Outcome Evaluation of Zumbro Valley Health Center Primary Care Service

Zumbro Valley Health Center is a private, 501(c)(3) organization that provides behavioral health and substance use disorder services to residents of Olmsted, Fillmore, and surrounding counties. In December 2013, Zumbro Valley Health Center added a primary care clinic with the goals of increasing access to multiple health services and improving the health of patients. Integrating primary care and behavioral health services improves access to primary care services and improves health conditions; see for example: Nielsen, Langner, Zema, Hacker, and Grundy (2012), Snyder, Dobscha, Ganzini, Hoffman, and Delorit (2008), Woltmann, Grogan-Kaylor, Perron, Georges, Kilbourne, and Bauer (2012). This report shows evidence that Zumbro Valley Health Center's primary care service generates positive health outcomes similar to those found in the literature. Patients experience a reduction in inpatient claims and emergency room utilization. At the same time, patients increase their utilization of services provided at community health centers and in particular case management and dental services. In addition, we place the outcomes of Zumbro Valley Health Center's primary care service in a social return on investment (SROI) framework to show the economic worthiness of the program. We estimate the economic benefits of this program and compare them to the costs of the program. Based on benefits from reduced claims payments, we show that society receives $2.10 in return for every dollar invested in Zumbro Valley Health Center's primary care clinic, while taxpayers (State government) receive a return of $2.63 for their investment.

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General methodology and data

The main goal of this study is to show the impact on health care outcomes from integrating primary care and behavioral health services at Zumbro Valley Health Center. We use claims data from the Minnesota Department of Human Services (DHS) to identify changes in patient utilization and the dollar value of claims charges and payments before and after being seen at Zumbro Valley Health Center's primary care clinic. DHS claims data are combined with data on patients' characteristics and some health outcomes retrieved from patients' records collected by the Zumbro Valley Health Center team. In addition, we implement a regression discontinuity design to assess the likelihood that the changes in claims charges and payments can be attributed to the integrated primary care and behavioral health services.

The provided claims data span over 71 months before and after each patient's first admission date to Zumbro Valley Health Center for behavioral health services. However, data become sparse beyond 12 months before or after the admission date; thus, we only use claims within 12 months before and after admission. About 157 patients were seen at the Zumbro Valley Health Center's primary care clinic between December 2013 and August 2015. Out of the total 157 patients, 124 were seen at the primary care clinic within 30 days of being seen at Zumbro Valley Health Center's behavioral health clinic for the first time. We consider these 124 patients our treated group. By selecting patients who were seen close to their admission to the behavioral health clinic, we are able to isolate the combined effect of behavioral health and primary care services when provided simultaneously and compare this impact to the effect of providing these services at different times. Out of these 124, we identify patients with 12 months of claims data (charges and/or payments) around admission to Zumbro Valley Health Center. This reduced sample of treated patients (between 29 and 62 patients) allows us to have pre- and post-admission periods with equal amounts of claims data. The reduced sample is used in the computations of changes in utilization and value of claims. When estimating economic benefits, we extrapolate the statistical results from the reduced sample to the 124 treated. Unless noted otherwise, all the statistics and results reported refer to the 124 patients in the treated group.

We compute two types of economic benefits. The first measure of benefits is the estimated reduction of average charges before and after patients have been treated at the primary care clinic. In a fee-for-service delivery system (FFS), charges refer to services billed to DHS by Minnesota Health Care Providers (MHCP). The second measure of benefits is the change in the average payment per claim made by DHS to MHCPs. This second measure shows the savings in reimbursements to providers accrued by the state. Relative charges and payments are computed using a regression discontinuity design model.

Program costs are based on financial and operational information prepared by Zumbro Valley Health Center's administration. Costs per patient are adjusted to show the cost of serving patients in the treated group used in the calculations.

Changes in health care utilization

Changes in number of claims

The 62 treated patients with claims data had 8,232 claims during the 12 months before being admitted to Zumbro Valley Health Center and 11,460 claims during the 12 months after admission, for a total of 19,692 claims used in the analysis (Figure 1). Zumbro Valley Health Center's primary care patients had an average of 536 claims in the 12 months prior to being seen at Zumbro Valley Health Center for the first time and 513 claims in the 12 months following their admission to Zumbro Valley Health Center. The reduction of 23 claims per year per patient after being seen at the primary care clinic is statistically significant.

1. Average number of claims per year

	Average total claims per patient	Standard error	N
Before admission	536	3.4	8,232
After admission	513	2.7	11,460
Difference	-23*		

** Statistically significant at the 95% confidence level*

Changes in number of claims by place of service

We assess changes in the number of claims and charges across different places of service. We found that the 62 primary care patients had a total of 123 fewer hospital inpatient claims during the 12 months after admission to Zumbro Valley Health Center, a reduction of 56 percent (Figure 2). Similarly, inpatient claims from psychiatry facilities declined 19 percent (52 fewer claims). These patients had 32 fewer claims from emergency rooms, a reduction of 11 percent.

In contrast, primary care patients had an increase in the number of claims from services provided at community behavioral health centers (93% increase), which is expected since they started visiting Zumbro Valley Health Center during this period. Claims also increased for psychiatric residential treatment centers (186%), outpatient hospitals (50%), and services received at home (58%). Notably, there were 32 additional claims from skilled nursing facilities within a year after patients were admitted to Zumbro Valley Health Center, contrasting with only one claim in the 12 months prior to being admitted to Zumbro Valley Health Center.

2. Change in number of claims by place of service

	Before Zumbro Valley Health Center	After Zumbro Valley Health Center	Difference	% change in claims
Inpatient Hospital	219	96	-123	-56%
Inpatient Psychiatry Facility	273	221	-52	-19%
Emergency Room - Hospital	301	269	-32	-11%
Ambulance Land	98	90	-8	-8%
Mass Immunization Center	2	0	-2	-100%
Group Home	1	0	-1	-100%
State or Local Public Health Center	2	4	2	100%
Walk-In Retail Clinic	3	6	3	100%
Skilled Nursing Facility	1	32	31	3,100%
Independent Laboratory	110	194	84	76%
Outpatient Hospital	279	419	140	50%
Office	1,903	2,094	191	10%
Psychiatric Res. Treatment Center	130	372	242	186%
Home	802	1,269	467	58%
Community Mental Health Center	580	1,119	539	93%
Other Unlisted Facility	1,376	2,359	983	71%
Total	6,080	8,544	2,464	41%

Changes in number of claims by type of claim

Primary care patients at Zumbro Valley Health Center had 48 percent fewer inpatient claims in the 12 months after being admitted (Figure 3). After "Nursing Facility/ICF-DD" claims (from 2 to 0 claims), the second largest reduction was in “MCARE Part A Crossover” claims, with a reduction of 78 percent. On the other hand, dental claims increased during the observed period (59%), as well as outpatient/rehabilitation claims (46%), primary care visits, Health Care Financing Administration (HDFA) claims (41%), and others.

3. Change in number of claims by type of claim

Claim type	Before Zumbro Valley Health Center	After Zumbro Valley Health Center	Difference	% change in claims
Inpatient	56	29	-27	-48%
MCARE Part A Crossover	18	4	-14	-78%
Renal Dialysis	6	3	-3	-50%
Nursing Facility/ICF-DD	2	0	-2	-100%
Pharmacy	0	2	2	-
MCARE UB-92 Part B Crossover	386	492	106	27%
Dental	217	345	128	59%
MCARE Part B Crossover	511	676	165	32%
Outpatient/Rehabilitation	1,711	2,504	793	46%
Outpatient	5,352	7,523	2,171	41%
Total	8,259	11,578	3,319	40%

Changes in number of claims by category of service

Extended transportation and radiology services decreased after admission to Zumbro Valley Health Center by 71 and 9 percent, respectively (Figure 4). Physician services showed a slight decrease of 2 percent, yet inpatient claims from hospitals decreased by 44 percent. Some of the services that increased during the post-admission period are associated with primary care and preventive services.

4. Change in number of claims by category of service

Category of service	Before Zumbro Valley Health Center	After Zumbro Valley Health Center	Difference	% change in claims
Extended Transportation	55	16	-39	-71%
Radiology, Technical Component	350	320	-30	-9%
Physician Services	1,243	1,215	-28	-2%
Inpatient Hospital, General	54	30	-24	-44%
Personal Care Services	135	119	-16	-12%
Nurse, Public Health Nursing	14	0	-14	-100%
Transport, Ambulance	102	90	-12	-12%
Inpatient Hospital Non-Drug	4	1	-3	-75%
Prosthetics and Orthotics	15	12	-3	-20%
Nursing Facility Level I	2	0	-2	-100%
Transitional Services	2	0	-2	-100%

4. Change in number of claims by category of service (continued)

Category of service	Before Zumbro Valley Health Center	After Zumbro Valley Health Center	Difference	% change in claims
Anesthesia	18	16	-2	-11%
Speech Therapy	0	1	1	-
Nurse Midwife Services	0	1	1	-
Home Delivered Meals	11	12	1	9%
Pharmacy Services	0	2	2	-
Case Management, Other	11	15	4	36%
Podiatry	2	6	4	200%
Chiropractic	17	21	4	24%
Extended Medical Supplies/DME	3	8	5	167%
Occupational Therapy	0	8	8	-
Eyeglasses/Contact Lenses	57	66	9	16%
Vision	37	46	9	24%
Physical Therapy	86	101	15	17%
CTF Extended Care/Halfway House	14	29	15	107%
Homemaker Services	117	139	22	19%
Medical Supply/DME	112	141	29	26%
Consolidated Treatment Fund	104	179	75	72%
Case Management Behavioral Health	228	324	96	42%
Health Home Health Services	245	357	112	46%
Dental	217	345	128	59%
Outpatient Hospital Services	504	658	154	31%
Laboratory	1,256	1,481	225	18%
Nurse Practitioner Services	280	516	236	84%
Unable To Define	131	459	328	250%
Access Services	1,129	2,098	969	86%
Behavioral Health	1,704	2,746	1,042	61%
	8,259	11,578	3,319	40%

Changes in number of claims by provider type

Zumbro Valley Health Center primary care patients had 381 fewer claims from consolidated providers in the 12-month period after being treated for the first time at Zumbro Valley Health Center (Figure 5). This is a 39 percent reduction in claims. Claims from physicians were reduced by 5 percent or 83 claims.

5. Change in number of claims by provider type

Provider type	Before Zumbro Valley Health Center	After Zumbro Valley Health Center	Difference	% change in claims
Consolidated Provider Organization	974	593	-381	-39%
Physician	1,606	1,523	-83	-5%
Federally Qualified Health Center	12	0	-12	-100%
Personal Care Provider	230	219	-11	-5%
Public Health Nursing Org	30	21	-9	-30%
Bill Entity For Physician Services	7	0	-7	-100%
Family Planning Agency	9	5	-4	-44%
Nursing Facility	2	0	-2	-100%
Optometrist	2	0	-2	-100%
Podiatrist	1	0	-1	-100%
Optician	72	71	-1	-1%
Public Health Clinic		2	2	-
Licensed Prof. Clinic Counselor	11	14	3	27%
Chiropractor	17	22	5	29%
Pharmacy	32	41	9	28%
Dentist	100	118	18	18%
Target Case Management		18	18	-
Medical Supplier	44	67	23	52%
Bill Entity For Rehabilitation	11	38	27	245%
Home and Community Service Prov.	41	71	30	73%
Other Non-Traditional	68	100	32	47%
Psychologist	39	82	43	110%
County Reservations Services	47	111	64	136%
Intensive Residential Treatment Service	409	476	67	16%
Community Health Clinic	117	198	81	69%
Laboratory, Independent	104	189	85	82%

5. Change in number of claims by provider type (continued)

Provider type	Before Zumbro Valley Health Center	After Zumbro Valley Health Center	Difference	% change in claims
Home Health Agency	245	355	110	45%
Chemical Health	226	448	222	98%
Other Non-Physician	185	489	304	164%
Bill Entity for Behavioral Health	102	427	325	319%
Hospital	1,837	2,187	350	19%
Medical Transportation Provider	1,077	1,633	556	52%
Community Behavioral Health Center	602	2,060	1,458	242%
	8,259	11,578	3,319	40%

Changes in charges and payments associated with primary care service

The estimated average reduction in charges per patient after admission to Zumbro Valley Health Center is $18,302 (Figure 6). If we extrapolate this result to the total 124 patients seen at Zumbro Valley Health Center's primary care office within 30 days of admission, the savings in charges reaches $2.3 million. Furthermore, the average reduction in payments to Minnesota Health Care Providers (MHCP) is $5,915, with total savings in payments of $733,469 during the 12-month period after admission.

6. Reduction in charges and payments

	Average reduction per patient	Total savings (124 patients)
Charges	$18,302	$2,269,471
MHCP payments	$5,915	$733,469

The change in the value of claims showed above is computed by comparing the pattern of claim charges and payments for the 12 months prior to being seen at Zumbro Valley Health Center for the first time to the charges and payments from claims submitted during the 12 months after admission to Zumbro Valley Health Center. We implement a regression discontinuity design to assess whether the differences between the before and after trends are statistically different for a sample of patients in the treated group with charges and payments during the 12 months after the date of admission (see Appendix for detailed results and parameters). Total reductions in charges and payments are extrapolated to the 124 treated patients using results from the econometric regressions. In addition, we examine the difference in charges and payments for some population characteristics: alcohol and drug use, exercising, and body mass index (BMI).

Changes in charges by selected patient characteristics

We observe that patients with healthier habits (e.g., those who exercise weekly, have a lower BMI, and do not consume alcohol or tobacco) tend to experience a significant reduction in average charges and payments per claim in the 12-month period after being seen at Zumbro Valley Health Center's primary care clinic. The following tables summarize the statistical results for these groups of patients. A regression discontinuity design was used for all of the analyses.

Charges and payments by tobacco use

About 47 percent of patients self-report to be non-tobacco users. Non-tobacco users had a 32 percent reduction in the average charge per claim in the 12 months after being admitted to Zumbro Valley Health Center (Figure 7). Tobacco users also show a small reduction of 0.2 percent, however this change is not statistically significant. Non-tobacco users show a statistically significant reduction of 49 percent in the average payment per claim. This result suggests that the integrated service makes more of an impact on the value of claims for non-smokers.

7. Change in average charge per claim and payments after admission to Zumbro Valley Health Center by patients' tobacco use

	Change in average charges	Change in average payments	Percentage of patients
Non-tobacco users	-32%*	-49%*	47%
Tobacco users	-0.2%	6%	53%

** Statistically significant at 95% level of confidence*

Charges and payments by alcohol use

Non-alcohol users had a 16 percent reduction in the average charge per claim in the 12 months after being admitted to Zumbro Valley Health Center (Figure 8). However, this result is not statistically significant. Non-alcohol users did show a statistically significant reduction of 31 percent in payment amount. Alcohol users had increases in average charges and payments, yet these results are not statistically significant.

8. Change in average charge per claim and payments after admission to Zumbro Valley Health Center by patients' alcohol use

	Change in average charges	Change in average payments	Percentage of patients
Non-alcohol users	-16%	-31%*	89%
Alcohol users	15%	13%	11%

** Statistically significant at 95% level of confidence*

Charges and payments by weekly exercise

Patients who exercise at least once a week had a 3 percent reduction in the average charge per claim in the 12 months after being admitted to Zumbro Valley Health Center

(Figure 9). However, the result is not statistically significant. These patients showed a statistically significant reduction of 33 percent in payments to MHCPs. On the other hand, patients who do not exercise showed an increase of 28 percent in average charge and 24 percent in average payments, yet these results are not statistically significant.

9. Change in average charge per claim and payment after admission to Zumbro Valley Health Center by patients' weekly exercise

	Change in average charges	Change in average payments	Percentage of patients
No weekly exercise	28%	24%	41%
Exercise at least once per week	-3%	-33%*	59%

** Statistically significant at 95% level of confidence*

Charges by body mass index (BMI)

Patients with a lower BMI of less than 25 (healthy BMI), have an average charge per claim that is 40 percent lower in the 12 months after being admitted to Zumbro Valley Health Center than the 12 months prior (Figure 10), which is statistically significant. Healthy BMI patients also show a significant reduction in average payment, a decrease of 52 percent. Patients with a BMI of 25 or higher (overweight or obese) also show significant reductions in charges and payments, yet these changes are smaller than for those patients with lower BMI.

10. Change in average charge per claim and payment after admission to Zumbro Valley Health Center by patients' BMI

	Change in average charges	Change in average payments	Percentage of patients
BMI of less than 25	-40%*	-52%*	28%
BMI of 25 or higher	-22%*	-15%*	72%

** Statistically significant at 95% level of confidence*

Return on investment

The economic benefits of investing in Zumbro Valley Health Center's integrated behavioral health and primary care can be presented in a return on investment framework. Social return on investment (SROI) compares the estimated economic value of selected outcomes of the program with their associated investments. We compare the benefits to the investment in the program by computing a cost-benefit ratio (benefits divided by costs). The resulting number shows the returns to society and taxpayers for every dollar invested in the program.

We compute two types of economic benefits:

- Savings from reduction in average payment per claim made by DHS to MHCPs.
- Savings from reduction of average charges before and after patients have been treated at the primary care clinic.

The total benefits from reduced charges associated with Zumbro Valley Health Center's primary care clinic reach $2.3 million (Figures 11 and 12). These benefits come from 124 patients who were treated at the primary clinic within 30 days of their first visit to Zumbro Valley Health Center between December 2013 and August 2015.

We compute the SROI from two perspectives. The first SROI shown in Figure 11 contains the returns to the Minnesota DHS from its direct investment in this project via a grant. The Minnesota Department of Human Services invested a total of $347,008 since the opening of the clinic. The grant cost of serving the 124 patients in the treated group is $278,967. The return from every dollar invested by DHS in the treated patients is $8.14 when charges are used as the measure of benefit. The return from reduced payments is $2.63.

11. Return on investment to the Minnesota Department of Human Services (dollars)

	SROI from reduced charges	SROI from reduced payments
Benefits	2,269,471	733,469
Costs	278,967	278,967
Benefits minus costs	1,990,504	454,502
SROI	8.14	2.63

The second SROI uses the total cost of serving the 124 treated patients, including overhead costs of the program. We call this the SROI to society since overheard costs may be financed using several sources besides the main DHS grant. The total cost of treating these patients (including overhead costs) is approximately $349,565. From the perspective of the whole society, the return from every dollar invested in the treated patients is $6.49 when charges are used as the measure of benefit. The return from reduced payments is $2.10.

12. Return on investment to society (dollars)

	SROI from reduced charges	SROI from reduced payments
Benefits	2,269,471	733,469
Costs	349,565	349,565
Benefits minus costs	1,919,906	383,904
SROI	6.49	2.10

Patient's satisfaction

Zumbro Valley Health Center staff collected satisfaction surveys (designed by Wilder) from patients who presented to the clinic. Originally the data collection schedule consisted of 2 weeks of data collection at the end of every other month, with data collection taking place at the end of November 2014 and January 2015. Due to low response rates, this schedule was increased to 2 weeks at the end of every month in March 2015, until the end of data collection in October 2015. Overall, 20 patients responded to the survey during this time.

Respondent characteristics

All respondents who answered the questions identified as non-Hispanic Caucasian (Figure 13). With regard to gender, respondents were split fairly evenly with 55 percent identifying as female and 45 percent identifying as male. The majority of respondents (70%) were age 45 to 64. Seventy-nine percent had pursued education after high school (53% some college or a 2-year degree; 26% 4-year college graduate).

13. Respondent characteristics (N=19-20)

Race	**%**
White or Caucasian	100%
American Indian or Alaska Native	0%
Asian	0%
Black or African American	0%
Native Hawaiian or Other Pacific Islander	0%
Other	0%
Don't know	0%
Ethnicity	
NOT Hispanic or Latino	100%
Hispanic or Latino	0%
Gender	
Female	55%
Male	45%
Other	0%

13. Respondent characteristics (N=19-20), continued

Age	
18 to 20	0%
21 to 24	5%
25 to 44	15%
45 to 64	70%
65+	10%
Highest grade or level of school completed	
8th grade or less	5%
High school graduate or GED	16%
Some college or 2-year degree	53%
4-year college graduate	26%
More than 4-year college degree	0%
Help completing survey	
Yes	0%
No	100%

Alternative care options

When asked what they would do if Zumbro Valley Health Center did not offer primary care services, less than half (40%) said they would go to a different primary care clinic for care (Figure 14). Of the 60 percent remaining, 25 percent did not know what they would do, 10 percent each would go to an urgent care facility or would not seek care, 5 percent reported they would go to an emergency department for care, while an additional 10 percent would do something else.

14. If Zumbro Valley Health Center did not offer primary care services, what would you do? (N=19-20)

Go to a different primary care clinic for care	40%
I don't know	25%
I would not seek care	10%
Go to an urgent care facility for care	10%
Go to an emergency department for care	5%
Something else*	10%

**"Something else" responses included: "I would not seek all the care I need." And "Austin AMC"*

Satisfaction

All respondents "agreed" or "strongly agreed" that they are satisfied with the care they receive at Zumbro Valley Health Center, with 95 percent "strongly agreeing" with the statement (Figure 15). All respondents also agreed their Zumbro Valley Health Center team works together to provide them the care they need and their behavioral health has improved since coming to Zumbro Valley Health Center. Almost all respondents (95%) "agreed" or "strongly agreed" it is more convenient for them to get their primary and behavioral health care at the same place, they could get an appointment soon enough when they needed one, they see a primary care doctor more often because of the services at the Zumbro Valley Health Center's clinic, and their physical health has improved since coming to Zumbro Valley Health Center.

15. How much do you agree or disagree with the following statements about the Primary Care Clinic and its relationship to the rest of Zumbro Valley Health Center? (N=19-20)

	Strongly agree	Agree	Disagree	Strongly disagree
I am satisfied with the care I receive at Zumbro Valley Health Center	95%	5%	0%	0%
It is more convenient for me to be able to get my primary health care and my behavioral health care at the same place	85%	10%	5%	0%
My Zumbro Valley Health Center team works together to provide me the care I need	80%	20%	0%	0%
When I needed an appointment, I could get one soon enough	75%	20%	5%	0%
My behavioral health has improved since coming to Zumbro Valley Health Center	70%	30%	0%	0%
I see a primary care doctor more often because of the clinic at Zumbro Valley Health Center	60%	35%	0%	5%
My physical health has improved since coming to Zumbro Valley Health Center	26%	68%	5%	0%

Clinic strengths

When asked what they liked most about Zumbro Valley Health Center, several people commented on the care and friendliness of the Zumbro Valley Health Center's staff (n=8). An additional four individuals commented on the excellent quality or availability of services, while three appreciated the convenience of having all their care at one facility. One individual liked that he/she felt more comfortable asking for help in an

environment where they already knew his/her history, while another individual liked the one-on-one nature of the clinic and that it was not crowded.

Suggestions for improvement

When asked how they could improve the services offered, most individuals had no further suggestions or provided further praise for the facility. Of the six individuals that did have feedback, no common themes emerged.

Conclusions

The primary care program at Zumbro Valley Health Center shows positive economic returns to society and taxpayers. The net benefits can reach $1.9 million, nearly $15,400 net benefits per patient. Taxpayers (via a grant from Minnesota Department of Human Services) accrue returns of $2.63 in reduced payments and $8.14 in reduced charges. Society receives $2.10 from reduced payments and $6.49 in reduced charges for every dollar invested during the first 22 months of operation.

These economic benefits do not include other positive outcomes associated with improving the health outcomes of patients, as well as many positive ripple effects on society for which it is difficult to assess the monetary value using the available patients' data. These potential benefits include, but are not limited to:

- Long-term health care cost savings from increased preventive care
- Benefits from gained or retained employment due to improved health
- The presence of an on-site pharmacy provided by Genoa and on-site dental provided by Apple Tree Dental contributes to overall improved health
- Indirect benefits from reduced drug and alcohol abuse, including: reduced future crime, reduced loss of property and productivity, and reduced losses from suicidal behavior

An important conclusion from the analysis is that providing primary and behavioral health services within 30 days of admission to the behavioral health setting is more effective than providing these services at different times (see Appendix for detailed results). Concurrent delivery of these services should be an important goal when designing policies, service models, and assignation of future funding.

In addition, the integrated services are more effective for those patients with healthier habits and lifestyles. This result suggests the importance of health education that includes the importance of healthy diets, exercising, smoking cessation, etc.

Benefits shown in this report refer to a short-term 12-month period. Further analysis using longitudinal data would shed light on the long-term effects of the integration of services.

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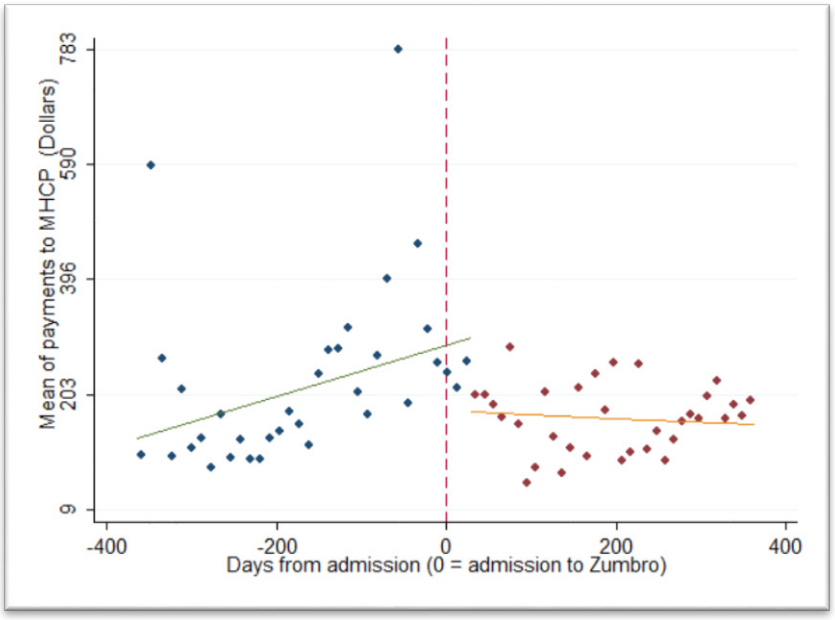
Appendix

Economic benefits: Additional results and computations

The number of claims, charges, and payments are affected by behavioral health services as well as by the primary care services. When these two services occur within a relatively short period of time from each other, and assuming that no other significant change in care or other health outcome has occurred during this period, we can presume that any change in service utilization and charges/payments can be attributed to the integrated services. Thus, we construct the treated group using patients who received primary care services within 30 days of admission to Zumbro Valley Health Center for the first time. We compare the information from the 12 months of pre-admission claims to the 12 months of data following the integrated service.

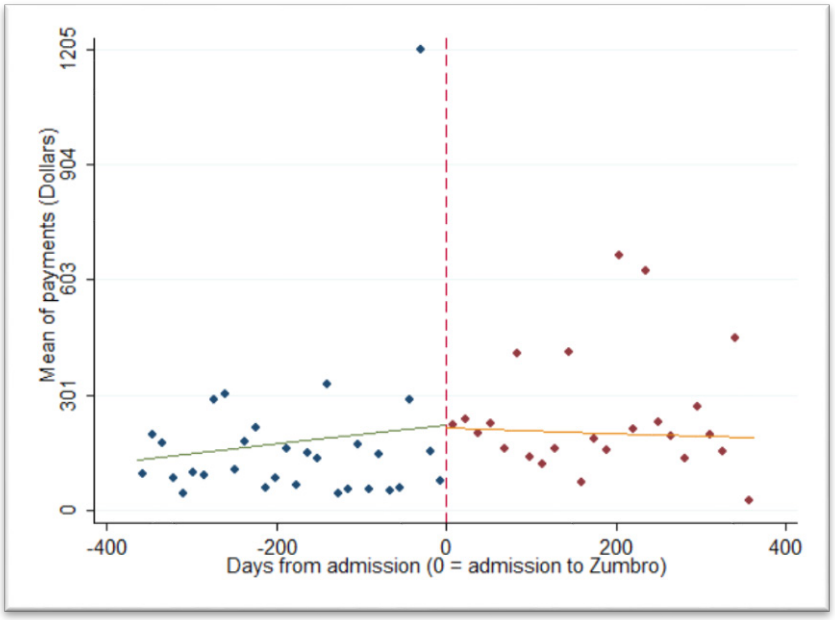
To illustrate, the following figure shows the pattern of average MHCP payment per claim in the treated group. Each point in the chart represents the average payment per claim in a given day before and after the day of admission to Zumbro Valley Health Center (noted as zero in the horizontal axis). The trajectory of the points to the left of zero (blue dots) are compared to the trajectory of the points on the right side (red dots). Patients show an increasing trend in the average payment before admission to Zumbro Valley Health Center. This trend is reversed after 30 days of admission to Zumbro Valley Health Center.

16. Average MHCP payment per claim before and after admission to Zumbro Valley Health Center of treated group



When we construct the same graph for a group of patients who were seen at the primary care clinic after 90 days of being admitted to Zumbro Valley Health Center, we also observe a stabilization on the trend of payments, yet the change is not as strong as in the treated group. The graphical analysis of the change in charges shows similar results. This may be an initial indication that integration of the behavioral and primary care services is more effective than providing these services separately.

17. Average MHCP payment per claim before and after admission to Zumbro Valley Health Center for comparison group



We compute average payment and charges per claim for a reduced sample consisting of patients with claims and charges for the 12 months before and after admission to Zumbro Valley Health Center. The mean payments went from $228 to $174 and the sum of payments dropped $148,087 (Figure 18). Similarly, the mean charge went down from $565 to $340, with a total reduction in charges of $606,008 (Figure 19).

18. MHCP payment per claim before and after admission to Zumbro Valley Health Center (dollars)

	Mean payment	Total sum of payments	Standard deviation	Claims
Before admission	228	610,825	1,080	2,674
After admission	174	462,738	473	2,665

19. Charges per claim before and after admission to Zumbro Valley Health Center

	Mean charge	Total sum of charge	Standard deviation	Claims
Before admission	565	1,511,281	3,715	2,674
After admission	340	905,273	2,182	2,665

To confirm the visual observation and initial descriptive results, the regression analysis is shown in the figures below. The treatment group experienced a decrease in the average payment per claim of 27.8 percent in the 12 months after admission to Zumbro Valley Health Center (Figure 20). This change is statistically significant. Similarly, average charges per claim are reduced 34.9 percent during the observed period (Figure 21). When we run the same analysis using patients who were seen at the primary care clinic after 90 days of being admitted to Zumbro Valley Health Center, there is no statistically significant change in the trend of payments and charges. **We can conclude that the integration of services within a 30-day period results in a significant reduction in payments and charges when compared to providing the two services separately.**

20. Percentage change in average MHCP payment per claim after admission to Zumbro Valley Health Center

Primary care	% change	Standard error	z	P>z	[95% Conf. Interval]		N (claims)
Comparison group: after 90 days	0.187	0.093	2.000	0.046	0.004	0.369	18,165
Treatment group: within 30 days	-0.278*	0.068	-4.104	0.000	-0.411	-0.145	57,951

** Statistically significant at 95% level of confidence*

21. Percentage change in average charge per claim after admission to Zumbro Valley Health Center

Primary care	% change	Standard error	z	P>z	[95% Conf. Interval]		N (claims)
Comparison group: After 90 days	0.458	0.344	1.331	0.183	-0.216	1.133	1,686
Treatment group: Within 30 days	-0.349*	0.103	-3.375	0.001	-0.552	-0.146	5,339

** Statistically significant at 95% level of confidence*

A factor that may be contributing to this reduction is that patients who received the primary care services earlier require care more quickly than those patients who are seen in the primary care clinic later on. Thus, a bigger change in health is generated quickly with respective reduction in subsequent claims. **The timing of primary care services for these more "urgent" patients seems to be important in the generation of utilization of future health care services and economic savings.**

Estimation of benefits

Without loss of generality with respect to defined benefits (either as charges or payments), the total change in the value of claims (ΔTotal$) can be defined as:

(1) $\Delta Total\$ = \#Claims_{after} \times Ave\$Claim_{after} - \#Claims_{before} \times Ave\$Claim_{before}$

Where $\#Claims_{after/before}$ is the number of claims before or after admission and $Ave\$Claims_{before/after}$ is the average value of claims measured by charges or payments. This expression indicates that the change in the value of claims is the difference between the value of claims before admission and the value of claims after admission.

Alternatively, from the regression results, we can use the percentage change in the average value of claims ($\%\Delta Ave\$$) and the average value per claim before admission ($Ave\$_{before}$) to compute the change in value per claim ($\Delta Ave\$$):

(2) $\Delta Ave\$ = \%\Delta Ave\$ \times Ave\$_{before}$

If we multiply the change in the average value per claim from equation (2) by the number of claims after admission, we obtain the total change in value of claims:

(3) $\Delta Total\$ = \Delta Ave\$ \times \#claims_{after}$

We would like to use equation (3) to compute total benefits since we are relying on the regression results to carry out the computation. However, equation (3) differs from the definition in equation (1). We define the difference between these two expressions (D) as:

(4) (1) = (3) + (D) or D = (1) – (3)

With a little manipulation, equation (3) can be expressed as:

(3') $\Delta Total\$ = \#Claims_{after} \times Average\$Claim_{after} - \#Claims_{after} \times Average\$Claim_{before}$

Substituting equations (1) and (3') in equation (4), we have that

$D = \#Claims_{after} \times Average\$Claim_{after} - \#Claims_{before} \times Average\$Claim_{before} - \#Claims_{after} \times Average\$Claim_{after} + \#Claims_{before} \times Average\$Claim_{before}$ or

(5) $D = Average\$Claim_{before} \times (\#Claims_{after} - \#Claim_{before})$

Equation (5) shows the fraction of the benefits that is not captured in our initial definition in equation (3). For the lack of a better name, we call this value *D,* "the fraction of benefits from reduction in the number of claims."

The total benefits (or change in value of claims) is then the sum of the results from equation (3') and D. In Figure 22 we show the detailed values resulting from these computations.

22. Benefits from reduced payments

		Value
(a)	Percentage change in average payment ($\%\Delta Ave\$$)	-0.28
(b)	\$ Change per claim ($\Delta Ave\$$)	-\$64
(c)	Reduced payments ($\Delta Total\$$)	-\$169,481
(d)	Savings from reduced number of claims (D)	-\$2,056
(e)	Total benefits from reduced payments (only for treated patients)	-\$171,537
(f)	Total reduction in payments per patient	-\$5,915
(g)	Total benefits for 124 patients in the treated group	-\$733,469

Sources and computations:

(a) From regression discontinuity design (Figure 20).
(b) % change in payment x Average payment before admission: (1) x \$228 (Figure 18)
(c) \$ Change per claims x Number of claims after: (2) x 2,665 (Figure 18)
(d) Equation (5) solved using values from Figures 18 and 19.
(e) (c) + (d)
(f) (2) / Number in reduced sample (29 patients with claims with payments)
(g) (f) x Number of patients in treated group (\$5,915 x 124)

Benefits from reduced charges are computed following the same procedure.

23. Benefits from reduced charges

		Value
(a)	Percentage change in average charge ($\%\Delta Ave\$$)	-0.35
(b)	\$ Change per claim ($\Delta Ave\$$)	-\$197
(c)	Reduced charges ($\Delta Total\$$)	-\$525,677
(d)	Savings from reduced number of claims (D)	-\$5,087
(e)	Total benefits from reduced charges (only for treated patients)	-\$530,763
(f)	Total reduction in charges per patient	-\$18,302
(g)	Total benefits for 124 patients in the treated group	-\$2,269,471

Estimation of investment

The total operating cost of the program for the period between December 2013 and September 2015 is $434,824. Out of these costs, there is an estimated overhead cost associated with 1.5 full-time employees (FTE) of $87,816.

24. Operating costs

	2013	2014	2015 (through September)	Total
Operating funds from DHS grant	55,584	163,423	128,001	347,008
Overhead (from other sources)	$31,643	$32,099	$24,074	$87,816
Total costs	$87,227	$195,522	$152,075	$434,824

To compute the return on investment to society and taxpayers (DHS), benefits and costs need to refer to the same group of patients. That is, since benefits are estimated from the group of treated (124 patients seen within 30 days of admission), we need to estimate the cost of treating these same patients. In Figure 25 we show the steps to obtain such costs. First, we compute per patient costs by dividing the cost in each year by the number of patients seen in that year (columns 6 and 7). We do this for the total cost and the grant funds to obtain the cost to DHS. Then we multiply the average costs by the number of patients in the treated group seen each year to obtain the cost of seeing these patients. The totals from columns 8 and 9 are then used in the ROI estimations.

25. Estimated cost of treated group

Year	Num. of patients (duplicated) All	Treated	Grant funds+ Overhead	Cost to DHS (Grant funds)	Total cost per patient	Per patient cost to DHS	Total cost of treated	Cost to DHS of treated
2013	7	7	$87,227	$55,584	$12,461	$7,941	$11,936	$9,526
2014	113	89	$195,522	$163,423	$1,730	$1,446	$151,762	$121,113
2015	135	109	$152,075	$128,001	$1,126	$948	$185,866	$148,329
Total	255	205	$434,824	$347,008	$1,705	$1,361	$349,565	$278,967

ROI scenarios

The ROI estimations presented here are based on statistical inferences from the regression model. Thus, these results could vary for different samples or cohorts of patients. Using the standard error of the regression discontinuity model (Figures 21 and 22), we can expect with a 95 percent level of confidence that the SROI of Zumbro Valley Health Center's primary care would be between $1.11 and $3.09 with benefits measured as reduction in

payments. Similarly, the ROI based on savings from reduced charges is likely to fall between $2.76 and $10.23. The ROIs in the intervals are all greater than 1, indicating that positive returns are very likely to be obtained if the estimations are repeated with (many) other samples of patients.

26. Scenarios of ROI to society (Savings from payments)

	Low	Medium	High
Total benefits	387,362	733,469	1,079,592
Cost	349,565	349,565	349,565
ROI	1.11	2.10	3.09

27. Scenarios of ROI to society (Savings from charges)

	Low	Medium	High
Total benefits	964,123	2,269,471	3,574,774
Cost	349,565	349,565	349,565
ROI	2.76	6.49	10.23

The ROI to DHS is also positive in all the scenarios, ranging from $1.39 to $3.87 in return for every dollar invested by DHS for benefits from reduced payments, and ROI of $3.46 to $12.81 for benefits from reduced charges.

28. Scenarios of ROI to DHS (Savings from payments)

	Low	Medium	High
Total benefits	387,362	733,469	1,079,592
Cost	278,967	278,967	278,967
ROI	1.39	2.63	3.87

29. Scenarios of ROI to DHS (Savings from charges)

	Low	Medium	High
Total benefits	964,123	2,269,471	3,574,774
Cost	278,967	278,967	278,967
ROI	3.46	8.14	12.81

Regression results for specific population characteristics

30. Percentage change in average payment per claim after admission to Zumbro Valley Health Center by patients' tobacco use

	% change	Standard error	z	P>z	[95% Conf. Interval]	
Non-tobacco users	-0.494	0.097	-5.120	0.000	-0.683	-0.305
Tobacco users	0.061	0.070	0.881	0.378	-0.075	0.198

31. Percentage change in average charge per claim after admission to Zumbro Valley Health Center by patients' tobacco use

	% change	Standard error	z	P>z	[95% Conf. Interval]	
Non-tobacco users	-0.324	0.143	-2.258	0.024	-0.605	-0.043
Tobacco users	-0.002	0.175	-0.013	0.989	-0.345	0.340

32. Percentage change in average payment per claim after admission to Zumbro Valley Health Center by patients' alcohol use

	% change	Standard error	z	P>z	[95% Conf. Interval]	
Non-alcohol users	-0.312	0.072	-4.317	0.000	-0.453	-0.170
Alcohol users	0.130	0.110	1.182	0.237	-0.086	0.345

33. Percentage change in average charge per claim after admission to Zumbro Valley Health Center by patients' alcohol use

	% change	Standard error	z	P>z	[95% Conf. Interval]	
Non-alcohol users	-0.164	0.125	-1.310	0.190	-0.408	0.081
Alcohol users	0.152	0.347	0.439	0.661	-0.528	0.833

34. Percentage change in average payment per claim after admission to Zumbro Valley Health Center by patients' weekly exercise

	% change	Standard error	z	P>z	[95% Conf. Interval]	
No exercise	0.236	0.088	2.688	0.007	0.064	0.408
Exercise at least once per week	-0.330	0.160	-2.064	0.039	-0.644	-0.017

35. Percentage change in average charge per claim after admission to Zumbro Valley Health Center by patients' weekly exercise

	% change	Standard error	z	P>z	[95% Conf. Interval]	
No exercise	0.283	0.273	1.035	0.301	-0.253	0.818
Exercise at least once per week	-0.030	0.180	-0.164	0.870	-0.383	0.324

36. Percentage change in average payment per claim after admission to Zumbro Valley Health Center by patients' BMI

	% change	Standard error	z	P>z	[95% Conf. Interval]	
Low BMI	-0.523	0.140	-3.725	0.000	-0.799	-0.248
High BMI (>25)	-0.149	0.060	-2.493	0.013	-0.267	-0.032

37. Percentage change in average charge per claim after admission to Zumbro Valley Health Center by patients' BMI

	% change	Standard error	z	P>z	[95% Conf. Interval]	
Low BMI	-0.402	0.210	-1.913	0.056	-0.813	0.010
High BMI (>25)	-0.223	0.120	-1.863	0.062	-0.457	0.012