

Utilization of Mathematical Modeling to Determine Possible Cost Savings and Cost Avoidance for Implementation of MTM Services in a Specialty Population

Ndzerem, E; Higgs, C.; Holtzer, CD Ramsell Pharmacy Solutions, Oakland, CA

Abstract

Background: While the Cost Savings and Avoidance with Medication Therapy Management (MTM) services have been well documented in general medicine populations, there are little data on these measures in specialty high cost populations. Utilizing published data and results, a mathematical model was used to predict likely cost savings and avoidance from the provision of MTM services to HIV patients.

Objective: Utilizing mathematical modeling of published data on clinical results of MTM services in HIV patients, applicable clinical trial data on adherence to antiretroviral therapy (ARV) and the clinical outcome relationship between the two and general medical cost data from progressive stages of HIV infection and AIDS, a determination of possible cost savings and avoidance through the implementation of MTM services in HIV patients was done.

Methods: All data used in the mathematical model were abstracted from previously published or presented sources. Data on the cost of care for HIV infected patients at various stages of HIV infection/AIDS were from presented abstracts. ARV use patterns were pulled from the 2006 DHHS guidelines for the use of antiretroviral therapy (latest guidelines related to abstracted costs of therapy). Adherence improvement data with MTM therapy for HIV patients was pulled from published reports with the assumptions of an average increase in adherence of 18.2% and decrease in changes to ARV therapy of 22.6%. Data on the relationship between HIV ARV adherence and % change of having an undetectable viral load, as well the clinical consequences of having an undetectable vs. a detectable viral load, were abstracted from published reports. A 1:1 correlation with adherence vs. the achieving of an undetectable viral load across the adherence range of 50-80% was assumed from previously published trials. All patients were assumed to have less than 80% adherence at the beginning of MTM therapy. All cost data were corrected for the rate of healthcare inflation (averaged to be 3.9% over the past 10 years) to bring values in line with 2011 dollars. Costs of MTM therapy were assumed to be \$250 per patient per year. Costs of increased adherence (direct medication costs) were factored in as well. All data were then simulated using mathematical modeling to determine any cost savings or avoidance.

Results: Results: Previously published data had shown significant cost avoidance due to decreased healthcare utilization, lower medication costs and decreased incidence of opportunistic infections when failure of an ARV regimen due to non-adherence was avoided. When these factors were modeled with documented increases in adherence and clinical success rates (as measured by % of viral loads as being undetectable) with increasing adherence, it was possible to estimate total cost avoidance in an HIV-infected MTM population. Cost avoidance was determined to be, on average, \$1,177 dollars per patient per year (PPPY) in drug costs and \$1,788 PPPY for all healthcare costs. Cost avoidance for all healthcare dollars ranged from \$881 PPPY for early stage patients, \$2,356 in middle stage patients, and \$2,531 in late stage patients. When a total cost of MTM care was factored, an ROI of up to 7:1 was determined for the provision of MTM services to HIV-infected patients with low adherence.

Conclusion: While the model used is limited by using data from various, unrelated sources, and utilizes data from different time points and stages in the evolution of ARV therapy, it does allow us to get some sense of the cost avoidance that can be achieved when MTM services are offered to HIV-infected patients. Theoretical cost avoidance of an average of up to \$1,788 PPPY and a maximal ROI of 7:1 on MTM therapy makes further research in this area of interest and validation.

Background

• HIV infection is a very costly disease to treat both in the use of antiretrovirals to prevent disease progression and the costs associated with the complications of HIV infection such as opportunistic infections and lost productivity. In 2006, \$7.1 billion dollars were spent on antiretroviral medications in the US with the total cost of these medications expected to rise to \$10.6 billion in the US by 2015¹. In addition, antiretroviral medications are difficult to use, demand adherence >95% for maximal efficacy²⁻⁴ and have many, common adverse effects and drug interactions. The need for support in both patient adherence and medication therapy monitoring are high in these patient populations.

• The degree of success of Antiretroviral (ARV) therapy has been shown to hinge on near perfect adherence by patients⁵⁻⁸. While >95% adherence is correlated with the highest degree of antiretroviral therapy success, adherence <80% been shown to be a predictor of virologic failure. A recent meta-analysis has shown that only 62% of HIV-infected patients on ARV therapy achieved adherence levels greater than 90%.⁹ Interesting, in the range of 50-80% adherence in antiretroviral therapy, there is a near 1:1 correlation with a rise of adherence to the percentage of patients reaching a viral load that is below the limit of detect (primary goal of therapy)⁴.

• While the need is apparent, there is little data on the effects on cost that antiretroviral therapy adherence has on the overall cost of HIV therapy. Currently, there are specific regimens that are recommended for use in HIV patients initiating therapy on ARV regimens (aka "Naïve" patients) and others that are recommended for later lines of therapy¹. Unfortunately, medications for later stage patients can cost up to 70% more than drugs used for the treatment of naïve patients (2009 AWP data – data on file (Sustiva vs. Isentres). In addition, data from 1998 have shown that there is a clear rise in direct and indirect costs by about \$700 (1998 dollars) per patient per year associated with failure of antiretroviral therapy regimens⁸. Finally, while there is not a lot of data on the clinical effects of MTM therapy in HIV infected patients, limited data shows that adherence can be raised as much as 18.6% over a year with a decrease in changes in ARV therapy by 22.6%, but at the cost of a rise in direct medication costs by \$570 dollars per year (2009 dollars)⁹. All of these factors coupled together give a basis for predicting what the cost avoidance, cost savings the potential ROI in an MTM program focused on HIV infected patients.

• The RamsellMTM Solution is a Medication Therapy Management (MTM) solution that has been designed from the ground up to meet any current or future Part D requirements, any MTM service delivery model and to be flexible enough to meet the goal of delivering MTM services to specialty patients. Recently, Ramsell clinical pharmacists have begun utilizing the Ramsell MTM solution to deliver MTM services to HIV-infected patients to multiple customers. While the cost benefit and return on investment (ROI) for MTM services have been well quantified for various Part D – related diseases states such as diabetes, CHF and others, there exists no direct data on the potential cost savings, cost avoidance or ROI for MTM services for HIV-infected patients¹⁰⁻¹². Cost effectiveness for HIV adherence interventions have previously been shown to have a threshold of \$100/month⁴. Whether or not MTM services for HIV infected patients has not been looked at previously.

• Based on this information, Ramsell Corporation has attempted to model the potential cost avoidance and ROI that might be seen by a program sponsor at least 1 year after the implementation of an HIV-specific MTM program.

Methods

Give the lack of direct evidence for all cause cost avoidance and estimated ROI from HIV specific MTM therapy, the authors attempted to develop a model based on disparate, but related known factors that affect ARV therapy success, costs associated with failure of ARV therapy and known effects of HIV specific MTM services had on changes to ARV therapy and patient adherence. All factors were combined and modeled using straight line estimation.

– All data used in the mathematical model were abstracted from previously published or presented sources.

– Data relating the cost of failure of ARV regimens was utilized from were pulled from a previous abstract and were assumed to be (in 1998 dollars)⁸

- \$703 per year on average cost increase for a ARV failure
- \$716 increase due to adherence only failure
- \$1087 increase do to all causes failure

– ARV use patterns were pulled from the 2006 DHHS guidelines for the use of antiretroviral therapy (latest guidelines related to abstracted costs of therapy)¹³.

– Adherence improvement data with MTM therapy for HIV patients was pulled from published reports with the assumptions of an average increase in adherence of 18.2% and decrease in changes to ARV therapy of 22.6%⁹.

– Data on the relationship between HIV ARV adherence and % change of having an undetectable viral load, as well the clinical consequences of having an undetectable vs. a detectable viral load, were abstracted from published reports. A 1:1 correlation with adherence vs. the achieving of an undetectable viral load across the adherence range of 50-80% was assumed from previously published trials⁴.

– All patients were assumed to have between 50-80% adherence at the beginning of MTM therapy.

– All cost data were corrected for the rate of healthcare inflation (averaged to be 3.9% over the past 10 years) to bring values in line with 2011 dollars.

– Costs of MTM therapy were assumed to be \$250-500 per patient per year.

– Costs of increased adherence (direct medication costs) were factored in as well and assumed to be \$570/year⁹.

– Previous abstracts had utilized definitions of therapy such as early, middle and late stage therapy. These were interpreted to mean preferred, alternative then acceptable regimens per the 2006 DHHS guidelines for the use of ARV agents¹⁴.

– Adherence related ARV costs included projected drug costs and associated monitoring costs only.

– All Cause ARV failure costs were calculated including pharmacy, medical provider office visits, ED visits, hospitalization and laboratory costs

– All data were then simulated using mathematical modeling to determine any cost savings or avoidance.

– Cost effectiveness of HIV MTM services were review based on cost avoidance, ROI and previous research showing a cost effectiveness threshold of \$100 per month.

Miscellaneous Assumptions:

- All cause avoidance of ARV regimen change will mirror ARV adherence changes costs
- Increases in adherence will directly lead to proportional increases in viral load suppression
- 1:1:1 ratio of patients in early, middle and late stage ARV therapy

Results

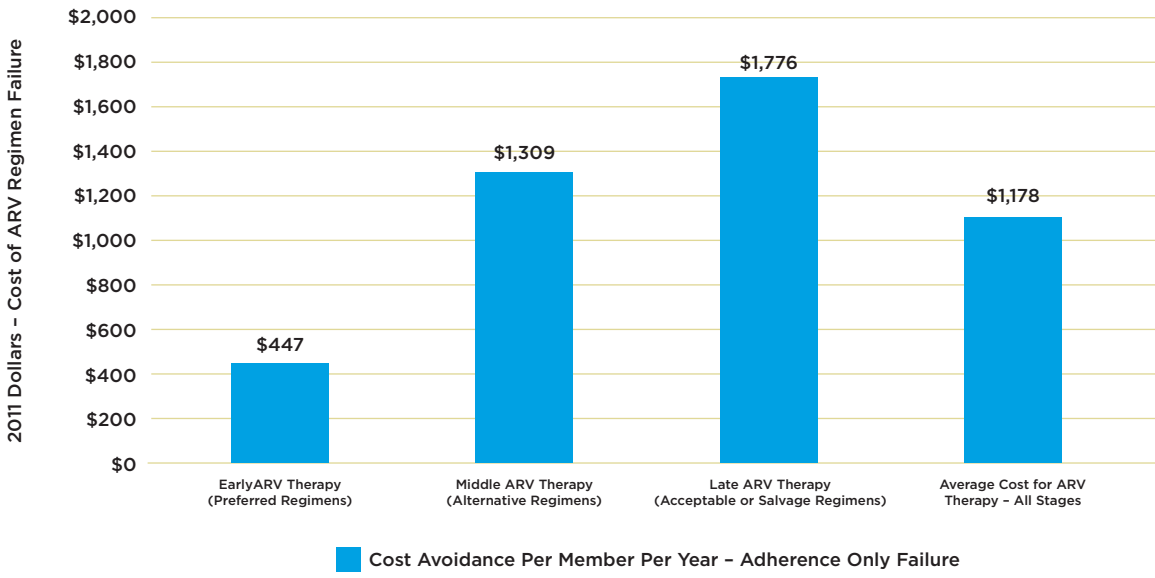
Cost avoidance was determined to be, on average, \$1,177 dollars per patient per year (PPPY) in drug costs.

Cost avoidance was determined to be, on average, \$1,788 PPPY for all healthcare costs.

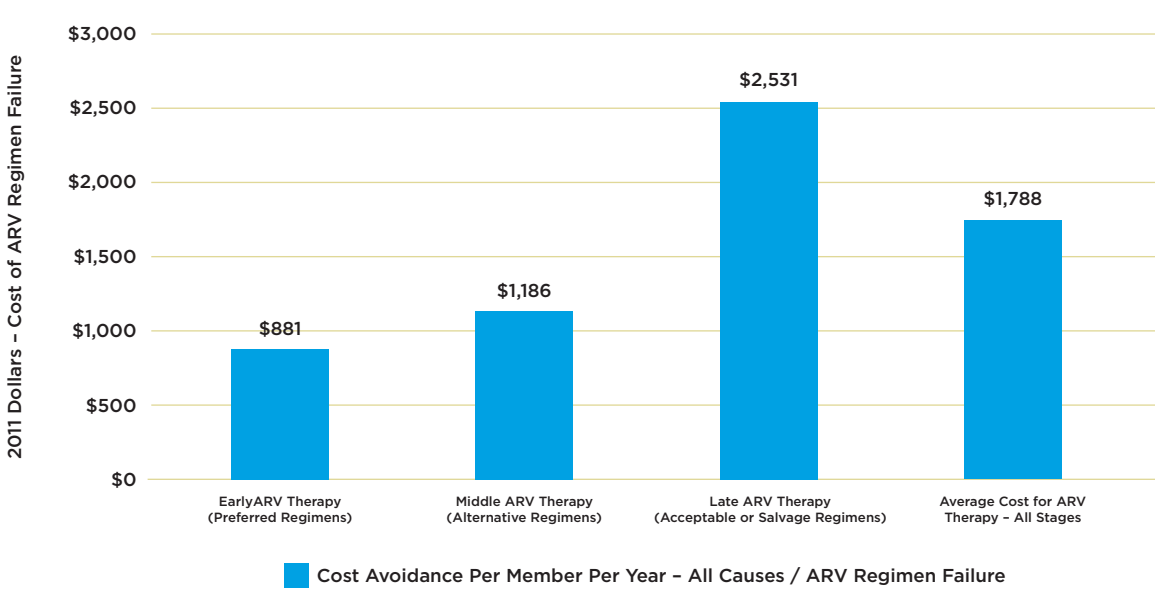
Cost avoidance for all healthcare dollars ranged from \$881 PPPY for early stage patients, \$2,356 in middle stage patients, and \$2,531 in late stage patients.

When a total cost of MTM care was factored, an ROI of up to 5:1 (at \$500 PPPY) and 10:1 (at \$250 PPPY) were determined for the provision of MTM services to HIV-infected patients with low adherence.

Indirect ARV Cost Avoidance due to MTM Interventions – Adherence only



Indirect ARV Cost Avoidance due to MTM Interventions – All Causes



ROI Estimates for HIV specific MTM Services by failure cause and patient stage

	Early ARV Therapy (Preferred Regimens)	Middle ARV Therapy (Alternative Regimens)	Late ARV Therapy (Acceptable or Salvage Regimens)	Average Cost for ARV Therapy – All Stages
Cost Avoidance For Member Per Year – All Cause ARV Regimen Failure	\$881	\$1,186	\$2,531	\$1,788
ROI – MTM Services at \$500	1.762	2.372	5.062	3.576
ROI – MTM Services at \$250	3.52	4.74	10.12	7.15

	Early ARV Therapy (Preferred Regimens)	Middle ARV Therapy (Alternative Regimens)	Late ARV Therapy (Acceptable or Salvage Regimens)	Average Cost for ARV Therapy – All Stages
Cost Avoidance For Member Per Year – All Cause ARV Regimen Failure	\$447	\$1,309	\$1,776	\$1,178
ROI – MTM Services at \$500	0.89	2.62	3.55	2.36
ROI – MTM Services at \$250	1.79	5.24	7.10	4.71

Conclusions

- HIV Specific MTM Services are projected to have or be:**
- Produce a cost avoidance of \$1178 per year, on average, for direct drug and adherence related costs
 - Produce a cost avoidance of \$1788 per year, on average, for all costs relating to ARV failure
 - Produce an average ROI of 3.5 for all cost avoidance
 - Produce an average ROI of 2.36 for direct medication and adherence costs
 - Are cost effective at \$500 per year (\$42/month) based on previously determine cost effectiveness thresholds
 - HIV Specific MTM services have more ROI for later stage patients and may not be cost effective in ARV naïve patients without other risk factors (e.g. poor adherence, substance abuse issues, etc), but actual data is needed for further quantification.

Limitations of this study:

- Estimate only based previously published data
- Straight Line Mathematical model and not based on actual cost data
- Data sources are diverse and heterogeneous in nature
- Actual costs may vary depending on service model and provider knowledge in the area of HIV care.

Resources

- 1 Henry J Kaiser Family HIV/AIDS report April 2007 – referenced from Thebody.com, March 2012: <http://www.thebody.com/content/art40611.html>
- 2 Arnstead et al. Antiretroviral Therapy Adherence and Viral Suppression In HIV-Infected Drug Users: Comparison of Self-Report and Electronic Monitoring. CID 2001;33;1417-23.
- 3 Paterson et al. Adherence to Protease Inhibitor Therapy and Outcomes in Patients with HIV Infection. Ann Intern Med.2000;133:21-30
- 4 Nachega et al. Adherence to Nucleoside Reverse Transcriptase Inhibitors-Based HIV Therapy and Virologic Outcomes. Ann Intern Med. 2007;146:564-573
- 5 Grossberg R, Zhang Y, Gross R. A time-to-prescription-refill measure of antiretroviral adherence predicted changes in viral load in HIV. J Clin Epidemiol. 2004;57(10):1107-10.
- 6 Ortego C, Huedo-Medina TB, Llorca J, et al. Adherence to highly active antiretroviral therapy (HAART): A meta-analysis. AIDS Behav. 2011;15(7):1381-1396.
- 7 Guidelines for the Use of Antiretroviral Agents in HIV-1-Infected Adults and Adolescents. August 11, 2011; pp 1-174. Available at <http://www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf>
- 8 Incremental Costs of HIV Suppression in HIV Therapeutic Failure J. Stansell, J. Barrett, C. De Guzman, C. Holtzer, and D. Lapins. 7th CROI, 2000, Abs. #761
- 9 Evaluation of First Year of a Pilot Program in Community Pharmacy: HIV/AIDS Medication Therapy Management for Medi-Cal Beneficiaries. Hirsch, JD, Rosenquist A, Best B, et al. JMCPh Jan/Feb. 2009 15(1): 32-41
- 10 Cantwell-McNelis K, James CW. Role of clinical pharmacists in outpatient HIV clinics. Am J Health Syst Pharm. 2002;59(5):447-52.
- 11 March K, Mak M, Louie SG. Effects of pharmacists' interventions on patient outcomes in an HIV primary care clinic. Am J Health Syst Pharm. 2007;64(24):2574-78.
- 12 Cranor CW, Bunting BA, Christensen DB. The Asheville Project: long-term clinical and economic outcomes of a community pharmacy diabetes care program. J Am Pharm Assoc. 2003;43:173-84.
- 13 Bunting BA, Cranor CW. The Asheville Project: long-term clinical, humanistic, and economic outcomes of a community-based medication therapy management
- 14 Isetts BJ, schondelmeyer SW, artz MB, lenarz LA, heaton AH, wadd WB, brown LM, cipolle RJ. Clinical and economic outcomes of medication therapy management services: the Minnesota experience. J Am Pharm Assoc (2003). 2008 Mar-Apr;48(2):203-11
- 15 Guidelines for the Use of Antiretroviral Agents in HIV-1-Infected Adults and Adolescents October 10, 2006; pp 1-121. Available at: http://medicine.yale.edu/mtmed/infdis/images/HIV-treatment_tcm319-31408.pdf
- 16 The cost of HIV medication adherence support interventions: results of a cross-site evaluation. Schackman BR, Finkelstein R, Neukermans CP, Lewis L, Eldred L; CENTER FOR ADHERENCE SUPPORT AND EVALUATION (CASE) TEAM. AIDS Care. 2005 Nov;17(8):927-37.