

THE IMPACT OF THE FULL SERVICE PARTNERSHIP PROGRAMS ON
INDEPENDENT LIVING:
A MARKOV ANALYSIS OF RESIDENTIAL TRANSITIONS

Petris Report # 2010-3

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Summary

In this report, we evaluated the implementation of the Full Service Partnership (FSP) programs with a focus on independent living. Our analysis shows that a large proportion of FSP participants can be found living independently. However, a small proportion of FSP participants had their residency in undesirable settings such as homelessness and jails.

The following consumer characteristics have been identified as being associated with an increased likelihood of independent living among FSP participants: older age, being white, being male, not having schizophrenia and/or bipolar disorder, and not having a substance abuse disorder.



Chapter 1: Introduction

In November 2004, Californians approved the ballot measure Proposition 63 (which became the Mental Health Services Act (MHSA) in January of 2005). This report focuses on one subcomponent of the MHSA, the Full Service Partnership (FSP) program, which is part of the Community Services and Supports (CSS) component of the MHSA. The CSS component provides funding for direct services and supports to adults and children with a serious mental illness (SMI) or serious emotional disturbance (SED)

Full Service Partnerships, according to the California Code of Regulations (Title 9, § 3620, 2010), may include the following services for adults:

Full Service Partnership Service Category.

(a) The County shall develop and operate programs to provide services under the Full Service Partnership Service Category. The services to be provided for each client with whom the County has a full service partnership agreement may include the Full Spectrum of Community Services necessary to attain the goals identified in the Individual Services and Supports Plan (ISSP). The services to be provided may also include services the County, in collaboration with the client, and when appropriate the client's family, believe are necessary to address unforeseen circumstances in the client's life that could be, but have not yet been included in the ISSP.

(1) The Full Spectrum of Community Services consists of the following:

(A) Mental health services and supports including, but not limited to:

- (i) Mental health treatment, including alternative and culturally specific treatments;*
- (ii) Peer support;*
- (iii) Supportive services to assist the client, and when appropriate the client's family, in obtaining and maintaining employment, housing, and/or education.*
- (iv) Wellness centers;*
- (v) Alternative treatment and culturally specific treatment approaches;*
- (vi) Personal service coordination/case management to assist the client, and when appropriate the client's family, to access needed medical, educational, social, vocational rehabilitative and/or other community services;*
- (vii) Needs assessment;*
- (viii) ISSP development.*
- (ix) Crisis intervention/stabilization services;*
- (x) Family education services.*

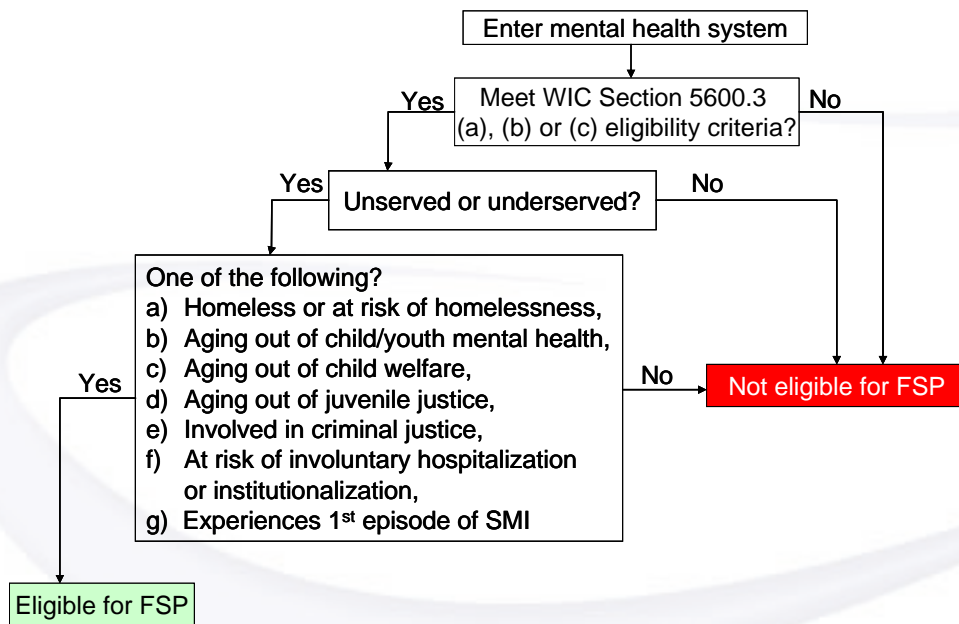
(B) Non-mental health services and supports including, but not limited to:

- (i) Food;*
- (ii) Clothing;*
- (iii) Housing, including, but not limited to, rent subsidies, housing vouchers, house payments, residence in a drug/alcohol rehabilitation program, and transitional and temporary housing;*
- (iv) Cost of health care treatment;*
- (v) Cost of treatment of co-occurring conditions, such as substance abuse;*
- (vi) Respite care.*

(C) Wrap-around services to children in accordance with WIC Section 18250 et. seq.

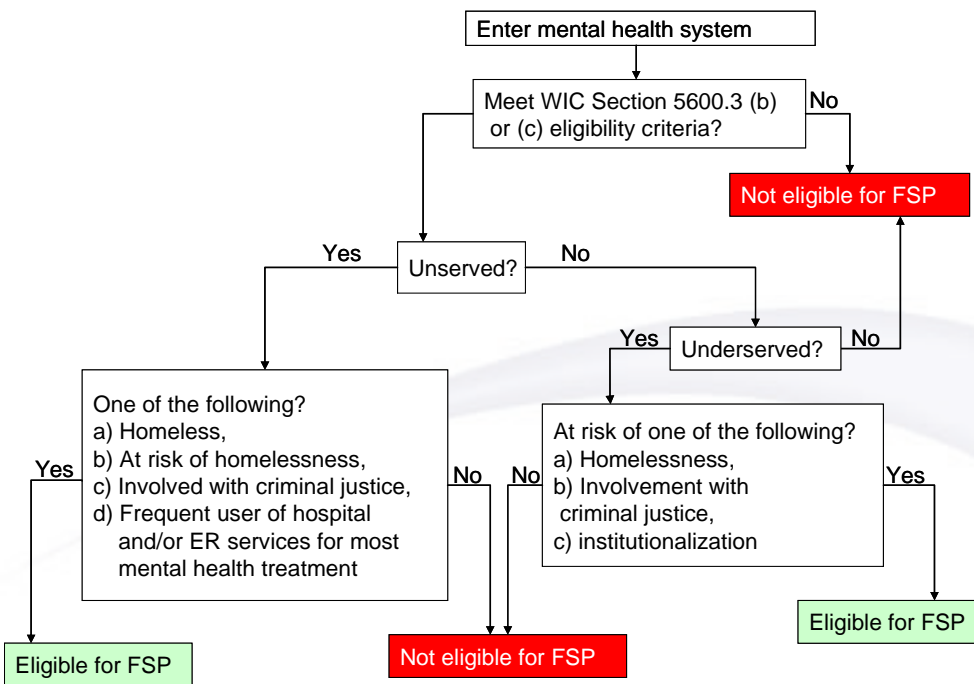
Figures 1.1, 1.2 and 1.3 show the criteria for admission into FSP programs for transition age youth, adults and older adults respectively. First, a person must meet the eligibility criteria for mental health services as defined in WIC Section 5600.3 (a), (b) or (c). Next, an individual must be unserved or underserved. Unserved is defined as someone with an SMI or SED who is not receiving mental health services. People who have only had emergency or crisis-oriented contact and/or services are considered unserved. The definition of underserved is broad, including anyone with a SMI or SED who does not receive services to support their wellness, recovery or resilience (California code of regulations, Title 9, § 3200.300, 2010). The last criteria that participants must meet varies by age group but can include: homelessness, being at risk of homelessness, involvement or being at risk of involvement with the criminal legal system, being at risk of institutionalization, being a frequent user hospitals and/or emergency room treatment for mental health care, or for transition age youth, aging out of the child and youth mental health system, child welfare system or juvenile legal system (California code of regulations, Title 9, § 3620.05, 2010)

Figure 1.1: FSP Criteria for Transition Age Youth



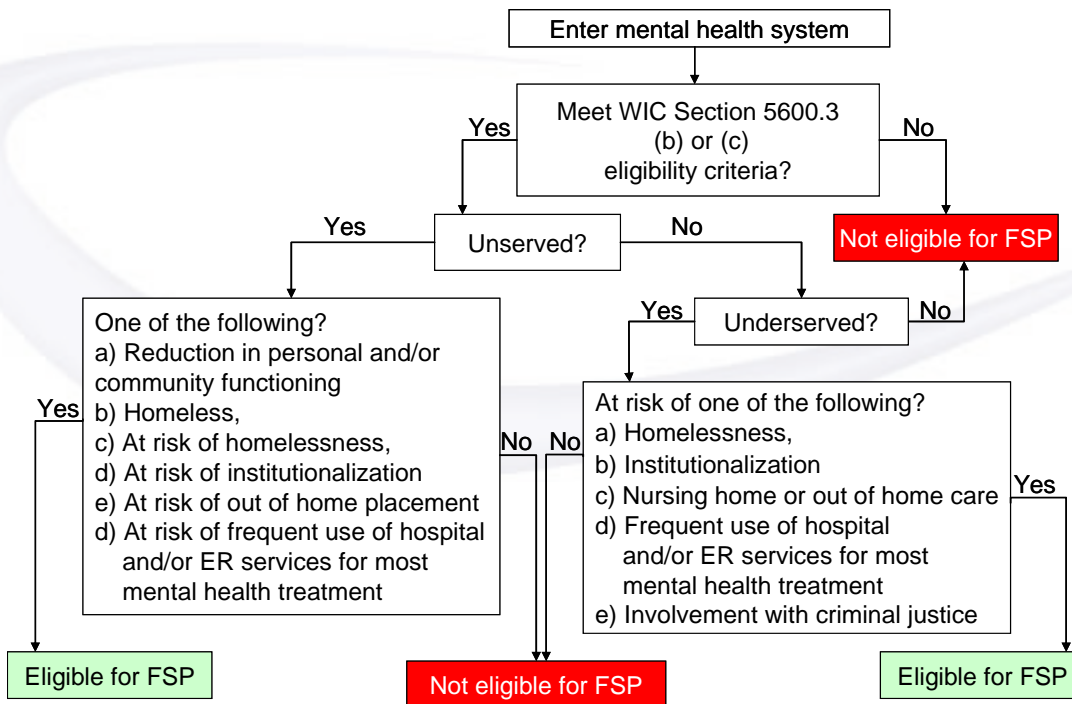
Notes: Petris Center Analysis of the California Code of Regulations, Title 9, Section 3620.05. FSP=Full Service Partnership.

Figure 1.2: FSP Criteria for Adults



Notes: Petris Center Analysis of the California Code of Regulations, Title 9, Section 3620.05. FSP=Full Service Partnership.

Figure 1.3: FSP Criteria for Older Adults



Notes: Petris Center Analysis of the California Code of Regulations, Title 9, Section 3620.05. FSP=Full Service Partnership.

Housing Outcomes

In this report, we analyze movements in and out of residency settings among FSP participants to answer the following questions:

- (1) Do socio-demographic characteristics of FSP participants alter patterns of residential transitions, and thereby influence the probability of independent living?
- (2) Does psychiatric diagnosis, including substance abuse, change the likelihood of independent living among FSP participants?
- (3) Does continuous enrollment in the FSP programs affect outcomes?

Answering these questions will assist policy makers and providers to better identify those consumers who are more/or less likely to remain in independent living status.

Chapter 2: Data and Methods

2.1. Data

The data for this analysis comes from several sources. The main source of information is Data Collection and Reporting System (DCR). Supplementary data are from the Client and Service Information (CSI) System. All systems are maintained by the California Department of Mental Health. All results are for FSP participants ages 18 or older who are participating in the Full Service Partnership (FSP) program.

Data

The main focus of our study was to examine how individuals move between different residential settings. The DCR contains information on approximately 20 different types of residential settings. For purposes of tractability, we collapsed these 20 categories into 8 main categories: Independent Living, Shelter, Homelessness, Supervised Residential, Acute Medical Hospital, Psychiatric Hospital, Licensed residential, and Jail. We originally considered Long-Term Care as a separate residential setting category, but after discovering that the sample size for this category was too small to give reasonable results given our analytical approach, we decided to exclude this setting. The various residential settings were collapsed in the following manner:

- 1) Independent Living:
 - a. In an apartment/house alone/with spouse/partner/minor children/other dependents/roommate- must hold lease or share in rent /mortgage.
 - b. With one or both biological/adoptive parents
 - c. With adult family member(s) other than parents
 - d. Single room occupancy (must hold lease)
- 2) Shelter:
 - a. Emergency shelter/temporary housing (includes people living with friends without paying rent)
- 3) Homeless:
 - a. Homeless (includes people living in their cars)
- 4) Supervised Residential:
 - a. Unlicensed but supervised individual placement (includes paid caretakers and personal care attendants)
 - b. Assisted living facility
 - c. Unlicensed but supervised congregate living (includes group living homes and sober living homes)
 - d. Licensed community care facility (board and care)
- 5) Acute Medical Hospital
- 6) Psychiatric Hospital:
 - a. Acute psychiatric hospital/psychiatric health facility (PHF)
 - b. State psychiatric hospital
- 7) Licensed residential:
 - a. Licensed residential treatment (includes crisis, short-term, long-term, substance abuse, and dual diagnosis residential programs)
 - b. Skilled nursing facility (physical)
 - c. Skilled nursing facility (psychiatric)
- 8) Jail:
 - a. Jail
 - b. Prison

Individuals who enter a FSP program are administered a Partnership Assessment Form (PAF), or baseline questionnaire, which collects information on program participation, living situation, employment, education, conservatorship, probation, and admission to emergency room (ER) facilities. When FSP program participants changed residences, data on the residential change was collected using the Key Event Tracking (KET) questionnaire. Finally, participants in the FSP program were asked to complete a quarterly (3M) questionnaire once every three months. We focused mainly on residential information from the KET and baseline residential information from the PAF.

We include sociodemographic factors as well as psychiatric diagnoses in our analysis. Sociodemographic information was taken from both the DCR dataset and the CSI dataset. Variables from the DCR dataset include race/ethnicity, gender, age, employment, sources of financial support, and education.

Psychiatric diagnoses were obtained from the CSI dataset. The diagnostic codes used the formats from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association, 2000). Psychiatric diagnoses were grouped into seven categories: schizophrenia, bipolar disorder, substance abuse disorder, depression, anxiety disorder, personality disorder, and other mental disorders. These categories were decided upon in consultation with Dr. Neal Adams, the collaborating psychiatrist for this project. Psychiatric diagnoses were used in the analysis as an indicator of medical history. All past psychiatric diagnoses were included in the analysis. This method was used primarily due to the high rate of comorbid psychiatric conditions often found in consumers with SMI (Ciapparelli *et al.*, 2007; Pulay *et al.*, 2009; Tamam, Karakus, & Ozpoyraz, 2008; Uwakwe & Gureje, 2010).

Sampling

Data are collected on all FSP participants when they enter a FSP, every 3 months following entry into a FSP, and whenever they have an event change, known as a key event. These surveys vary slightly depending on the age of the consumer. Children range from ages 0-15, transition age youth (TAY) range from ages 16-25, adults range from ages 26-59, and older adults are aged 60 years or older. Our analysis included participants 18 years of age or older per their last KET questionnaire on record. As a result, some individuals we include will be 16 years of age when they enter a FSP and complete their baseline questionnaire. If these participants remain in a FSP for two years or more, they satisfy the 18 years or older criterion as per the last KET on record and are included in this study.

Data are also collected each time a person seeks service in a county mental health facility. Consumers admitted into a county mental health facility are diagnosed with an appropriate psychiatric condition that is recorded into the CSI database.

We used FSP data from 2005-2009. At the time of this analysis, FSP data was only available for 43 of 58 California counties: Butte, Calaveras, Colusa, Contra Costa, Del Norte, El Dorado, Fresno, Glenn, Humboldt, Imperial, Inyo, Kern, Lake, Los Angeles, Madera, Mariposa, Merced, Mono, Napa, Nevada, Orange, Plumas, Sacramento, San Benito, San Bernardino, San Diego, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Stanislaus, Trinity, Tulare, Tuolumne, Ventura, Yolo, and Sutter/Yuba. The results of this study are generalizable to consumers residing in the remaining 15 counties excluded from this study to the extent that the consumers and FSP programs in the excluded counties are similar to the consumers and FSP programs in the included counties.

2.2. Statistical Approach

Markov Model of Residential Transitions

We estimated a Markov model of residential moves which calculates probabilities of movement from one residential status to another. Markov analysis has been widely used as a program evaluation tool for policy questions relating to transitions among mutually exclusive and exhaustive states of the world (Poterba and Summers 1986; Keeler, Wells and Manning 1987; Norton 1992). Most recently, for example, Norton *et al.* (2006) used a Markov model to examine the effect of a managed behavioral carve-out on transitions (movement) among jail, the public mental health system, and community living among persons with serious mental illness.

We examined movement among eight residential settings or living situations including (1) independent community living, (2) medical hospitals, (3) psychiatric hospitals, (4) supervised living facilities, (5) licensed residential facilities, (6) shelter, (7) homeless, and (8) jail. In our models, we adjusted for education, race/ethnicity, age, gender, and previous psychiatric diagnoses to see how each of these factors may influence movement between residential settings. For detailed information on our statistical approach, please see the Technical Appendix of this report.

Chapter 3: Results

Two-Week and Equilibrium Probabilities of Residential Transitions

In Table 1, we provide transition probabilities that we calculated using the estimated multivariate Markov models. The transition probabilities in Panel A are 1-period (2-week) probabilities calculated for a representative 41-year-old continuously-enrolled white man with schizophrenia and substance abuse problems who does not have a college diploma and who has participated in a FSP program for 1 year. This person is referred to as the reference person in this report.

This representative person is likely to remain in the same residential status, although independent living status is the most frequent new residential status if a transition is made. Equilibrium transition probabilities corresponding to Panel A are reported in Panel B. For example, the steady-state (or unconditional) probabilities of independent living and jail detention are 52% and 5%, respectively.

Influence of Socio-Demographic Characteristics

A 20-year-old person is less likely than the reference person (*i.e.*, 41-year old counterpart) to have independent living status, use medical hospitals, or be homeless (see Table 3.2 (A1)). However, the probability of being in jail is significantly greater for the 20-year-old person, meaning that jail stays among the FSP participants decreases with age. Similarly, a 60-year-old person appears more likely to be in independent living although the difference of equilibrium probabilities was not significant (See Table 1 (A2)). Compared to the reference person, this 60-year-old is more likely to use medical hospitals, but is less likely to be in psychiatric hospitals or jail. To summarize, increases in age are significantly associated with a greater probability of medical hospital use, a greater probability of independent living up to around age 60, but a lower probability of being in undesirable residential settings such as homelessness (until about age 50) or jail.

Compared to whites, non-whites are more frequently found in residential settings related to less-desirable recovery outcomes such as psychiatric hospitals, supervised living facilities, homelessness, and jail. Non-whites are less likely than whites to be in medical hospitals.

Gender plays a role only in determining the use of hospitals (see Table 1 (A4)). Women are less likely than men to use medical hospitals, but are more likely to use psychiatric hospitals.

Finally, there is no statistically significant influence of education levels on residential transitions. Please see Table 1(A5).

Influence of Psychiatric Disorders and Substance Abuse

Compared to those with schizophrenia, persons with a record of bipolar disorder are more often found in independent living settings (see Table 1 (B1)). They are less likely to be in psychiatric hospitals or licensed residential facilities, but are more frequently found in shelters. For persons with other types of mental disorders such as depression, personality or anxiety disorders, the likelihood of independent living is significantly greater as compared to persons with schizophrenia or bipolar disorders (see Table 1 (B2)). They are also less frequently found in psychiatric hospitals and licensed residential facilities.

Substance abuse appears to have a detrimental effect on independent living. Compared to the reference person, persons without a record of substance abuse are significantly more likely to live independently in the community, and are less likely to be in licensed residential facilities, be homeless, and be in jail (see Table 1 (B3)).

Length of Participation in FSP Programs

Compared to the reference person who participated in a FSP program for six months, persons who participated longer, up to two years, are more often found in psychiatric hospitals. However, this difference does not exist for persons who participated more than two years. The decreases in the probability of living in licensed residential facilities are always statistically significant. The probability of being in shelters is smaller for persons in the program for more than two years, compared to the reference person. Surprisingly, jail stays increase with the length of participation.

In fact, this result may be due to the fact that the FSP programs endeavor to serve persons with the most debilitating symptoms who are in jail more frequently. To further investigate this issue, we collapsed our data at the person level and ran a regression of the number of days in FSP programs. The model controlled for covariates similar to those in the Markov model. We found that nonwhites, as well as people with schizophrenia, and bipolar disorders are significantly associated with the duration of FSP participation. This finding implies that the trend towards jail is likely due to the fact that FSP participants with more severe symptoms tend to remain in the program for a longer period of time due to the severity of their illness.

This interpretation is supported by results reported in Table 1 (C3). Continuous participation was found to be significantly associated with a greater likelihood of independent living as well as a smaller probability of being in supervised living facilities, being homeless, and being in jails.

Chapter 4: Conclusion

The purpose of this report was three-fold. We analyzed data on residential transitions among FSP participants, aiming to answer the following questions.

- (1) Do socio-demographic characteristics of FSP participants alter patterns of residential transitions, and thereby influence the probability of independent living?
- (2) Does psychiatric diagnosis, including substance abuse, change the likelihood of independent living among FSP participants?
- (3) Does continuous enrollment in the FSP programs affect outcomes?

Our analysis shows that a large proportion (52%) of FSP participants can be found living independently. However, a small proportion of FSP participants had their residency in undesirable residential settings such as homelessness (4.8%) and jails (5.3%).

The following consumer characteristics have been identified as being associated with a decreased likelihood of independent living among FSP participants: younger age, being non-white, being a woman, having schizophrenia and/or bipolar disorders, and having substance abuse disorders. These findings warrant continuous and focused efforts to improve recovery outcomes for these consumers.

We also find that continuous program participation in a FSP program improves the likelihood of independent living. Efforts to reduce drop-outs among the participants may improve the likelihood of recovery among consumers.

Tables and Figures

Table 1: Effects of individual characteristics on equilibrium transition probabilities for a representative person in a FSP for six months

	<i>Next period:</i>							
	Independent living	Medical hospital	Psychiatric hospital	Supervised living	Licensed residential	Shelter	Homeless	Jail
	Compared to: 41-year-old white man with schizophrenia and substance abuse who did not have a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.5170	0.0087	0.0310	0.0475	0.2485	0.0466	0.0484	0.0525
(A) Socio-Demographic Characteristics								
	(A1) 20-year-old white man with schizophrenia and substance abuse who does not have a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.4746	0.0033	0.0347	0.0569	0.2621	0.0525	0.0371	0.0789
Difference	-0.0424*	-0.0054*	0.0037	0.0094	0.0136	0.0059	-0.0113*	0.0264*
95% Lower bound	-0.0747	-0.0073	-0.0009	-0.0042	-0.0140	-0.0043	-0.0189	0.0121
95% Upper bound	-0.0101	-0.0035	0.0083	0.0230	0.0412	0.0161	-0.0037	0.0407
	(A2) 60-year-old white man with schizophrenia and substance abuse who does not have a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.5394	0.0193	0.0265	0.0484	0.2315	0.0421	0.0583	0.0345
Difference	0.0224	0.0106*	-0.0045*	0.0009	-0.0170	-0.0045	0.0099	-0.0180*
95% Lower bound	-0.0072	0.0055	-0.0080	-0.0076	-0.0400	-0.0117	-0.0010	-0.0247
95% Upper bound	0.0520	0.0157	-0.0010	0.0094	0.0060	0.0027	0.0208	-0.0113
	(A3) 41-year-old non-white man with schizophrenia and substance abuse who does not have a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.4867	0.0054	0.0379	0.0614	0.2213	0.0461	0.0678	0.0734
Difference	-0.0303	-0.0033*	0.0069*	0.0139*	-0.0272	-0.0005	0.0194*	0.0209*
95% Lower bound	-0.0735	-0.0060	0.0004	0.0016	-0.0657	-0.0112	0.0021	0.0043
95% Upper bound	0.0129	-0.0006	0.0134	0.0262	0.0113	0.0102	0.0367	0.0375

	<i>Next period:</i>							
	Independent living	Medical hospital	Psychiatric hospital	Supervised living	Licensed residential	Shelter	Homeless	Jail
	(A4) 41-year-old white woman with schizophrenia and substance abuse who does not have a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.5000	0.0049	0.0418	0.0565	0.2472	0.0434	0.0534	0.0529
Difference	-0.0170	-0.0038*	0.0108*	0.0090	-0.0013	-0.0032	0.0050	0.0004
95% Lower bound	-0.0581	-0.0066	0.0045	-0.0024	-0.0370	-0.0118	-0.0043	-0.0100
95% Upper bound	0.0241	-0.0010	0.0171	0.0204	0.0344	0.0054	0.0143	0.0108
	(A5) 41-year-old white man with schizophrenia and substance abuse who has a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.5120	0.0101	0.0239	0.0591	0.2580	0.0470	0.0454	0.0446
Difference	-0.0050	0.0014	-0.0071	0.0116	0.0095	0.0004	-0.0030	-0.0079
95% Lower bound	-0.0965	-0.0052	-0.0200	-0.0304	-0.0563	-0.0246	-0.0261	-0.0354
95% Upper bound	0.0865	0.0080	0.0058	0.0536	0.0753	0.0254	0.0201	0.0196
(B) Types of Psychiatric Disorders and Substance Abuse								
	(B1) Diagnosis of mental disorders: 41-year-old white man with bipolar and substance abuse who does not have a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.5820	0.0121	0.0184	0.0496	0.1717	0.0717	0.0473	0.0472
Difference	0.0650*	0.0034	-0.0126*	0.0021	-0.0768*	0.0251*	-0.0011	-0.0053
95% Lower bound	0.0066	-0.0009	-0.0207	-0.0146	-0.1183	0.0074	-0.0178	-0.0201
95% Upper bound	0.1234	0.0077	-0.0045	0.0188	-0.0353	0.0428	0.0156	0.0095
	(B2) Diagnosis of mental disorders: 41-year-old white man with other mental disorders and substance abuse who does not have a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.6255	0.0072	0.0100	0.0468	0.1619	0.0633	0.0380	0.0471
Difference	0.1085*	-0.0015	-0.021*	-0.0007	-0.0866*	0.0167	-0.0104	-0.0054
95% Lower bound	0.0672	-0.0040	-0.0267	-0.0143	-0.1175	0.0011	-0.0226	-0.0180
95% Upper bound	0.1498	0.0010	-0.0153	0.0129	-0.0557	0.0323	0.0018	0.0072

	<i>Next period:</i>							
	Independent living	Medical hospital	Psychiatric hospital	Supervised living	Licensed residential	Shelter	Homeless	Jail
	(B3) Substance abuse: 41-year-old white man with schizophrenia who does <i>not have substance abuse problems</i> and a college diploma and who continuously participated for 6 months.							
Equilibrium probabilities	0.6026	0.0113	0.0376	0.0449	0.1966	0.0436	0.0364	0.0270
Difference	0.0856*	0.0026	0.0066	-0.0026	-0.0519*	-0.0030	-0.0120*	-0.0255*
95% Lower bound	0.0423	-0.0018	-0.0005	-0.0148	-0.0870	-0.0140	-0.0233	-0.0372
95% Upper bound	0.1289	0.0070	0.0137	0.0096	-0.0168	0.0080	-0.0007	-0.0138
(C) Effectiveness of the FSP Programs								
	(C1) 41-year-old white man with schizophrenia and substance abuse who did not have a college diploma and who continuously participated for 1 year.							
Equilibrium probabilities	0.5312	0.0096	0.0351	0.0487	0.2163	0.0445	0.0499	0.0647
Difference	0.0142	0.0009	0.0041*	0.0012	-0.0322*	-0.0021	0.0015	0.0122*
95% Lower bound	-0.0044	-0.0007	0.0008	-0.0036	-0.0467	-0.0079	-0.0047	0.0037
95% Upper bound	0.0328	0.0025	0.0074	0.0060	-0.0177	0.0037	0.0077	0.0207
	(C2) 41-year-old white man with schizophrenia and substance abuse who did not have a college diploma and who continuously participated for 2 years.							
Equilibrium probabilities	0.5462	0.0111	0.0462	0.0500	0.1605	0.0361	0.0494	0.1004
Difference	0.0292	0.0024	0.0152*	0.0025	-0.0880*	-0.0105	0.0010	0.0479*
95% Lower bound	-0.0282	-0.0031	0.0020	-0.0123	-0.1224	-0.0260	-0.0178	0.0089
95% Upper bound	0.0866	0.0079	0.0284	0.0173	-0.0536	0.0050	0.0198	0.0869
	(C3) 41-year-old white man with schizophrenia and substance abuse who did not have a college diploma and who continuously participated for 3 years.							
Equilibrium probabilities	0.5396	0.0122	0.0601	0.0502	0.1155	0.0248	0.0436	0.1541
Difference	0.0226	0.0035	0.0291	0.0027	-0.1330*	-0.0218*	-0.0048	0.1016*
95% Lower bound	-0.0830	-0.0071	-0.0015	-0.0225	-0.1776	-0.0428	-0.0359	0.0035
95% Upper bound	0.1282	0.0141	0.0597	0.0279	-0.0884	-0.0008	0.0263	0.1997

	<i>Next period:</i>							
	Independent living	Medical hospital	Psychiatric hospital	Supervised living	Licensed residential	Shelter	Homeless	Jail
	(C4) 41-year-old white man with schizophrenia and substance abuse who did not have a college diploma and who continuously participated for 4 years.							
Equilibrium probabilities	0.5057	0.0125	0.0757	0.0490	0.0796	0.0148	0.0348	0.2279
Difference	-0.0113	0.0038	0.0447	0.0015	-0.1689*	-0.0318*	-0.0136	0.1754
95% Lower bound	-0.1819	-0.0122	-0.0146	-0.0349	-0.2196	-0.0536	-0.0558	-0.0180
95% Upper bound	0.1593	0.0198	0.1040	0.0379	-0.1182	-0.0100	0.0286	0.3688
	(C5) 41-year-old white man with schizophrenia and substance abuse who did not have a college diploma and who did not continuously participate.							
Equilibrium probabilities	0.3821	0.0125	0.0366	0.0675	0.2440	0.0547	0.0857	0.1168
Difference	-0.1349*	0.0038	0.0056	0.0200*	-0.0045	0.0081	0.0373*	0.0643*
95% Lower bound	-0.1733	-0.0021	-0.0029	0.0011	-0.0405	-0.0051	0.0144	0.0357
95% Upper bound	-0.0965	0.0097	0.0141	0.0389	0.0315	0.0213	0.0602	0.0929

Notes: Difference = New equilibrium probability – Reference equilibrium probability. The 95% confidence intervals are based on bootstrapped standard errors with 200 repetitions. FSP=Full Service Partnership.

* Significant at the 95% level.

Technical Appendices

Appendix I. Markov Analysis

Illustrative Example of a Markov Analysis

A Markov model of residential transitions describes movement between discrete states of the world. For example, a simple Markov model might follow FSP participants through the states of stable community living, homeless, hospital, and jail. The following simple Markov model illustrates the main points.

	<i>Community</i>	<i>Homeless</i>	<i>Hospital</i>	<i>Jail</i>
<i>Community</i>	.6	.1	.2	.1
<i>Homeless</i>	.1	.5	.1	.3
<i>Hospital</i>	.6	.1	.3	0
<i>Jail</i>	.3	.1	0	.6

P refers to a Markov matrix of one-period system transition probabilities. Rows refer to today's residential place (henceforth, state), and columns refer to tomorrow's state. Because the Markov model follows a client from today to tomorrow, each row corresponds to transition probabilities from an initial state. Thus, the row probabilities sum to 1. For example, if today's state is being in jail, the probability of stable community living, homeless, hospital, and jail is 30%, 10%, 0%, and 60%, respectively.

Markov Transition Probabilities – Raw Data

Table.A.1 presents probabilities of residential transitions, not adjusted for any socio-demographic or medical history information. To avoid discarding too much information, we used the time interval of two weeks. In our preliminary analysis, we also tested a one-month time interval period, and found similar results.

Over a two-week period, most FSP participants did not change their residential status. Overall, a transition from medical hospitals to independent living was the biggest residential setting change while a residency change from jail to medical hospitals included only five transitions.

The independent living status almost always was the most frequent destination of residential transition. For transitions from psychiatric hospitals, licensed residential facilities were the destination of highest frequency, followed by independent living. In most cases, licensed residential facilities were the second most frequent residential destination.

Markov Transition Probabilities - Multinomial Logit Models

Table 2 reports summary statistics for variables we controlled for in our multinomial logit models. See Appendix II for details regarding multinomial logit models. The average age is 41. Seventy percent of the program participants are white, 43% are women, and about 5% had at least 4-year college education. Approximately 63% and 48% were ever diagnosed with schizophrenia and bipolar disorders, respectively, during the evaluation period. About 54% had substance abuse disorders. On-average clients participated in a FSP program was approximately eleven months with a maximum of four years and one month. Approximately 77% were continuously enrolled.

Table A.3 presents a sample of results from a multinomial logit model for the initial residential status of independent living. Many of our covariates are statistically significant at the 95% level although our results

depend on which destination we are interested in. For example, the probability of transition from independent living to medical hospital appears increasing with age while the likelihood of transition to psychiatric hospital, licensed residential facility, shelter, or jail decreases with age. The categories of psychiatric disorders (*i.e.*, schizophrenia and bipolar disorders) often significantly predict residential transitions. The coefficient on the length of time in a FSP (*time in FSP*) is always highly significant and negative, suggesting that the longer a consumer participates in a FSP, the greater the probability of remaining in the same residential status. Continuous enrollment significantly predicts fewer transitions to homelessness. In other unreported models, our covariates often are highly predictive of which residential setting a person will move to. For example, in a multinomial logit model of transition from shelter, continuous enrollment is found to increase transition to independent living and to reduce transition to psychiatric hospital (see Appendix II).

Effect of a person's socio-demographic characteristics on residential transitions

We first evaluated whether an individual's socio-demographic characteristics may alter an individual's probability of transitioning among different residential settings. We included as our covariates in a multinomial logit model the continuous age variable (*age*) as well as binary indicators for nonwhites (*nonwhite*; whites as a reference group), female (*female*; male as a reference group), and having at least a college degree (*college*; those who were not college graduates consist of the reference group).

One issue that needs to be addressed whenever model building is concerned is the issue of having too few observations for one of the variables included in the model. This can occur because the exposure is rare (*i.e.* presence of a brain tumor), or because of missing data. To improve the stability of our models, we only included variables that did not have small cell count problems. In our initial analysis, we include a fuller set of covariates such as age, race/ethnicity (African-American, Hispanic, Asian, and other race), female, education levels (having a high school diploma, having a junior college or some four-year college education, or having a college diploma), being without any financial support, and diagnostic categories of serious mental illness (schizophrenia, bipolar disorder, depression, personality disorder, anxiety disorder, and other miscellaneous diagnoses). A more comprehensive specification with these variables was initially found to give us misleading results because of small cell counts. Therefore, we removed variables with small cell count problems, creating a model with fewer variables.

Effect of Severity of mental illness and substance abuse on residential transitions

Transition probabilities were also specified as a function of diagnostic categories of two serious mental illnesses including schizophrenic (*schizophrenia*) and bipolar disorder (*bipolar*). The base category of mental illness included depression, personality disorders and anxiety disorders as well as other less prevalent mental illnesses. We also included an indicator for substance abuse disorders (*SA*).

Length of Participation in FSP programs

In the absence of a comparable control group and pre-implementation data, it is difficult to evaluate whether the implementation of the FSP programs improve independent community living among participants. Nevertheless, it is still possible to test the effectiveness of FSP implementation by considering two measures of FSP status: time in FSP and continuous enrollment in a FSP.

We included in the model the length of time for which a person participated in a FSP program (*time_FSP*) to evaluate whether the duration of FSP participation relates to residential transitions. In this context, a useful way to evaluate the effectiveness of the FSP programs is to compare persons who were continuously enrolled in the program to their counterparts who had a discontinuation or interruption of program participation. In our preliminary analysis, we discovered that approximately 20% of participants discontinued their participation in a FSP. Therefore, we included a binary variable indicating whether a person had ever discontinued FSP participation.

Equilibrium Transition Probabilities

An equilibrium transition probability is another term for an unconditional transition probability. Estimating equilibrium probabilities allows us to shift our focus to address which characteristics affect *where a client is living at any given time, without having information on where the client resided previously*. These probabilities are useful for two reasons. One, it allows us to make inferences on where a client will likely be living, if we did not have information on a client's initial residential setting. Two, it allows us to make inferences about what types of participants, with respect to factors such as gender, age, medical history, continuous enrollment in a FSP program, and education, will likely live in each residential setting.

Appendix II – Markov Analysis with Multinomial Logit

A Markov analysis calculates a matrix of transition probabilities in which P_{jk} , an element of a Markov matrix P , refers to the transition probability that a person goes from state j this period to state k next period (See Appendix I for an illustrative example). Each Markov transition probability between the different residency settings was specified as a function of several covariates using multinomial logit. This parameterization of transition probabilities allowed us to evaluate the impact of variables of interest on residential movement.

Parameterization of Residential Transition Probabilities

Each row of the Markov matrix was modeled using a multinomial logit framework since a Markov matrix of transition probabilities has each row summed to one. Since there are the 8 residency settings, we estimated 8 multinomial logit models, one for each row j . Thus, the transition probability from residency setting j to residency setting k for an individual i is:

$$p_{jk}(X_i | k \neq j) = \frac{\exp(X_i \beta_{jk})}{1 + \sum_{k \neq j} \exp(X_i \beta_{jk})} \quad (1)$$

where X includes a set of covariates. The transition probability for a base group is

$$p_{jk}(X_i | k = j) = \frac{1}{1 + \sum_{k=j} \exp(X_i \beta_{jk})} \quad (2)$$

The above p_{jk} is a one-period Markov transition probability conditional on the current state as well as on covariates as following:

$$\begin{aligned} X_i \beta_{jk} = & \beta_{0jk} + \beta_{1jk} \cdot age_i + \beta_{2jk} \cdot nonwhite_i + \beta_{3jk} \cdot female_i + \beta_{4jk} \cdot college_i \\ & + \beta_{5jk} \cdot schizophrenia_i + \beta_{6jk} \cdot bipolar_i + \beta_{7jk} \cdot SA_i \\ & + \beta_{8jk} \cdot time_FSP_i + \beta_{9jk} \cdot continuation_i \end{aligned} \quad (3)$$

Model Assumptions

We estimated the multinomial logit model to compute Markov residential transition probabilities. Therefore, the accuracy of our probability estimates depends on the accuracy of multinomial logit estimates. Importantly, the multinomial logit model assumes the independence from irrelevant alternatives (IIA) (Hausman and McFadden, 1984). Under the IIA assumption, adding or eliminating any residential status would leave the ratio of the probabilities of any remaining residential statuses the same. The IIA assumption is violated if the error terms are not independent each other. We tested whether the IIA assumption holds (Hausman and McFadden, 1984), and found no evidence of serious violation of the assumption. We conducted a total of 64 IIA tests including a test omitting the base category of the original multinomial estimation. Except for 2 cases, no test rejected the null hypothesis that IIA holds.

In addition, it is worth noting that the Markov model employed here maintains some stringent assumptions (see Kemeny and Snell, 1976). Importantly, the model assumes that the probability of a transition from residential status j to k on period t depends on residential status on the immediately preceding period $t+1$, not on a history of residential status. To test whether this assumption may hold, we created continuous variables capturing the number of counts in residential status during the past year separately for each residential status. We then re-estimated multinomial models, and found that these 1-year lagged variables were almost always statistically insignificant. Therefore, it is not likely that our model violates this assumption. Our minor assumptions include: (1) that FSP participants can be found in one of the eight mutually exclusive and exhaustive residential statuses; (2) that transition probabilities are constant; (3) that the probability that a person makes a transition does not depend on the day the person makes the transition; and (4) that time intervals are constant between observations. Together, these assumptions define a finite, time-homogeneous, first-order Markov chain.

Equilibrium Transition Probabilities

Because we examine transitions among the eight different residential settings, our Markov model would yield a matrix of one-period residential transition probabilities with 8 rows and 8 columns. With the one-period transition matrix, however, it may not be easy to examine our research questions because a residential transition is conditional on the current residential status. For example, one of our main objectives is to examine whether there is a relationship between the likelihood of independent living and the duration of participation in the FSP programs. Suppose that we are interested in residential transitions for up to 4 years. In this case, we may end up examining up to ninety-eight 8×8 matrices (given that the time interval between observations is 2 weeks).

However, a time-homogeneous Markov chain has a very useful property that simplifies the interpretation of resulting transition probabilities. A matrix of Markov transition probabilities can be used to obtain equilibrium or steady-state transition probabilities which are unconditional probabilities of being in each state. In equilibrium, transition probabilities do not depend on the current state (*i.e.*, all rows of a matrix have the same probability vectors). Therefore, we only need to examine 1×8 vectors. Also, equilibrium probabilities are still conditional on covariates, implying that we are still able to examine our research questions with parameterization of transition probabilities. Therefore, for the sake of simplicity and without losing evaluative purposes, we calculated equilibrium transition probabilities to examine our research questions.

These equilibrium probabilities are easily derived from the one-period Markov model. Let P be a one-period matrix of transition probabilities. Then,

$$\lim_{n \rightarrow \infty} P^n = W. \quad (4)$$

That is, as $n \rightarrow \infty$, the powers P^n approach a limit matrix W with all rows the same vectors.

Table A.1: Raw Two-week transition probabilities (counts) for the entire period, Jan. 1, 2005 – Feb. 1, 2009

	<i>Next period:</i>								
	Independent living	Medical hospital	Psychiatric hospital	Supervised living	Licensed residential	Shelter	Homeless	Jail	Total
<i>This period:</i>									
Independent living	98.73% (128,710)	0.16% (203)	0.3% (396)	0.11% (143)	0.25% (320)	0.14% (183)	0.08% (106)	0.23% (302)	100% (130,363)
Medical hospital	4.5% (157)	90.02% (3,140)	0.66% (23)	1.63% (57)	1.89% (66)	0.69% (24)	0.37% (13)	0.23% (8)	100% (3,488)
Psychiatric hospital	2.84% (309)	0.24% (26)	91.19% (9,927)	1.16% (126)	3.14% (342)	0.55% (60)	0.54% (59)	0.34% (37)	100% (10,886)
Supervised living	1.53% (230)	0.26% (39)	0.49% (73)	95.28% (14,291)	1.33% (200)	0.47% (70)	0.33% (50)	0.31% (46)	100% (14,999)
Licensed residential	0.88% (482)	0.18% (98)	0.58% (315)	0.27% (146)	97.12% (52,915)	0.25% (135)	0.29% (156)	0.43% (235)	100% (54,482)
Shelter	2.06% (486)	0.19% (45)	0.36% (85)	0.27% (63)	1.02% (240)	95.05% (22,370)	0.6% (142)	0.45% (105)	100% (23,536)
Homeless	1.17% (234)	0.14% (27)	0.42% (83)	0.33% (66)	0.8% (160)	0.63% (126)	96.03% (19,206)	0.49% (97)	100% (19,999)
Jail	1.52% (192)	0.04% (5)	0.33% (42)	0.66% (83)	1.48% (187)	0.47% (59)	0.37% (47)	95.14% (12,049)	100% (12,664)

Based on 270,416 observations, 9,208 individuals.

Table A.2: Summary statistics for the multivariate Markov analysis.

Variables	Mean	Std. Dev.	Minimum	Maximum
Age	41.1	15.6	16	96
Nonwhite	0.31	0.46	0	1
Female	0.43	0.49	0	1
College diploma	0.05	0.22	0	1
Schizophrenia	0.63	0.48	0	1
Bipolar disorders	0.48	0.50	0	1
Depressive disorders	0.52	0.50	0	1
Substance abuse	0.54	0.50	0	1
Time (2-week period)	21.6	16.4	1	99
Continuation	0.77	0.42	0	1

Table A.3: Sample of multinomial logit results: Transition from the independent living to the other residency settings

	<i>From Independent Living to:</i>						
	Medical hospital	Psychiatric hospital	Supervised living	Licensed residential	Shelter	Homeless	Jail
Age	0.0433*** (0.0050)	-0.0086* (0.0037)	0.0120 (0.0068)	-0.0245*** (0.0049)	-0.0172** (0.0057)	0.0040 (0.0060)	-0.0229*** (0.0040)
Nonwhite	-0.33 (0.18)	0.31** (0.11)	0.01 (0.19)	-0.42** (0.14)	-0.37* (0.18)	-0.80** (0.27)	-0.02 (0.14)
Female	0.08 (0.16)	0.34** (0.11)	0.10 (0.19)	0.10 (0.13)	0.17 (0.17)	-0.16 (0.22)	-0.50*** (0.14)
College	-0.36 (0.32)	0.24 (0.23)	-0.39 (0.46)	0.40 (0.27)	-0.16 (0.42)	0.78* (0.35)	-0.69 (0.52)
Schizophrenia	-0.11 (0.16)	1.34*** (0.14)	0.45* (0.19)	0.37** (0.13)	0.09 (0.16)	0.59* (0.23)	0.29* (0.14)
Bipolar	0.36* (0.15)	0.75*** (0.11)	0.42* (0.18)	0.32** (0.12)	0.17 (0.16)	0.67*** (0.21)	0.12 (0.13)
Substance Abuse	0.10 (0.17)	-0.10 (0.11)	0.36* (0.19)	0.56*** (0.13)	0.12 (0.16)	0.74*** (0.23)	0.93*** (0.15)
Time in FSP	-0.0178*** (0.0054)	-0.0294*** (0.0039)	-0.0329*** (0.0058)	-0.0430*** (0.0050)	-0.0454*** (0.0069)	-0.0345*** (0.0080)	-0.0313*** (0.0047)
Continuous participation in FSP	0.08 (0.19)	0.04 (0.14)	-0.01 (0.22)	-0.01 (0.15)	-0.03 (0.19)	-0.58** (0.22)	0.27 (0.14)
Constant	-8.28*** (0.38)	-6.48 (0.24)	-7.37*** (0.38)	-4.93*** (0.23)	-5.25*** (0.30)	-7.12*** (0.46)	-5.04*** (0.26)

Notes: (N=116,403) * significant at 0.05, ** significant at 0.01, *** significance is less than 0.001

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