate is so low and difficult to calculate on a family by family basis, we have left it out of our calculation of program costs. We have also left out the Family Resource room opportunity costs. These rooms are donated to the ATP for therapy use and include previously existing rooms in the school. Since the need for these classrooms is determined on a school by school basis, we cannot conclude that these rooms are costing the school by taking up valuable classroom space. One measure we assumed that could be an estimate of the opportunity costs of another classroom would be the cost of a portable classroom that would be added if the school runs out of classrooms. However, some schools are not space constrained and this is not a problem. Potentially lower cost alternatives such as room sharing and using a common space like a cafeteria or library may be an option as well.

Taking into consideration the explicit and implicit costs of the ATP, we have formed an estimate of what this program would cost yearly if implemented in another city. Our calculation assumes using the format of Project Alliance, which included three schools in the same school district. This measure includes the start-up costs of the FRC and the teacher survey compensation costs, which would only be needed for the first year. The total for all the costs discussed is \$161,267 per year. The total minus the start-up costs would be \$147,267 per year. We divided both these totals by the number of students who were in the treatment group (n=326) to obtain a cost per student measure. With start-up costs, the cost per student per year is \$495 and then \$452 per year after that. These are the total program costs and costs per student that we will use to conduct our cost-effectiveness analysis.

2.3 Methodology of Regression Analysis

The effectiveness of the program is calculated using OLS regression analysis. Data provided by the Child and Family Center consisted of responses to survey questions taken from the students, parents and teachers during all four waves of the ATP. Our regression specifies the log of the self-reported substance use (+1) of the students (drugl) as the dependent variable and attempts to explain it using various explanatory variables from the data. Self reported substance use is the number of times a student has smoked a cigarette, had an alcoholic beverage, or has smoked marijuana in the last month. As is common, we used the log form of the substance use to understand the percentage change in each student's substance use and added one to avoid a log of 0 (which equals negative infinity and thus does not exist). The regression shows us the relationship between the chosen explanatory variables and the percentage change in the student's substance use. These explanatory variables will consist of the parents education level (educ), family income (income), assessed risk level (risk), time (wave), whether the student was in the treatment group or not (treatmnt), the interaction variable between risk, time and the treatment group (trewavrisk), and the interaction term between time and the treatment group (trewave).

We expect that the parent's education and income level will be negatively correlated with the percent change in substance use and thus have a negative coefficient. As family income and education levels increase, the adolescent will be less likely to use substances. We expect that the coefficient for the assessed risk level will be positive. Higher risk students will be more likely to use substances than lower risk students will.

The coefficient for time is expected to be positive. As adolescents get older, we expect that their substance use will increase. The treatment group variable has an expected coefficient of 0, assuming random assignment. There is no expected sign for the coefficient of the interaction term treatment, time and risk. This variable will inform us if the treatment was more effective for certain risk levels. It may be the case that the program is more effective for high-risk students or, alternatively, for low risk students. The most important variable in our analysis of the effectiveness is the interaction term between the treatment group and time. If the treatment is effective in limiting the increase of substances consumed, overtime this interaction coefficient will be negative. This would indicate the extent to which the treatment group is using fewer substances than the control group overtime.

We will also run similar regressions examining specific substance use, such as cigarettes smoked (smokel) and alcohol consumed (alcl). This will give us the effect that the ATP had on smoking and drinking among youths instead of the combined effect of smoking, marijuana use, and drinking. In addition, we will run a regression that specifies the dependent variable as the student's GPA to determine whether the ATP had an effect on grades.

Problems with the regression can occur when bias is present in the data. If the students in the treatment and control group were not chosen completely at random, there could be some bias that makes the amount of substance use higher in one group. However, by adding the binary variable 'treatment' to the regression, we will be able to separate the initial values of the substance use between the treatment and control groups. This will not necessarily correct for all bias, however it will compensate for the

difference in the initial values of the treatment and control group. Another problem that may occur is attrition. Attrition occurs when subjects leave the study in a non-random manner. Because certain students are more likely to leave than others, this may create bias in the results of the regression. As long as there is an even, unbiased amount of attrition between the treatment group and the control group there should not be a large problem with attrition. However, we will check for attrition in our results and compensate if necessary.

2.4 Regression Results

Regression Analysis was used to determine the effectiveness of the ATP. Our regressions allowed us to control for other factors that might contribute to adolescent substance use such as parent income and education level. It also allowed us to observe our variables over time by putting the data into panel form. We can thus look at the change of substance use over time rather than simply comparing means. Lastly, we used regressions to observe any non-random assignment of the treatment and control group. This allows us to take this variable into account when carrying out our analysis and compensate for any initial difference in substance use.

The first regression of “drug1” examines the basic effectiveness of the program in deterring adolescent substance use. The dependent variable used was the log of the self-reported adolescent substance use in the last month (i.e. number of cigarettes + number of alcoholic beverages + number of marijuana uses) added to one to avoid a log of zero. The independent variables applied in the regression were the binary variable “treatmnt” with a value of 1 for students in the treatment group and 0 for students in the control group, the

variable “wave” indicating time and the variable “trewave” which describes the treatment group over time. The results of the regression are displayed in Table 2.4.1.

All of the variables had their expected sign and were significant at the 99% confidence level. As expected, the “wave” coefficient indicated that student’s substance use increases as they get older. The “treatmnt” coefficient denotes that there was selection bias when choosing the control and treatment groups. Initially the treatment group had a higher substance use then the control group. This bias may also affect the slope coefficient if students who are initially using more substances, continue using more in the future at a higher rate. This could actually underestimate the effectiveness that the ATP has on substance use. The “trewave” coefficient, which is the most important in determining the effectiveness of the ATP, shows that the treatment group has a smaller rate of substance use over time in comparison with the control group.

The results, after taking the regression coefficients out of the log plus one form, are displayed in the chart, Table 2.4.2 and the Graph 2.4.3. These results indicate the estimated average number of substance uses by students overtime. As previously stated, it is shown that the treatment group averages a higher substance use initially, but over time the treatment group increases their substance use at a 72% slower rate then the control group. In the student’s 6th grade year (wave 1), the treatment group is using an estimated average of 2.40 substances per month as opposed to 1.17 substances per month in the control group. However, by their 9th grade year (wave 4), the treatment group is using an estimated average of 3.27 substances per month as opposed to the control group’s average estimated use of 4.32 substances.

A more complete regression was also run for the log of substance use (+1) to investigate further factors that contribute to adolescent substance use. The full regression is displayed in Table 2.4.4. These additional explanatory variables include the binary variable of “risk2”, indicating all students with an assessed risk level of two (at-risk), and “risk3”, indicating an assessed risk level of three (high-risk). In addition, the variables “trewavrisk2” and “trewavrisk3” were the interaction terms between the risk level and treatment group over time. These variables examine what affect the ATP had on substance use for different risk levels over time. It shows us if the ATP was more effective for certain risk levels.

The income and education level of the students’ parents was also used in the regression. Due to substantial missing data from the parent surveys about income and education levels, the number of observations dropped considerably from 2373 in the first regression to 1027 in the full regression. This dropped the significance level of all of the coefficients and rendered many insignificant. The coefficients “income” and “educ” were both highly insignificant due to this missing data. In addition, the fact that many parents did not answer this part of the survey could indicate that parents who completed the survey were not a random selection. These parents may have similar traits, such as a higher income and education level in comparison with the parents as a whole. The regression however, does have some significant coefficients despite the drop in observations. The regression indicates that, once again, student’s substance use increases as they get older. The other variable that is significant is “risk3”, which indicates that students with risk level three use substances at a higher level than the lower risk students. The “trewavrisk2” and “trewavrisk3” coefficients are highly insignificant indicating that

the program does not affect the substance use of any risk level more than any other. Students with a risk level of three do not benefit from the program any more than students with a risk level of one.

A regression was also run for the log of the number cigarettes smoked (+1) in the last month (smokl) along with a regression of the log of the number of drinks of alcohol consumed (+1) in the last month (alcl). These regressions are displayed in Table 2.4.5 and Table 2.4.6. Unfortunately, many of the coefficients are insignificant in the smokl regression. The only concrete information obtained from the regression is from the “wave” variable that indicates that adolescents smoke more as they get older. All of the coefficients in the “alcl” regression are significant. Once again, these coefficients indicate that adolescents consume more alcohol as they get older, the treatment group initially consumes more alcohol, but at a slower rate over time in comparison with the control group. Together, these results imply that most of the action in the aggregate regression results comes from drinking, not smoking.

In addition to the regressions on substance use, a regression was run to examine whether the program had an effect on the GPA of the students. The calculated benefits of the program would increase if the ATP had a positive effect on grades. The regression is shown in Table 2.4.7. Unfortunately, the regression displayed insignificant coefficients that would indicate that the program had no effects on GPA.

After running these regressions, we examined the potential problem of attrition. The attrition during wave one and wave two was fairly even between the treatment and control group. However, during the third and fourth wave, students were leaving from the treatment group at a one third higher rate than the control group. Because many of these

students were high risk, the results had the potential to be skewed in favor of the treatment's effectiveness over time. Furthermore, 7.05% of students in the treatment group were not present for both of the third and fourth wave as opposed to 3.28% in the control group. To compensate for the problem of attrition, these students who were not present for both of the last two waves were dropped from the regression. By dropping these students from the study, the attrition in the third and fourth wave between the treatment and control group became even. The regression is displayed Table 2.4.8. The compensation for the attrition does not change the results of the original regression dramatically. The only noticeable effect is a slightly lower coefficient for the treatment group, indicating a lower initial value of substance use. The "trewave" variable was not dramatically affected and thus the relationship of the substance use over time for the control and treatment group should not change.

2.5 Methodology of Cost-Effectiveness Analysis

The effectiveness of the program is calculated by taking the results from the regressions and building a model that compares the substance use of the treatment group with the control group over time. The regression results allow us to measure this while holding other factors, such as education levels and risk, constant. The difference between the control and treatment groups' substance use will be the effectiveness of the ATP. The cost effectiveness combines this calculation of the effectiveness per student with the cost per student. We will use three different scenarios to examine the cost-effectiveness by assuming different levels and rate of change of substance use throughout the lifetime of the student. This will determine the quantity of substances not consumed by the treatment

group over a lifetime. We will then divide the reduction of substance use into the cost per student, per year and determine the lifetime effectiveness of the ATP.

2.6 Cost-Effectiveness Analysis

Using the regression results, we were able to calculate the overall effectiveness of the ATP per year. Our estimated averages of the substance use for both the treatment and the control groups, calculated from our original regression of “drug1” and setting initial values to be equal, conclude that at wave four the treatment group is consuming 2.28 fewer substances per month than the control group. Multiplying this reduction by 12 months of the year, the result is 27.36 fewer substance uses per year for the treatment group at the fourth wave. The total amount of substances consumed for the treatment group over all four waves of the ATP was 34.08 fewer than that of the control group. Given that, on average, students in the control group of the fourth wave are only consuming an estimated average of 4.32 substances, this reduction of 2.28 substances per month is a 53% reduction.

In order to calculate the cost of this reduction in substance use per year among the treatment group, we calculated the yearly cost of each student in the treatment group. Using our two total cost measurements of \$161,267 per year with start-up costs and \$147,267 per year without, we divided these totals by the 326 students that received treatment throughout the program. With start-up costs, the cost per student per year is \$495 and then \$452 per year after that. These results indicate that for all four waves of the ATP, the total cost per student is \$1851. Using this cost per student, we will

formulate three assumptions to best assess the cost-effectiveness of the ATP; conservative, moderate and generous.

First, we can make a conservative assumption that any effect of the ATP is transitory and once the program ends, students instantly revert back to the same level of substance use and rate of change in use overtime that they would have had without the program. We calculated that the reduction in substance use over the four waves was 34.08. Thus, after dividing the total student cost by the unit amount of substance reduction, the cost per unit of substance reduction is \$54.28. This implies that for every cigarette not smoked or alcoholic beverage not consumed, the cost is \$54.28.

Second, we can make a moderate assumption that the effect of the ATP is permanent in terms of levels of substance use, but transitory in terms of rates of change. This implies that there are future benefits of the program, beyond the wave four, but that these benefits do not include a permanent change in the rate of substance use. Instead, we assume that the difference between the treatment group and control group's substance use will stay at the same overtime. If we consider the total substance use reduction over a lifetime, assuming that the treatment group will always consume 27.36 fewer substances per year, over a 60 year period, this is a reduction of 1,676 units of substance use. After dividing the cost per student by this unit reduction, each unit of substance reduction costs \$1.10.

Third, we can make a generous assumption that both the level of substance use and the rate of change in substance use effects of the ATP are permanent, at least for a certain period of time. This is the most optimistic assumption and will lead to the largest measure of benefits. If we assume that the rate of change of substance use in the

treatment and the control group remain the same during a four year period, and after that period revert back to having a constant difference between the groups. This results in a 7,090 unit reduction in substance use. Thus, after dividing the total program costs per student by this amount of substance reduction, the cost per unit of substance reduction is \$0.26.

The cost-effectiveness results allow us to estimate how much this program would cost per student if implemented elsewhere, taking into account the three different possible scenarios. These results can also be used when evaluating the benefits this reduction creates and when evaluating, how much people are willing to pay to see the results the treatment produces.

2.7 Methodology of Cost-Benefit Analysis

The cost-benefit analysis will take the benefits calculated over a lifetime and compare them to the costs of the program to determine whether the ATP is worthwhile. The benefits are calculated using statistics from other studies about the cost of substance use. For example, in Jonathan Gruber and Botond Kozegi's study, *Is Addiction "Rational"?, Theory and Evidence*, they calculate that a pack of cigarettes costs \$30.44 in terms of lost life expectancy. We will use our three different scenarios of assuming the rate of change and substance use levels throughout the lifetime of the adolescent. This will determine the quantity of substances not consumed by the treatment group over a lifetime and we will multiply that by the costs not incurred such as the \$30.44 cost in the Gruber and Kozegi study. Using these values, we will attempt to estimate the quantitative value of the lifetime benefits of the treatment program.

2.8 Cost-Benefit Analysis and Implications

The benefits of substance use reduction are hard to calculate in dollar terms. Although the regression used is for all substance use, we may look at the specific example of smoking and attempt to calculate the averted cost of substance use. To calculate this averted cost, we can use the cost of a pack of cigarettes in life expectancy as \$30.44, calculated by the Gruber and Koszegi study. We will assume, for our analysis, that 50% of total substance use reduction was cigarette use. The benefit of this portion of substance reduction will then be calculated using the life expectancy cost of \$30.44. We will analyze the three different scenarios of benefits using our assumptions about the long-term effects of the ATP. The results of the cost-benefit analysis will be sensitive to these assumptions.

First, using the conservative assumption, we calculated the reduction in substance use over the four waves was 34.08. If we assume that half of the reduction in substance use was in cigarettes, over the four waves of the program, this equals a \$26 cost-averted in lost life per student. This implies that the benefits only include the differences we measure during the four waves.

Second, using the moderate assumption, we calculated the reduction in substance use remains at a constant difference after wave four, but that these benefits do not include a permanent change in the rate of substance use. Calculating the reduction of 1,676 units of substance use, if we assume that the treatment group will always smoke on average 1.14 fewer cigarettes, this is a \$1275 value per person. This is the benefit calculated over the 60 year period, for this moderate assumption.

Third, using the generous assumption, we calculated the level of substance use and the rate of change in substance use effects of the ATP are permanent. This results in a 7,090 unit reduction in substance use and the value of the cost averted over a lifetime would be \$5,395 per person

All three scenarios of our cost-effective and cost-benefit analysis are displayed in Table 2.81 and include the unit reduction in substance use, the cost per unit of substance reduced and the benefit per student. A graphical analysis of the three Assumptions is also given in Graph 2.8.2, Graph 2.8.3, and Graph 2.8.4.

We will assume that the most reasonable estimate of benefits is the second assumption of a constant difference in the rate of change of substance use between the treatment and control group. This seems the most reasonable so as not to underestimate or overestimate the effects of ATP over a lifetime. In order to conduct a cost-benefit analysis we have calculated the costs of the complete four waves of the ATP. This cost is \$1,851 per student. We compare this with the estimated benefit calculated in life expectancy at \$1,275. While the cost of the treatment is larger than the lifetime benefit of smoking less, the benefit estimate does not include the other 50% of substance use. This other 50% is likely to be alcohol or marijuana use, which will also incur other potential negative health consequences that we have not accounted for. Therefore, we cannot conclude that the costs outweigh the benefits of treatment. Other potential benefits are too difficult to quantify with our limited information, but may exist as benefits to the quality of life high school graduation rates and parent/student relations.

3. Conclusions and Further Research

This paper investigates the cost-effectiveness of intervention programs. By using ATP's study, we were able to evaluate a common form of youth intervention. Significant to our study is the implementation of this intervention program throughout Oregon middle schools. In order for implementation to take place elsewhere, there needed to be a clearer understanding of what this program will cost per student. By compartmentalizing costs into specific areas, we can examine more closely where cost reductions, if necessary, should be made. Knowing the costs per student allows the potentially participating school districts to evaluate the probability of risk among their students and assess how expensive the costs may be. Taking into consideration the effectiveness of the intervention, our findings show there is a significant reduction in substance use.

Our findings suggest that there is ample therapy time available between the three middle schools participating in the programs. This leads us to believe that it is possible for more students to participate in the program, thus lowering the costs per student per year, without harming the level of effectiveness of the intervention program. Schools most in need for family intervention and therapy time may require a resident therapist for each school, while schools with lower levels of risk would be able to share therapists. Although our cost-benefit analysis was inconclusive, our cost-effectiveness can be compared to other intervention programs and further research can be done to calculate more accurately the benefits of the ATP.

Given the information we had, our study uses the best methods known to calculate both the costs and the effectiveness of the ATP. However, improvements can be made concerning our estimation of costs where we lacked full cost data. Further evaluation of

the causes of adolescents' substance use should be done to factor in variables such as parent's income and parent's education levels. Our analysis was inconclusive for these variables and not statistically significant due to incomplete parent responses to these survey questions. These variables have proven significant in other studies of intervention program, such as the RAND study and should be shown as statistically significant for ATP as well.

Given our findings of substance reduction for the estimated costs, the decision to implement these programs resides in whether or not parents and school systems see intervention as beneficial and cost-effective. Survey questions can be added to a future study to evaluate how much parents and society as a whole are willing to pay for these reductions in substance use and its potential future benefits. Research has shown that preventing substance use at an earlier, developmental age has strong implications for preventing future use. Intervention programs successful at reducing substance use should be seen as vital to the well being of these potential users for the rest of their lives and should be given significant credibility.

Table 2.2.1: Total Costs of Adolescent Transitions ProgramExplicit Costs:

Startup Costs:

Family Resource Center:

| | |
|----------------------------------|---------|
| Computers (\$1,500 x 3): | \$4,500 |
| Television/VCR (\$200 x 3): | \$600 |
| Camcorder (\$250 x 3): | \$750 |
| Teacher incentives (\$25 x 326): | \$8,150 |

Costs per year:

| | |
|---|------------------|
| Services and Supplies: | \$2,688 |
| 50% of copying, telephone, and postage: | \$6,261 |
| Travel: | \$2,212 |
| Salaries: | \$96,359 |
| OPE/Benefits: | \$39,747 |
| Total: | \$162,267 |

Cost Per Student, Per Year:

| | |
|---------------------------------------|-------|
| First Year (Including Start-up Cost): | \$495 |
| Cost for each additional year: | \$452 |

Total Cost Per Student(Four Waves) \$1,851

Implicit Costs:

Parent time: \$13.74 per hour
 Donate Family Resource Center

Table 2.4.1
Regression of drugl

R-sq= .0099

Number of obs.=2373

Number of groups = 661

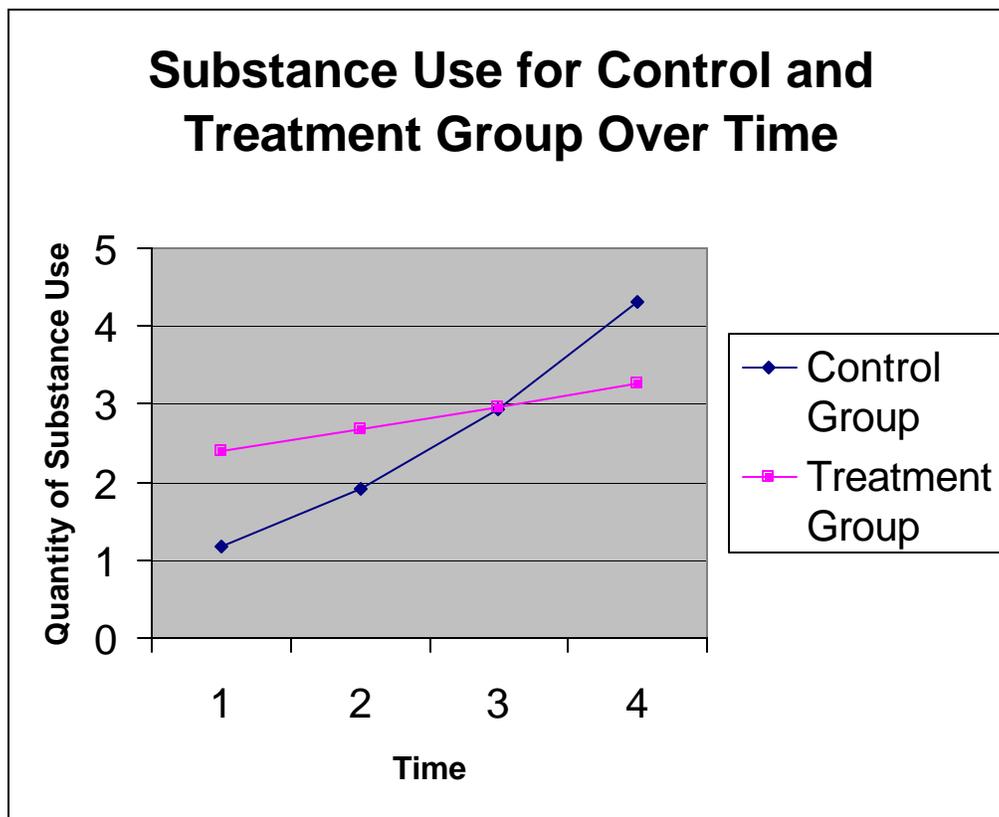
| drugl | Coef. | Std Err. | z |
|----------|------------|----------|-------|
| wave | 0.1300*** | 0.0224 | 5.81 |
| treatmnt | 0.2927*** | 0.1029 | 2.85 |
| trowave | -0.0969*** | 0.0322 | -3.01 |
| constant | 0.2055*** | 0.072 | 2.85 |

Note: * means the underlying coefficient is significantly different from 0 at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.

Table 2.4.2

| Quantity of Substance Use for Control and Treatment Groups Over Time | | |
|---|------------------|-----------------|
| Grade Level | Controlled Group | Treatment Group |
| Grade 6 (wave 1) | 1.17 | 2.4 |
| Grade 7 (wave 2) | 1.92 | 2.68 |
| Grade 8 (wave 3) | 2.94 | 2.96 |
| Grade 9 (wave 4) | 4.32 | 3.27 |

Graph 2.4.3



Note: * means the underlying coefficient is significantly different from 0 at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.

Table 2.4.4
Full Regression of drugl

R-sq= .038

Number of obs.=1027

Number of groups = 278

| drugl | Coef. | Std Err. | z |
|-------------|-----------|----------|-------|
| wave | 0.1371*** | 0.0388 | 3.53 |
| treatmnt | 0.3158** | 0.1705 | 1.85 |
| trowave | -0.1797 | 0.3704 | -0.49 |
| risk2 | 0.0956 | 0.2293 | 0.42 |
| risk3 | 0.5775*** | 0.2373 | 2.43 |
| trewavrisk2 | 0.0855 | 0.3518 | 0.24 |
| trewavrisk3 | 0.0037 | 0.3532 | 0.01 |
| income | 0.0025 | 0.0164 | 0.15 |
| educ | 0.0179 | 0.0309 | 0.58 |
| constant | -0.1142 | 0.2785 | -0.41 |

Table 2.4.5
Regression of smokl

R-sq= .0065

Number of obs.=2374

Number of groups = 661

| smokl | Coef. | Std Err. | z |
|----------|-----------|----------|------|
| wave | 0.0777*** | 0.0198 | 3.92 |
| treatmnt | 0.1500* | 0.0891 | 1.68 |
| trowave | -0.0371 | 0.0285 | -1.3 |
| constant | 0.0894 | 0.0624 | 1.43 |

Table 2.4.6
Regression of alcl

R-sq= .0023

Number of obs.=2373

Number of groups = 661

| alcl | Coef. | Std Err. | z |
|----------|------------|----------|-------|
| wave | 0.1161*** | 0.0558 | 2.08 |
| treatmnt | 0.0314*** | 0.0129 | 2.44 |
| trowave | -0.0382*** | 0.0186 | -2.06 |
| constant | 0.1737*** | 0.0391 | 4.45 |

Note: * means the underlying coefficient is significantly different from 0 at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.

Table 2.4.7
Regression of GPA

R-sq= .0027

Number of obs.=2615

Number of groups = 665

| GPA | Coef. | Std Err. | z |
|----------|------------|----------|-------|
| wave | -0.0681*** | 0.0086 | -7.94 |
| treatmnt | 0.019 | 0.0681 | 0.28 |
| trowave | 0.0038 | 0.0123 | 0.31 |
| constant | 2.7342*** | 0.0474 | 57.65 |

Table 2.4.8
Regression of drugl (Attrition)

R-sq= .0098

Number of obs.=2320

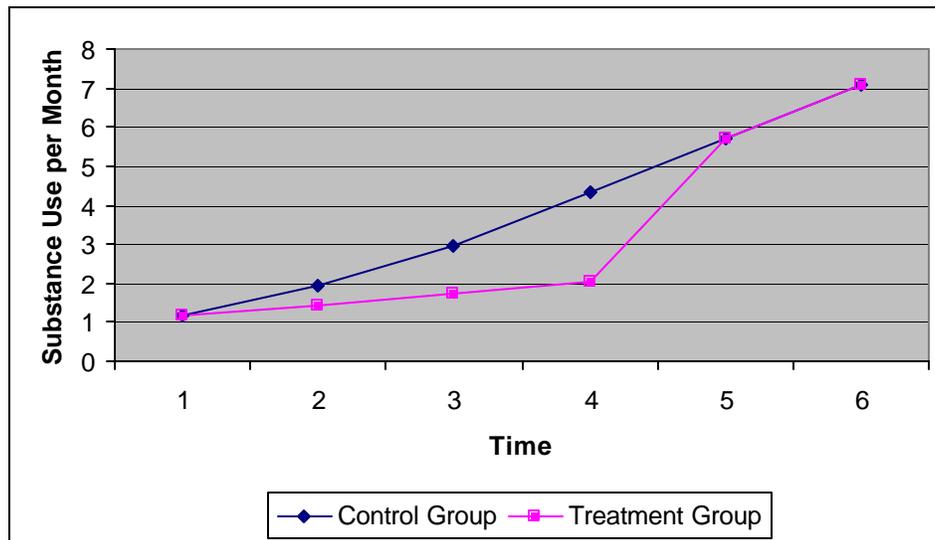
Number of groups = 627

| drugl | Coef. | Std Err. | z |
|----------|------------|----------|-------|
| wave | .1229*** | 0.0225 | 5.76 |
| treatmnt | 0.1293** | 0.1047 | 2.48 |
| trowave | -0.0932*** | 0.0324 | -2.87 |
| constant | 0.2119*** | 0.0727 | 2.92 |

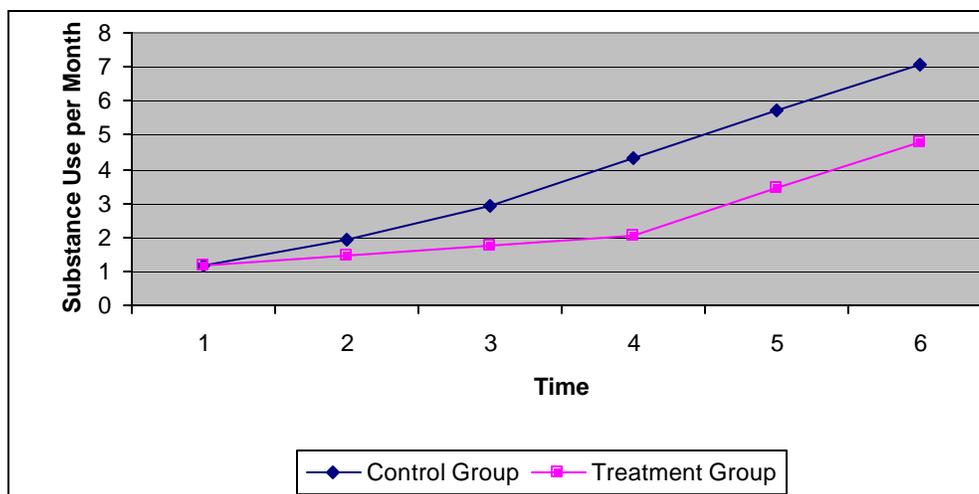
Table 2.8.1

| Cost Effectiveness and Cost Benefit Results Given the Three Assumptions | | | |
|--|---------------------------------|------------------------------------|-----------------|
| Assumption | Unit Reduction in Substance Use | Cost per Unit of Substance Reduced | Benefit/Student |
| Conservative | 34.08 | \$54.28 | \$26 |
| Moderate | 1,676 | \$1.10 | \$1,275 |
| Generous | 7,090 | \$0.26 | \$5,395 |

Graph 2.8.2
Conservative Assumption of Effectiveness



Graph 2.8.3
Moderate Assumption of Effectiveness



Graph 2.8.4
Generous Assumption of Effectiveness

