The Impact of Information Delivery Improvement on Prescription Adherence among HIV Positive Individuals

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I. INTRODUCTION

For patients with medical conditions, receiving adequate healthcare is essential to maintain a good quality of life. Patient adherence to prescribed medicine is crucial to improve long-term results, especially for chronic diseases. Non-adherence exacerbates diseases and increases the financial burdens of patients, healthcare providers, and the country. Prescription adherence is particularly critical for human immunodeficiency virus (HIV) treatment (Philipson et al. 1993). For example, skipping one dose of HIV medication can cause the virus to become resistant to certain medicines and thus increase hospitalization rates. Today, more than 1.1 million Americans live with HIV infection, and not following medication guidelines is the most common barrier to HIV treatment. Immigrants, minorities, and underserved populations are least likely to comply with treatment protocols (Andersen et al. 2000; Shapiro et al. 1999). Because HIV/AIDS has unique barriers to treatment, additional efforts are required to assist these individuals with obtaining adequate healthcare. In like manner, many recent studies evaluated the use of emerging technology to improve outcomes in different health care fields. In this paper, the main goal is to show how technology as a process effects prescription adherence behavior of HIV positive patients.

In its World Health Statistics 2013 publication, the World Health Organization reports that the United States has the highest total per capita health care spending ($8,233) among 194 developed countries. Despite investing billions of dollars, the country's efficiency of healthcare ranks near the bottom, in terms of mortality rates and life expectancy. Prescription non-adherence is a significant cause of poor healthcare return for such a large investment. For example, Osterberg and Blaschke (2005) report that, in the United States, poor medication adherence causes 33% to 69% of medication-related hospitalizations and costs around $100

billion annually. Along with the public health aspect, nonadherence to prescribed medication is a significant economic issue.

Economics science describes technology as "the implementation of new knowledge leading to higher output per unit input" (Sloan et al. 2012). An example could be a new application or a new process in practice rather than new machinery. However, a large number of adherence studies investigate technological progress as a product innovation such as portable or in-home remainders, smart pills…etc. Tailoring educational information to individual needs is a substantial process innovation in HIV treatment, especially considering HIV patients' unique barriers to treatment. For this reason, this paper examines the effect of tailoring educational information to individual needs on adherence preferences of HIV patients. The disease approach which is "*quantifying the marginal benefits of technological change"* is used in this research.[1]

II. LITERATURE REVIEW

The World Health Organization defines adherence as "the extent to which a person's behavior—taking medication, following a diet, and/or executing lifestyle changes—corresponds with agreed recommendations from a health care provider." Prescription adherence is one link in the chain of adherence behavior. Unfortunately, there is no universally accepted measurement of medication adherence, which creates a substantial challenge in reviewing the literature. Adherence measurements in previous studies can be grouped as self-reports, pharmacy records, pill counts, and electronic monitoring. Electronic monitoring provides the most accurate results,

[1] Sloan et al. (2012) states that there are three analytic approaches to measure health gains due to technology: 1) the disease approach, 2) the proxy variable approach, and 3) the accounting approach.

but it is a costly method and rarely used in studies (Maxwell et al. 2004). Pills counts and self-reports are the most frequently used methods, but it is difficult to measure accuracy based upon patient claims and impossible to determine if patients are taking incorrect doses or taking correct doses at incorrect times. Therefore, it is important to assess risk of bias in all of these studies.

Many studies do not include detailed socioeconomic characteristics of the participants, because of the inconsistent results in explaining medication adherence (Vermeire et al. 2001). Other studies show that a socioeconomic disadvantage is strongly associated with nonadherence behavior (Wamala et al. 2007; Kaplan et al. 2004). A recent study that was conducted in Denmark over seven years between 2004 and 2011 with 16,248,861 observations found that older patients tend to show higher adherence than do younger patients, men are less likely to adhere than are women, married people are more compliant than are single people, and immigrants are, on average, 3% less adherent than Danes. This study uses OLS and two-stage least squares analysis. (Koulayev et al. 2013). In addition to the socioeconomic characteristics, disease-related factors such as social stigma of being HIV positive reported as significant barrier to prescription adherence (Mills et al. 2006). Other researches from Chesney et al. (2000) and Magura, et al. (2002), indicated that those who suffer from psychiatric illnesses tend to comply less with their medical regimen. Initial medical and psychiatric condition is found to be important in patients' engagement in their therapy. In addition, health and medication beliefs of the patients are identified as substantial determinants of medication adherence (Mann, et al. 2007). Patients who have concerns about effectiveness of the medication or have concerns about the long term side effects are less likely to be adherent. Especially in HIV/AIDS treatments, there are many patients who do not believe that there is a cure for HIV. Also, therapy-related

factors such as regimen complexity is found to be negatively correlated with adherence (Rabkin et al. 1999).

There are many studies investigating the relation between prescription adherence and healthcare cost especially for chronic diseases such as HIV. Along with the monetary costs of adherence, economists studied the opportunity cost of being adherent to prescribed medication. A study from Lamiraud and Yves (2007) investigates the perceived costs' (such as expected side effects) effect on medication adherence preferences of HIV patients. According to the Probit model regression results, a 1% increase in expected side effects decreases adherence by 14%.

Along with the patient and disease characteristics that mentioned above, adoption of a specific protocol or a new technology to improve medication adherence is studied by the economists as well as health professionals. Even though most studies that evaluates effects of a new technological device on adherence controlled for device-related factors such as clarity, accessibility, applicability and replicability the results of these studies are inconsistent. The results are also inconsistent for process innovation technologies. For example, Gazmararian et al. (2010) found that implementation of a 3-step intervention (phone reminders, visual prescription cards and training pharmacists to communicate better with the patients) did not improve adherence significantly. On the other hand, a study from Center for Health Services Research, Henry Ford Hospital, Detroit found that implementation of a 3-step intervention (pill counts, training a family member to support adherence, and proving information to the patients when it is needed) increased the prescription adherence of uncontrolled hypertension patients. This study contributes to the literature by explaining the relation between prescription adherence and technological improvement as a process innovation. More specifically, this study analyses

the effects of implementing the process of tailoring educational information to specific patient needs on adherence preferences of HIV positive individuals by using the Disease Approach.

III. DATA

Data for this study comes from Positive Connections: Connecting HIV-Infected Patients to Care at Ann Arbor Michigan Inter-university Consortium for Political and Social Research and funded by United States Department of Health and Human Services Health Resources and Services Administration. The survey was conducted between 2004 and 2006 by using methods of record abstracts, face-to-face and telephone interviews, mail and on-site surveys in New England, United States. The data was obtained from 103 HIV-infected individuals who are 18 years old and older. In this study, there were 92 observations due to lack of available data for some of the variables used in the regression. The complete database contains 1366 variables. The database was specifically created to enhance the underserved populations' engagement in their treatment. Summary statistics are represented in the following table (Table 1).

Table 1

Variable	Number of Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
Adherence	101	0.6237624	0.486857	0	1
Gender Dummy	101	0.6732673	0.4713578	0	1
Year Dummy	101	0.7326733	0.4447716	0	1
Age	101	44.46535	8.031892	22	64
Partner Dummy	101	0.5841582	0.4953247	0	1
White Dummy	101	0.3960396	0.4915121	0	1
Child Dummy	101	0.1188119	0.3251808	0	1
Education Level	101	12.871129	2.492643	8	18
First HIV Diag.- Exam Time	101	0.70297703	28.78348	0	130
Stigma Score	101	0.7029703	1.315633	0	6

Incentive Dummy	101	0.1584158	0.36695516	0	1
Unmet Needs	101	3.39604	2.010369	0	7
Received Assistance	101	1.613861	1.979749	0	7
Side Effect Dummy	101	0.2079208	0.4078439	0	1
Cocaine Dummy	101	0.2475248	0.4337267	0	1
ER Visits	101	0.990099	1.486574	0	7
Information Needed Dummy	101	0.3960396	0.4915121	0	1
Mental Component Summary	101	40.23713	11.42157	17.19	63.51
Physical Component Summary	101	45.84297	11.06583	16.6	65.24
Years with HIV+	101	10.83861	5.841112	0	26.1
Scheduled Visits	101	3.722772	4.67686	0	30
Ease of Access Dummy	101	0.693069	0.2552421	0	1
Face-to-Face Meetings	101	2.168317	3.218911	0	19
Health Belief Score	92	1.076087	1.206518	0	6

IV. THEORETICAL MODEL

The theory starts from basic consumer preferences to have a better understanding of the factors that affect the decision-making. The observable factors that influence the decision-making process of a patient who chooses whether or not to comply with the prescribed medication is identified as five major groups: 1) sociodemographic characteristics, 2) economic factors, 3) disease-related factors, 4) therapy-related factors, and 5) medical and psychiatric condition. The choice relationship can be denoted as

(1) Adherence= f (sociodemographic characteristics, economic factors, disease-related factors, therapy-related factors, medical and psychiatric condition, other unobserved factors)

In the economic factors, monetary costs will not be taken into account since HIV treatments are free of charge in the United States. In this case, the cost includes the non-financial costs such as

cost of being adherent, loss of productivity and need for social welfare programs (Lamiraud et al. 2007; Ellickson et al. 1999; Scalera 2002).

Based on the previous studies, stigma is one of the most significant disease-related barriers to adherence, especially for individuals with living HIV (Rintamaki et al. 2006). Also, motivation to follow up with the medication is a substantial disease-related factor for HIV patients. In addition, social support plays a major role as an external factor of motivation. Support from peers, partner, children…etc. effects the patients' decision regarding the treatment because individuals do not make decisions isolated from each other. Manski (2000) and Leibenstein (1950) show that there are direct and indirect mechanisms that may affect individuals' decision-making process. The following function illustrates this relationship.

(2) Disease related factors: g [stigma, motivation h(social support)]

Models in this field analyze the therapy-related factors in depth to capture all possible variations in adherence behavior. The model of Pharmaceutical Choice and Welfare breaks down the therapy-related factors as the treatment effects on health, regimen complexity and access to care which can be represented as

(3.1) Therapy-related factors: f (treatment effects, regimen complexity, access to care)

In addition to the therapy-related factors above, technological process has a substantial impact on the health care outcomes. Besides the adherence studies mentioned in the literature review, there is a growing number of empirical evidence that shows technological improvement in medicine increased the longevity and the quality of life (Okunade et al. 2012; Lichtenberg, 2003). The

framework of this relationship between the inputs and the health care output is shown by the following figure (see Figure 1; CD4 Counts[2]).

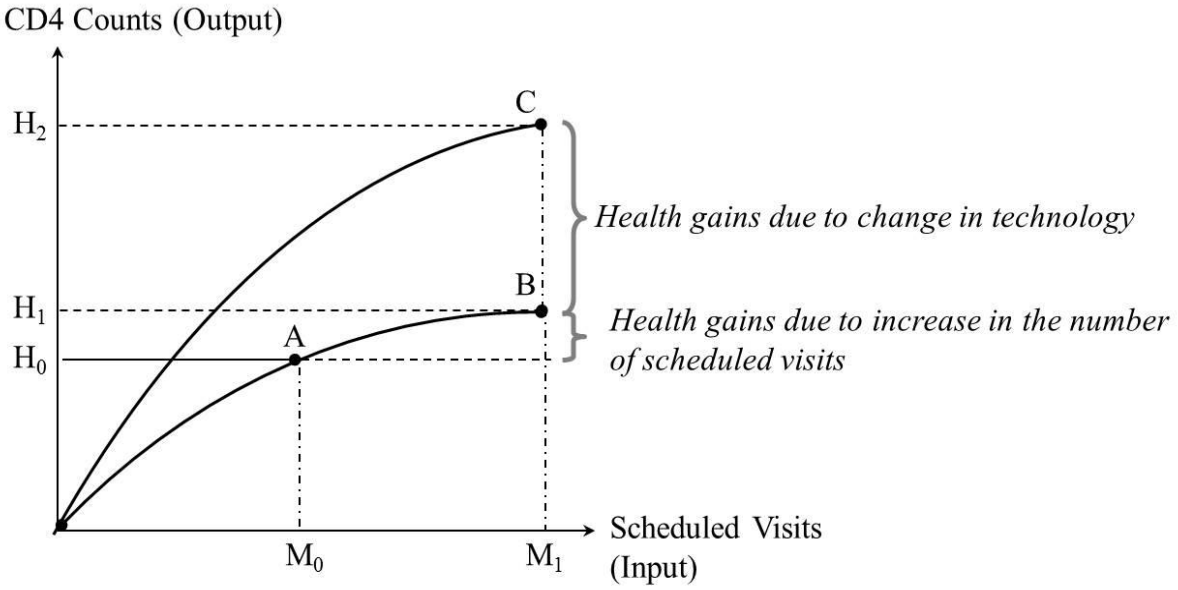


Figure 1: Health Production Function in a Static and Dynamic Context (Sloan et al. 2012)

The above production function may represent the relationship between various health inputs and output. At input level M_0, output level is at H_0 and marginal product of an input is the slope at point A. As the input increases, there will be diminishing returns to individual inputs. A technological progress will result as an upward shift (upper curve) in the total production function and slope at point C will give the new marginal product (Sloan et al. 2012). Therefore, extension of therapy related factors with technological improvement can be represented by the following function:

(3.2) Therapy related factors: f (treatment effects on health, regimen complexity, access to care, technology)

[2] CD4 cells play a major role in the immune system. Counting CD4 cells show how well the immune system functioning.

The assumption is that individuals make rationale choices in which they will obtain the highest possible level of satisfaction. As well as adherence, non-adherence is a rational choice influenced by the attributes of the factors listed above. In the decision-making process, individuals make their own cost and benefit analysis with the relevant information they have. In this case, the individual's overall medical and psychiatric condition is important in determining the initial level of "decision making capacity" (DMC). Anderson's Behavioral Model summarizes patient's medical and psychiatric condition as current health state, behavioral skills and health & medication beliefs (Andersen 1995).

(4) Medical and psychiatric condition = m (current health state, behavioral skills, health and medication beliefs)

Placing the equations (2), (3.1), (3.2) and (4) into equation (1), we obtain;

Adherence = f [sociodemographic characteristics, economic factors, disease related factors h(stigma, motivation g[social support]), therapy related factors k(treatment effects on health, regimen complexity, access to care, technology), medical and psychiatric condition m(current health state, behavioral skills, health & medication beliefs), other unobserved factors]

V. EMPIRICAL MODEL

Binary discrete choice models are used to examine the choice process. In another words, the model analyzes the consumer preferences to have a better understanding of the factors that affect the decision-making. In this model, our decision-making unit is the HIV positive individual who faces two discrete choices: being perfectly adherent or not adherent at all.

Therefore, individual preferences can only take two values corresponding to the two discrete choices and it can be represented as

$\Theta = 1$ if the patient is perfectly adherent

$\Theta = 0$ if the patient is not adherent

To analyze the determinants that influence the probability of a choice, Linear Probability Model can be used. The linear probability model is given by

$$Y_i = \beta_1 + \beta_2 X_{i2} + \ldots + \beta_k X_{ik} + \mu_i$$

The explanatory variables can be derived from the theoretical model. Since a predicator is not available in the data set, I will omit regimen complexity. The following variables are used by many prescription adherence studies including Trajtenberg (1990) and Philipson et al. (1993). The empirical equation can be written as

$$\begin{aligned} Adherence = {} & \beta_0 + \beta_1(age) + \beta_2(education\ level) + \beta_3(gender\ dummy) + \beta_4(white\ dummy) + \\ & \beta_5(Income) + \beta_6(unmet\ needs) + \beta_7(received\ assistance) + \beta_8(year\ dummy) + \\ & \beta_9(Years\ HIV+) \beta_{10}(stigma\ score) + \beta_{11}(child\ dummy) + \beta_{12}(incentive \\ & dummy) + \beta_{13}(partner\ dummy) + \beta_{14}(info\ needed\ dummy) + \beta_{15}(face\text{-}to\text{-}face \\ & meetings) + \beta_{16}(scheduled\ visits) + \beta_{17}(ER\ visits) + \beta_{18}(side\ effect\ dummy) + \\ & \beta_{19}(ease\ of\ access\ dummy) + \beta_{20}(mental\ summary\ score) + \beta_{21}(physical\ summary \\ & score) + \beta_{22}(first\ HIV\ diagnostic - examination\ time) + \beta_{23}(cocaine\ dummy) + \\ & \beta_{24}(health\ belief\ score) \end{aligned}$$

Independent Variables	Expected Sign	Explanation
1. Sociodemographic Characteristics		
Age	+/ –	By the theory, sociodemographic characteristics have far less effect on adherence than any other identified group. Previous studies have found that age has an influence on adherence but it is inconsistent. While some studies show a positive relationship, others find it to be negatively related with adherence.
Education Level	+	Education level in terms of schooling years have found to be strongly correlated with health (stronger than occupation an income in most cases). However some other studies showed no association.
White Dummy	+	Previous studies have showed that race is a significant predictor of adherence. Studies that are conducted in the U.S. indicated that white race show higher medication compliance levels than black race.
Gender Dummy	+/ –	Although some studies suggest that women adhere less, other studies found that it had no relationship with adherence.
2. Economic Factors		
Income	+	Low income is associated with poor adherence. Even though HIV treatment is free in the U.S., previous studies show that free medication does not completely remove the financial barriers of low-income patients.
Unmet needs	–	Total number of unmet needs based on Mental Health Services Act (7 needs) which includes whether or not the individual receives a service for housing, financial, employment, transportation, food, legal assistance or assistance to receive any of the first six service. It is expected to see lower levels of adherence as the unmet needs increase due to higher financial concerns.
Received Assistance	+	Total number of received services based on Mental Health Services Act, listed above.
Year Dummy	+/ –	The variable is created to capture the economic difference between 2004 and 2005.
3. Disease-related Factors		
Years HIV+	+	The variable refers to the total number of years that the patient is suffering from HIV. By the theory, the time that a patient suffers from a chronic illness contributes the patient's adherence behavior positively. Also, previous studies indicate a positive correlation with adherence.

Face-to-face meetings with OE	+	Higher numbers of face-to-face meetings have shown a strong relationship with adherence. Therefore, we expect to see a positive relationship.
Stigma		
Stigma Score	–	Social stigma is one of the most important barriers to adherence. It is expected to see a negative correlation.
Motivation		
Child Dummy	+	Having a dependent child (18 or younger) has been found to be strongly correlated with patients' motivation on their treatment. Therefore, a positive relationship between adherence and child dummy is expected.
Incentive Dummy	+	Previous studies indicate that patients who knew that she/he'd get something else (gift certificates, coupons…etc.) besides medical benefits when visiting the clinic have higher incentives to follow up with their regimen. This variable is created to capture this difference between the patients.
Social Support		
Partner dummy	+	Emotional and practical support a family member or partner is found to increase medication adherence of the patients. It helps patients to cope with possible barriers.
4. Therapy-related Factors		
Information needed dummy	+	The variable refers to the key technological process improvement: tailoring information to individual patient needs. The information given to the specific patient about specific problem regarding their current health/ social /financial condition helps patients to cope with unique barriers to adherence. Patients who needed information support and received the relevant information are more likely to adhere. When technology allows patients to receive information on time, it is expected to see a positive correlation with the patients' adherence preferences.
Treatment Effects on Health		
Number of scheduled visits	+	Patients who visit their healthcare provider regularly -as scheduled- are associated with better adherence due to the regular communication and check-up.
Number of ER visits	–	Especially for chronic diseases, poor adherence leads to frequent emergency room visits. Previous studies show a negative relationship

		between adherence and ER visits.
Side Effect Dummy	–	Side effects are one of the biggest challenges to medication adherence. Studies show that presence of side effects decreases medication adherence significantly.
Access To Care		
Ease of access dummy	+	HIV-infected patients face highly challenging tasks to achieve adequate adherence levels. Accessing a care center is one of these challenges and previous studies show that it is a primary determinant of adherence success. Easy access to a care center is associated with better adherence.
5. Medical and Psychiatric Condition		
Current Health State		
Mental Component Summary Score (MCS)	+	MCS SF-12 is a standardized, comprehensive survey that measures the mental health. Poor medication adherence is common among patients with mental disorders due to no or insufficient self-medication management. Therefore, higher MSC scores are associated with better medication adherence. The maximum MCS score is 100.
Physical Component Summary Score (PCS)	+/–	Unlike MCS score, PCS score does not lead to a certain behavior towards adherence. There are two possible outcomes: 1) A physically healthy patient does not feel need for medication; she/he adheres poorly. 2) Being healthy is considered to be a result of perfect adherence; she/he continues to be perfectly adherent. The maximum PCS score is also 100.
Behavioral Skills		
First HIV diagnostic- examination time	–	The time between the first HIV- positive test and seeing a healthcare provider for the first time indicates the patient's carelessness of her/his illness. It is expected to see a negative relationship with adherence behavior.
Cocaine dummy	–	Patients who use cocaine and heroin are more likely to show depression symptoms and side effects are stronger. Therefore, by the previous studies, crack cocaine use has found to be strongly associated with poor adherence.
Health- Medication Beliefs		
Health Belief Score	–	Lower perceived effectiveness of treatment is expected to decrease the adherence. Patients who does not believe that they can be cured are less likely to be adherent.

VI. REGRESSION RESULTS AND ANALYSIS

Regression results of the Linear Probability Model (LPM) and Probit Model are presented in the Appendix Table-2. The scatterplots of residuals versus dependent and independent variables suggest that there might be a heteroskedasticity problem (Appendix Scatterplots). Also, error terms are not normally distributed. These two problems show that there is a violation of linearity. In addition to the visual tests, Breusch-Pagan test results show that null hypothesis cannot be rejected at 95% level of significance (Appendix Table-3). Also, White test results are represented in the Appendix Table-4. Even though Goodness-of-fit test results show that overall regression model is a good fit for the data, the model speciation process showed that there is a major heteroskedasticity problem (Appendix Table-5). Therefore, Linear Probability Model robust is used as a benchmark.

Probit model is used to compare the results with the benchmark model (LPM). Also, Table-6 shows that 84.78% of the values correctly classified by the Probit Model (Appendix Table-6). Correlation matrix and variance inflation factors (VIF) do not indicate a multicollinearity issue (Appendix Table-7 and Table-8). The correlation matrix shows that there is no perfect or strong correlation.

***Major Findings**:* Probit Model Marginal effects

Based on the results of the probit model, the information needed dummy is significant at 99% significance level and shows a positive relationship with adherence. It shows that patients who needed information support and received the relevant information are 20.06724% more likely to adhere to the prescribed medication. The patient group showed a significant increase in the adherence behavior as a response to receiving tailored educational information. The results

show that the variable has one of strongest impacts on adherence behavior compared to the other explanatory variables. These patients were able to receive the information for their specific need by a phone call or face-to-face meeting (stopping by the clinic). Partner dummy is also statistically significant (at 99% level) and is positively correlated. Patients who have partners are 26.44345% more likely to be adherent than patients with no partner. Likewise, child dummy has been found to be positively correlated with patients' adherence to prescribed medication. As it is stated by the theory, parents have higher incentives to get better to take care of their dependent children. The results show that having a dependent child (18 years old or younger) increases probability of being adherent by 18.67106%. The PCS score has an unexpected effect on adherence: it shows that as the patients have higher scores, they are less likely to be adherent. When the patients feel healthier (physically), they are more likely to skip medication doses or stop using it. 1 unit (point) increase in the PCS score decreases the probability of being adherent by 0.74146 %.

VII. CONCLUSION

In this study, I attempt to answer whether technology as a process impacts prescription adherence behavior of HIV patients. The findings suggest that tailoring educational information to specific patient needs increases the prescription adherence of HIV positive individuals. When technology allows patients to receive information on time, they are more likely to adhere to the prescribed medication. It should be noted that the results of my regression would be bias; since I could not use a predictor for regimen complexity.

Suggestions for further research are; 1) finding data on regimen complexity which is the omitted variable in this research will help to get unbiased results; 2) more accurate results can be

obtained by measuring medication adherence through electronic monitoring or pharmacy records. However, these methods are costly to conduct on large sample groups. Lastly, 3) future research may examine the costs of the technological improvement and implementation compared to the economic costs of non-adherence. Many studies found that implementation of a new technology takes up a large part of health care costs due to the high costs of the new technological setting. It would be a large contribution to the literature to show the economic costs before and after applying a new technology in the long run.

Proposed Policy Implications

Based on the regression results, tailoring educational information to individual needs and social support have strong positive effects on medication adherence of HIV positive individuals. Therefore, implementation of a 2-step intervention: 1) providing educational information to the patients whenever it is needed (e.g. having a 24/7 call center) and 2) encouraging and training a family member or partner to support adherence will increase medication adherence. Also, to promote adherence to HIV regimens new research and studies should be encouraged and emphasized by the federal government. Further studies will bring the new technology (knowledge) that allows rapid improvements in the clinic and the public policy.

APPENDIX

Table 2: Regression Results

Independent Variable	Linear Probability Model (Robust)		Probit Model (Robust)		Probit Model (Marginal Effects)	
	Coefficient	**P > | t |**	**Coefficient**	**P > | t |**	**dy/dx**	**P > | t |**
Gender Dummy	-0.0607497	0.608	0.1844318	0.711	0.0367177	0.720
Year Dummy	-0.2872764	0.008***	-2.160937	0.002***	-0.2348872	0.003***
Age	0.0008285	0 0.889	0.0164621	0.571	0.00316	0.566
Partner Dummy	0.171804	0.093*	1.236309	0.001***	0.2644345	0.005***
White Dummy	0.0937642	0.349	0.9334919	0.025**	0.163535	0.017**
Child Dummy	0.2088166	0.078*	2.941649	0.004***	0.1867106	0.01***
Education Level	-0.003165	0.881	0.0597852	0.447	0.0114761	0.449
1st HIV Diag.- Exam	-0.0034877	0.046**	-0.0253254	0.001***	-0.0048613	0.000***
Stigma Score	0.0150628	0.718	-0.0492076	0.726	-0.0094457	0.724
Incentive Dummy	-0.1137095	0.427	-0.5787353	0.338	-0.1380349	0.412
Unmet Needs	-0.0423618	0.210	-0.2588512	0.073*	-0.0496878	0.103
Received Assistance	0.0272902	0.460	0.237988	0.104	0.045683	0.123
Side Effect Dummy	-0.1649635	0.261	-1.104493	0.033**	-0.2998613	0.103
Cocaine Dummy	0.0017169	0.989	0.6293186	0.253	0.1000148	0.145
ER Visits	-0.0298605	0.394	-0.2272803	0.099*	-0.0436276	0.124
Info Needed Dummy	0.0975853	0.328	1.127378	0.045**	0.2006724	0.009***
Mental Component Sum.	0.0051308	0.271	0.0265406	0.183	0.0050946	0.163
Physical Component Sum.	-0.0060261	0.225	-0.0386267	0.084*	-0.0074146	0.102
Years with HIV+	0.0159778	0.093*	0.1153307	0.022**	0.0221383	0.027**
Scheduled Visits	0.0134992	0.313	0.3641598	0.001***	0.0699024	0.000***
Ease of Access Dummy	-0.2349635	0.326	-0.6696234	0.437	-0.1746766	0.538
Face-to-Face Meetings	0.0150132	0.340	0.0783574	0.323	0.0150411	0.327
Health Belief Score	-0.0521581	0.214	-0.3453086	0.032**	-0.0662838	0.060*
Income	0.0000023	0.819	0.0000779	0.325	0.000015	0.343
Constant	0.7893777		-1.337234			

Significant at 10% = * Significant at 5% = ** Significant at 1% = ***

Linear Probability Model, Robust		Probit Model, Robust	
Number of obs.	92	Number of obs.	92
Prob > F	0.0000	Wald chi2(24)	62.28
R-squared	0.4180	Prob > chi2	0.0000
		Pseudo R2	0.5048

Table 3: Breusch-Pagan Test Results

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho:	Constant variance
Variables:	fitted values of Adherence
chi2(1) =	1.48
Prob. > chi2 =	0.2235

Table 4: White Test Results

Source	chi2	df	P
Heteroskedasticity	92.00	91	0.4510
Skewness	26.37	24	0.3349
Kurtosis	7.30	1	0.0069
Total	125.66	116	0.2542

Table 5: Goodness-of-fit Test Results

Probit model for Adherence, goodness-of-fit test

number of observations =	92
number of covariate patterns =	92
Pearson chi2(67) =	64.91
Prob. > chi2 =	0.5495

Table 6: Correctly Classified Values by Probit Model

Probit model for Adherence

	------True-------		
Classified	D	~D	Total
	51	7	58
	7	27	34
Total	58	34	92

Classified + if predicted PR(D) >= 0.5
True D defined as Adherence != 0

Sensitivity	Pr (+|D)	87.93%
Specificity	Pr (-|~D)	79.41%
Positive predictive value	Pr (D|+)	87.93%
Negative predictive value	Pr (~D|-)	79.41%
False + rate for true ~D	Pr (+|~D)	20.59%
False - rate for true D	Pr (-|D)	12.07%
False + rate for classified +	Pr (~D|+)	12.07%
False - rate for classified -	Pr (D|-)	20.59%
Correctly classified		84.78%

Table 7: Linear Correlation

	Adherence	Gender	Year	Age	Partner	White	Child	Educ. Lvl	1st HIV D.	Stigma S.
Adherence	1.0000									
Gender Dummy	-0.0217	1.0000								
Year Dummy	-0.3091	0.0506	1.0000							
Age	0.0715	0.2846	0.0331	1.0000						
Partner Dummy	0.2824	-0.0222	-0.1635	0.0095	1.0000					
White Dummy	0.0309	0.0688	0.0235	-0.0252	0.0039	1.0000				
Child Dummy	0.1950	-0.1943	-0.0597	-0.1246	0.0949	-0.1440	1.0000			
Education Level	0.0926	0.0512	0.1063	0.0584	-0.0610	0.0509	0.1070	1.0000		
First HIV Diag.- Exam Time	-0.1677	-0.0169	-0.0215	0.1602	-0.0133	0.0287	-0.0882	-0.0007	1.0000	
Stigma Score	-0.0566	0.0270	0.0118	0.0096	-0.0522	-0.0123	-0.0775	0.0092	0.0020	1.0000
Incentive Dummy	-0.1497	-0.1211	-0.0404	-0.0682	-0.0284	-0.0284	-0.1541	-0.2887	0.1840	0.0345
Unmet Needs	-0.1378	-0.1110	-0.0052	-0.1152	-0.0939	-0.0532	0.0417	-0.0837	0.0128	0.0831
Received Assistance	-0.0857	0.0631	0.0713	-0.1084	-0.1206	-0.0343	0.0870	0.0366	-0.0660	0.1769
Side Effect Dummy	-0.1577	-0.0754	-0.1414	-0.0223	0.0221	-0.0478	0.0137	-0.0631	0.1558	0.1507
Cocaine Dummy	-0.1820	-0.0664	0.1944	-0.1677	-0.2025	-0.0640	-0.1210	-0.1115	-0.0507	0.1130
ER Visits	-0.1226	-0.1261	0.1784	-0.0161	-0.0597	0.0175	0.0410	-0.0052	-0.0158	0.0570
Information Needed Dummy	0.0188	-0.1330	-0.0051	0.0699	-0.0463	-0.0756	-0.0169	-0.0524	0.0627	0.2949
Mental Component Sum.	0.1877	0.0521	0.0769	0.1515	0.0637	-0.1134	0.0392	0.1454	0.0974	-0.2098
Physical Component Sum.	-0.0422	-0.1051	-0.0647	-0.1165	0.0376	-0.0663	-0.2143	-0.0048	-0.1496	0.0178
Years with HIV+	0.1185	0.1051	0.0206	0.2499	-0.0419	-0.1130	-0.0855	0.0568	0.2708	-0.0601
Scheduled Visits	0.2080	-0.1761	-0.2780	0.1073	0.0915	0.0737	-0.0896	0.0170	0.1567	0.0172
Ease of Access Dummy	-0.2538	0.0952	0.1437	0.1420	-0.1236	0.1425	0.0492	-0.2701	0.0027	-0.0388
Face-to-Face Meetings	0.2584	0.1309	-0.0730	0.1262	0.1550	0.0030	0.0375	0.0650	-0.0746	-0.1021
Health Belief Score	-0.2893	0.0069	0.0561	-0.1542	-0.0906	-0.0520	-0.0221	-0.0517	0.0842	0.2931
Income	0.0825	-0.0338	-0.0139	0.0364	0.0514	-0.1352	0.1613	0.3010	-0.0269	0.0406

	Incentive	Unmet N.	Received Asst.	Side Effect	Cocaine	ER Visits	Info Needed	MCS	PCS	Years HIV+
Incentive Dummy	1.0000									
Unmet Needs	0.1609	1.0000								
Received Assistance	-0.0871	0.6233	1.0000							
Side Effect Dummy	0.0173	-0.0104	0.0672	1.0000						
Cocaine Dummy	-0.1869	-0.0185	0.0405	0.1132	1.0000					
ER Visits	-0.0451	0.1513	0.1982	0.0854	-0.0083	1.0000				
Information Needed Dummy	0.2168	0.1854	0.0511	0.1016	-0.1397	0.1036	1.0000			
Mental Component Sum.	0.0544	-0.1008	-0.1682	-0.1983	-0.2260	0.0287	-0.0408	1.0000		
Physical Component Sum.	0.0763	-0.1656	-0.1023	-0.1936	0.0646	-0.3333	-0.1486	-0.1164	1.0000	
Years with HIV+	-0.0302	0.0357	-0.0381	0.1398	0.0948	-0.1668	-0.0561	0.1531	0.0162	1.0000
Scheduled Visits	0.2864	-0.0845	-0.1521	-0.0760	-0.1832	0.0963	0.1065	0.0062	0.0203	0.0928
Ease of Access Dummy	0.0026	0.0488	0.2055	0.2145	0.0508	0.1412	0.0407	-0.1612	-0.1842	-0.1163
Face-to-Face Meetings	-0.0676	-0.0664	0.0643	-0.1458	-0.2606	-0.0005	0.0093	0.1060	0.0882	0.0714
Health Belief Score	0.1437	0.0524	0.0396	0.2732	0.1726	0.0230	0.1289	-0.1874	0.0310	0.0482
Income	-0.1327	-0.1986	-0.1957	0.1175	-0.1306	0.0099	0.0260	0.0549	-0.0234	-0.0168

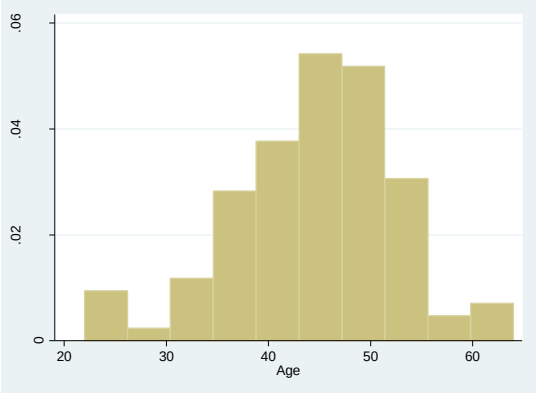
	Scheduled Visits	Access	Face2Face	Belief Score	Income
Scheduled Visits	1.0000				
Ease of Access Dummy	-0.1237	1.0000			
Face-to-Face Meetings	0.0925	-0.1498	1.0000		
Health Belief Score	-0.1048	0.2034	-0.2112	1.0000	
Income	0.0573	-0.1096	0.0305	0.0075	1.0000

Table 8: VIF Results

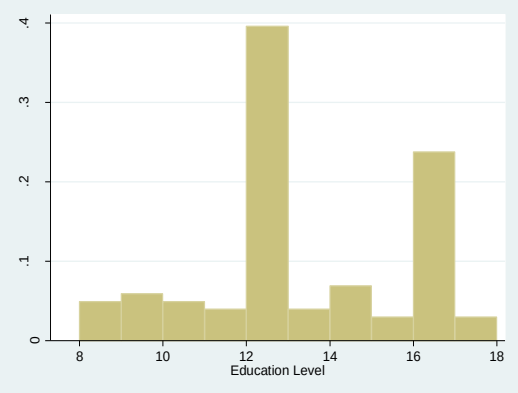
Variable	VIF	1/VIF
Received Assistance	2.29	0.435829
Unmet Needs	2.17	0.460829
Ease of Access Dummy	1.63	0.61355
Incentive Dummy	1.62	0.615476
Scheduled Visits	1.54	0.649507
Physical Component Summary	1.53	0.652578
Side Effect Dummy	1.50	0.667703
Education Level	1.50	0.668039
Cocaine Dummy	1.49	0.673086
Age	1.45	0.690566
Years with HIV+	1.44	0.694421
Gender Dummy	1.43	0.698471
Health Belief Score	1.40	0.712290
Year Dummy	1.38	0.723729
Stigma Score	1.38	0.725975
ER Visits	1.37	0.728098
Mental Component Summary	1.34	0.745071
Child Dummy	1.34	0.748911
Information Needed Dummy	1.32	0.759898
Income	1.30	0.771941
Face-to-Face Meetings	1.27	0.789987
First HIV Diag.- Exam Time	1.23	0.814869
White Dummy	1.19	0.837405
Partner Dummy	1.15	0.872419
Mean VIF	1.47	

Sampling Distribution Graphs

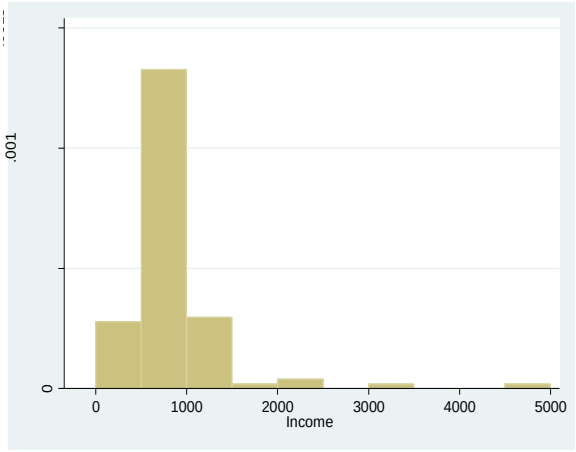
Graph A: Age



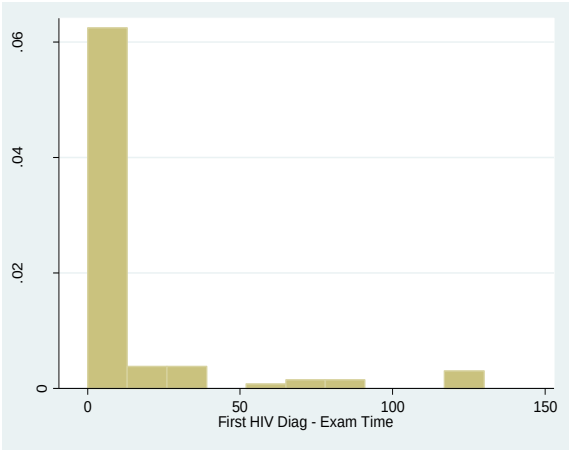
Graph B: Education Level



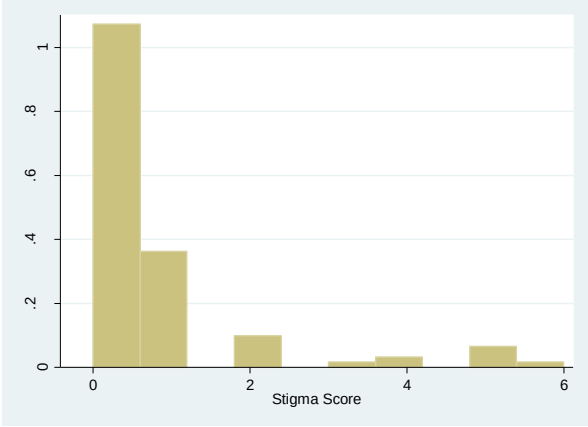
Graph C: Income



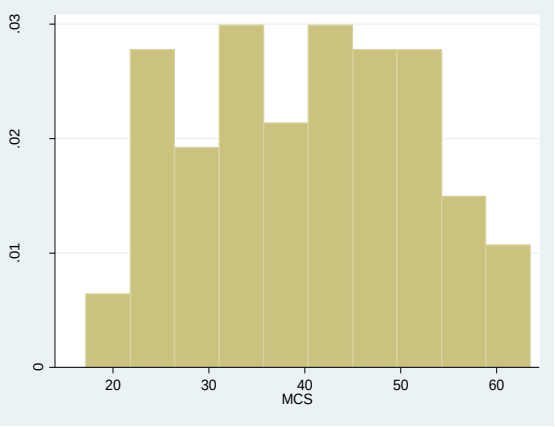
Graph D: First HIC. Diag. – Exam. Time



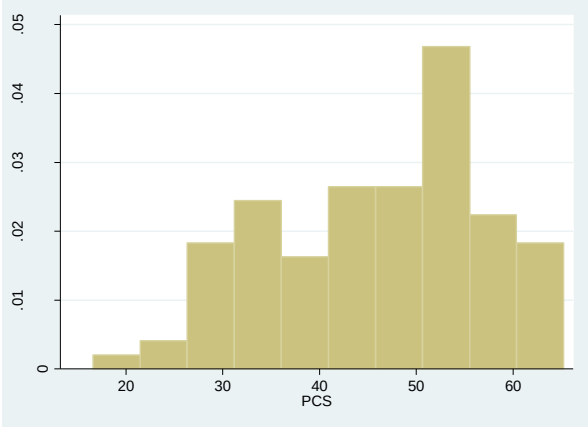
Graph E: Income



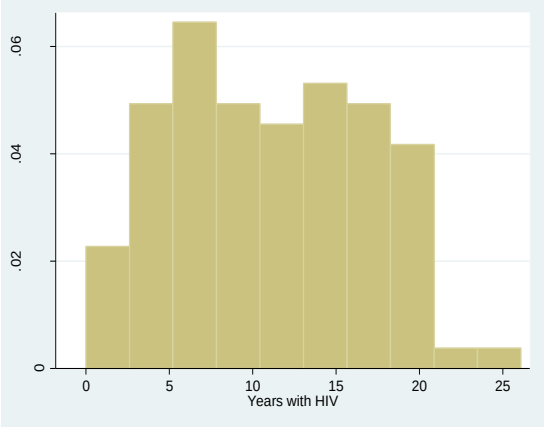
Graph F: Mental Component Sum. Score



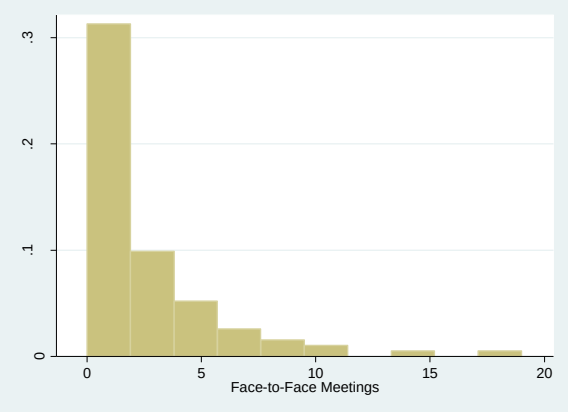
Graph G: Physical Component Sum. Score



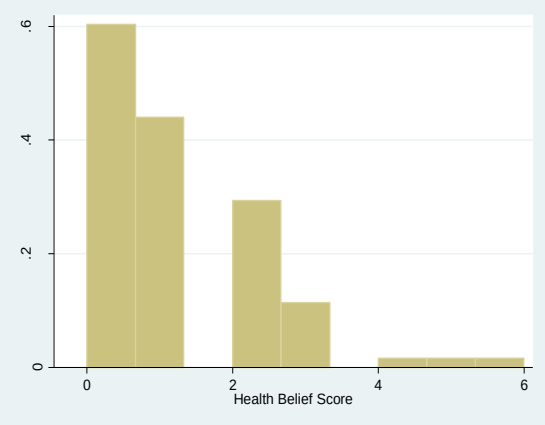
Graph H: Years HIV +



Graph K: Face-to-Face Meetings

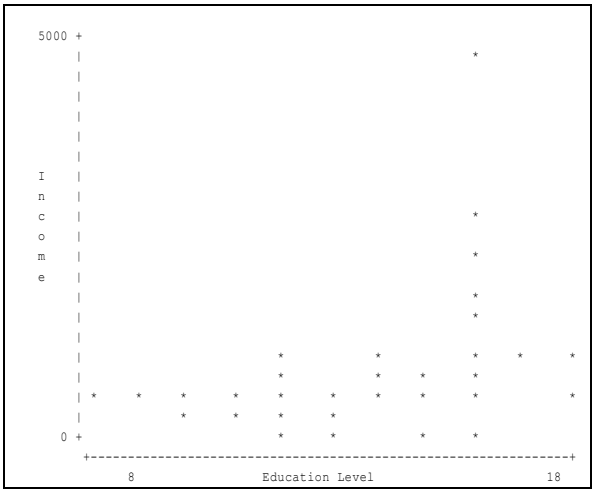


Graph L: Health Belief Score

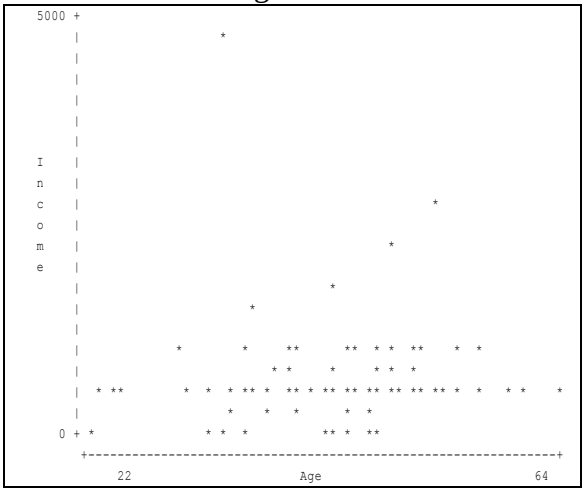


Scatterplots

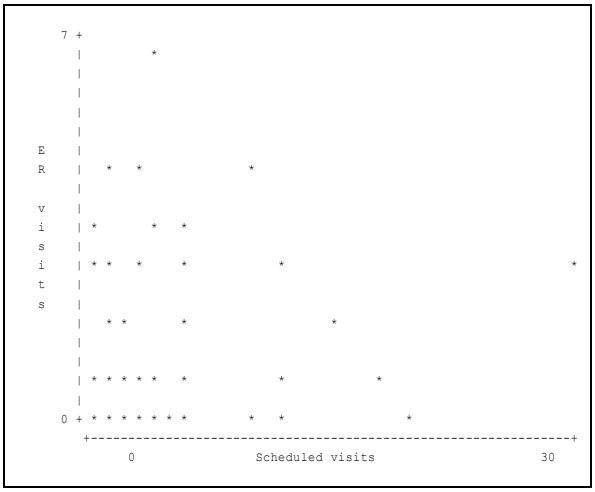
Plot A: Income vs. Education Level



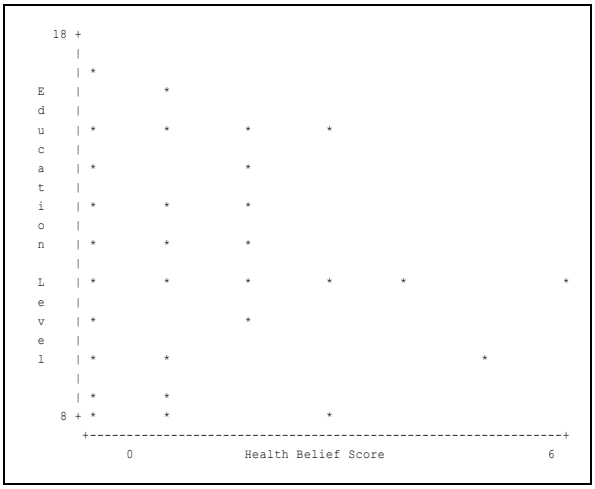
Plot B: Income vs. Age



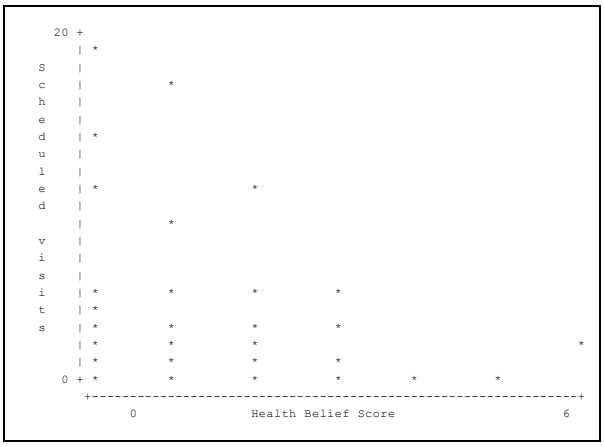
Plot C: ER Visits vs. Scheduled Visits



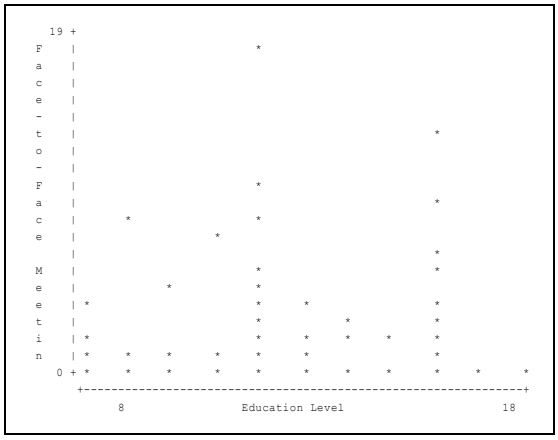
Plot D: Education Level vs. Health Belief Score



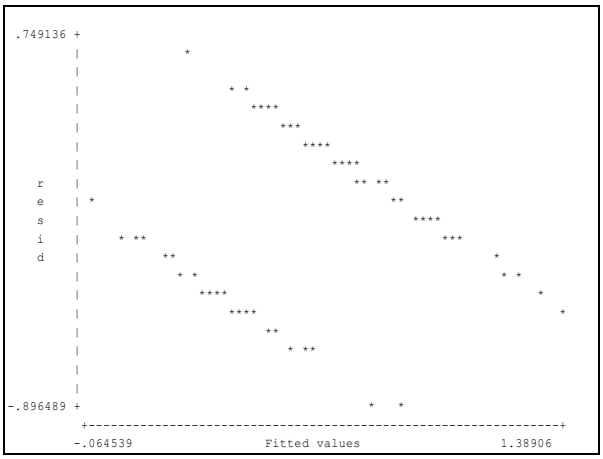
Plot E: Scheduled Visits vs. Health B. Score



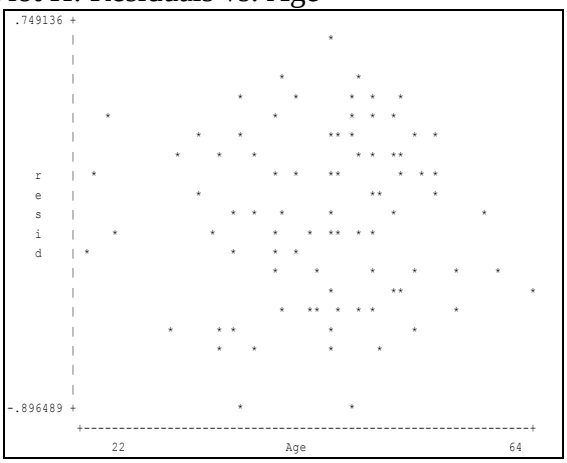
Plot F: Face-to Face Meetings vs. Educ. Lvl.



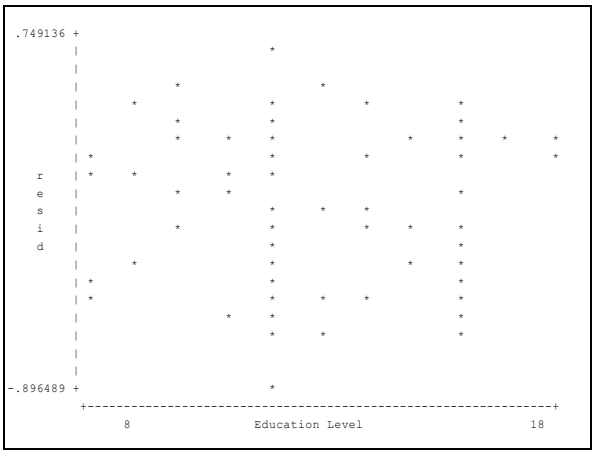
Plot G: Residuals vs. Fitted Values



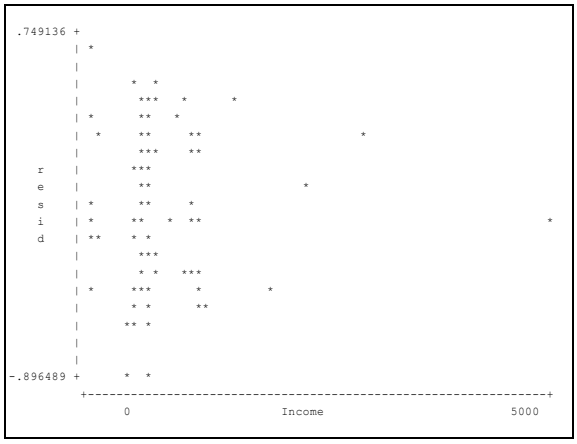
Plot H: Residuals vs. Age



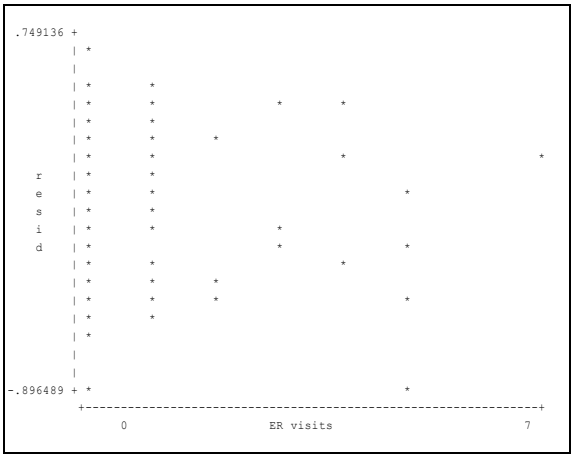
Plot I: Residuals vs. Education Level



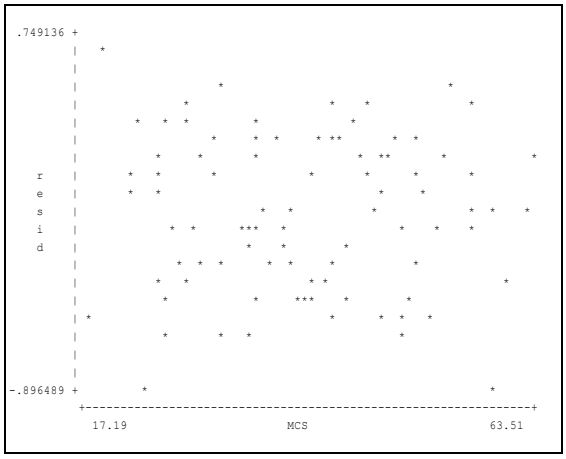
Plot J: Residuals vs. Income



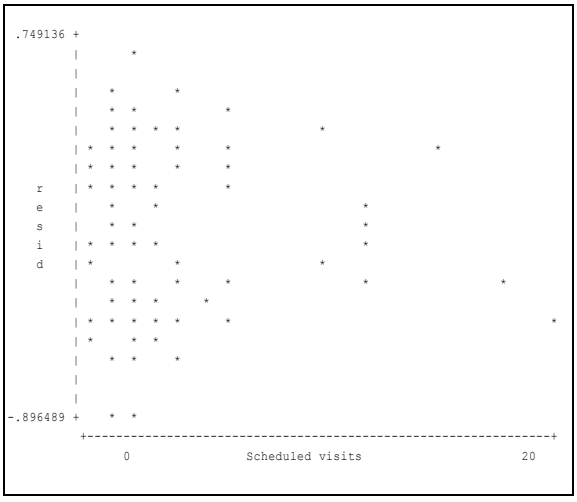
Plot K: Residuals vs. ER visits



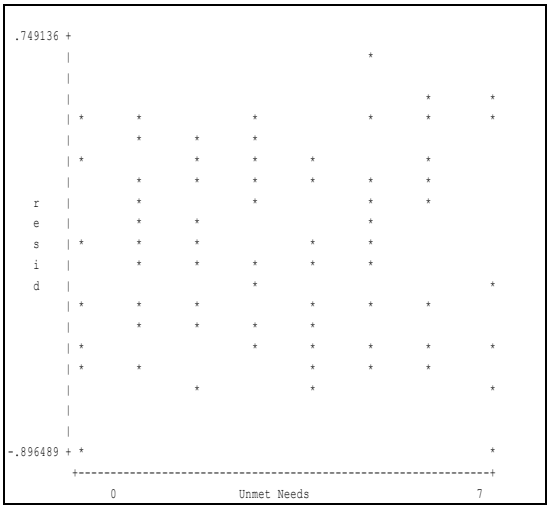
Plot L: Residuals vs. MCS



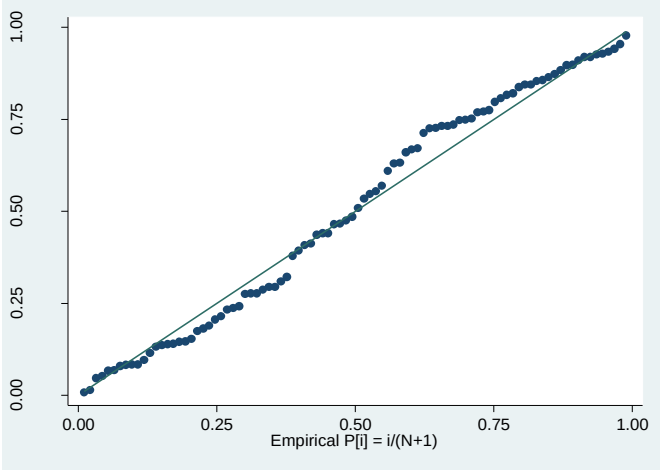
Plot M: Residuals vs. Scheduled Visits



Plot N: Residuals vs. Unmet Need



Normal Distribution of Residual



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