Analysis of the Vermont market for high-cost, high priority inpatient admissions, using the Truven/Brandeis dashboard

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Introduction

Vermont residents incur approximately 40,000 acute hospital admissions annually at a cost of over $1.5 billion dollars. Most of these take place at one of 14 Vermont acute care hospitals, Dartmouth Hitchcock Medical Center (DHMC), and to a smaller extent other New England states, New York, and other states. Just under half of acute inpatient stays by Vermonters within Vermont occur at the University of Vermont Medical Center (UVMMC). Because acute patient care and post-acute care spending for similar services varies widely across hospitals,[1] understanding the patterns of care for these services – where Vermonters seek care where for what services, and the variation in these costs after adjusting for patient differences – provides a baseline for understanding where savings may be gained in the future.

In 2014, the Truven/Brandeis analytic team was asked to provide a baseline picture of the Vermont acute care inpatient market for high cost high utilization admission types, using the Vermont Health Cost and Utilization Reporting and Evaluation System (VHCURES). The aim was two-fold:

1. To provide an origin-destination matrix, indicating where Vermonters were obtaining inpatient care, from both the patient perspective, and the hospital perspective (where patients at a particular hospital were coming from, for what services); and

2. Provide a computer application that Vermont Green Mountain Care Board (GMCB) staff could use to examine utilization and costs for different types of admissions across the state and other hospitals, and understand at what hospitals and regions costs varied significantly from state medians or from what is expected, adjusting for patient severity. This would provide a guide for understanding care preferences in detail, their cost implications, and opportunities for savings.

To accomplish these goals, the Truven/Brandeis team designed and developed a dashboard built upon the foundation of VHCURES 2011, including data for 81 Diagnostic Related Groups (DRGs) identified by the GMCB staff as high cost/high priority. These account for approximately 55 percent of all acute hospital admissions. Vermont resident locations are based on 'reduced market regions' (RRs), five areas of Vermont created by combining current health service areas (see **Figure 1**, map of reduced market regions). The dashboard has been submitted to GMCB, along with a user's guide. This report describes some of the results of the dashboard, in terms of patterns of inpatient care, and a demonstration of how users can answer policy questions that involve referral patterns, costs, patient health condition and risk, and opportunities for health care savings. The policy example in this report -- what major diagnostic conditions (MDCs) show the greatest opportunity for savings-- focuses individually on the commercial, Medicare and Medicaid markets.

Methods

This market analysis report demonstrates the overall health care inpatient origin-destination landscape, and includes acute care admissions for individuals included in VHCURES for 2011, covered by commercial insurance, Medicare, and Medicaid. Admissions are those that are included in the DRG types assigned by Vermont Green Mountain Care Board as high cost/high priority (see Appendix A). The

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[1] *Vermont Price Variation Analysis*, Prepared for the Green Mountain Care Board, August 2014.

covered population is limited to Vermont residents, and services include all acute care admissions, regardless of where they occur. The commercial population includes all commercially insured members, age less than 65. Medicare includes all admissions for all beneficiaries (including dually eligible), and Medicaid includes admissions for all Medicaid non-dually eligible beneficiaries. Admission spending includes both facility and professional services during the admission. The few admissions higher than $150,000 were truncated at $150,000, as requested by GMCB staff. While this report provides a summary of findings from specific questions, the dashboard can address a wide range of specific policy questions as needed. A users' guide describing how to frame and examine the policy questions, and full documentation of the dashboard and underlying methodologies are also provided to GMCB as deliverables.

Facility and professional claims used for defining acute and post-acute phases of care satisfied the following criteria:

Claims for the acute phase of care were identified using the facility claims and the following:

a) Bill type 11 (hospital inpatient) or 85 (critical access hospital).
b) Room and board revenue codes
c) Hospital taxonomy as defined in Truven health accounts completed in this contract.

Claims for post-acute phase care were identified using a 90-day time frame after the discharge date for acute care (i.e., the index admission). These included:

a) All claims associated with a readmission that occurs during the 90 days after the discharge date of the index admission; post-acute readmission claims are identified solely by the hospital admission date (of the readmission). In other words, if the readmission occurred in the 90-day post-acute time frame of the index admission, all readmission claims were included in the post-acute analysis even though the discharge date of the readmission could be outside of the 90-day post-acute time frame for the index admission.

   Note: If the readmission after an index admission with a DRG of interest was also a DRG admission of interest, the readmission was not allowed to be an index admission on its own in the market analysis.

b) All SNF, swing bed, and home health claims (bill types 21-29, 31-39, 61-69, 18, 75, 76, 81, 82, 83, 86, 89) commencing on or after the acute stay admission date (i.e., the index admission) and having a thru service date during the 90-day time frame after the discharge date for acute care (i.e., the index admission).
c) All other acute care claims commencing on or after the discharge date of the index admission and having a thru service date during the 90-day time frame after the discharge date (of the index admission).

Defining the market areas within and outside Vermont

Brandeis proposed a reduced set of service areas (Revised Regions, or RRs) after reviewing the existing Vermont Hospital Service Areas (HSAs), that have been defined using inpatient discharge data (VUHDDS) for all state residents, and tested using VHCURES. RRs were used as a foundation for analyzing the inpatient market, because of Vermont's interest in larger market groupings, and in order to have numbers and market areas large enough to support analyses at the DRG level. The Brandeis methodology used for creating the proposed RRs is described in detail in the report, by Truven Health Analytics and Brandeis, titled *Assessing the feasibility of using localized Vermont Hospital Service Areas (HSAs) as the basis for forming reduced service regions*. See **Figure 1** for a map of RRs superimposed on HSAs.

Figure 1: Map of Vermont reduced market regions (RRs)
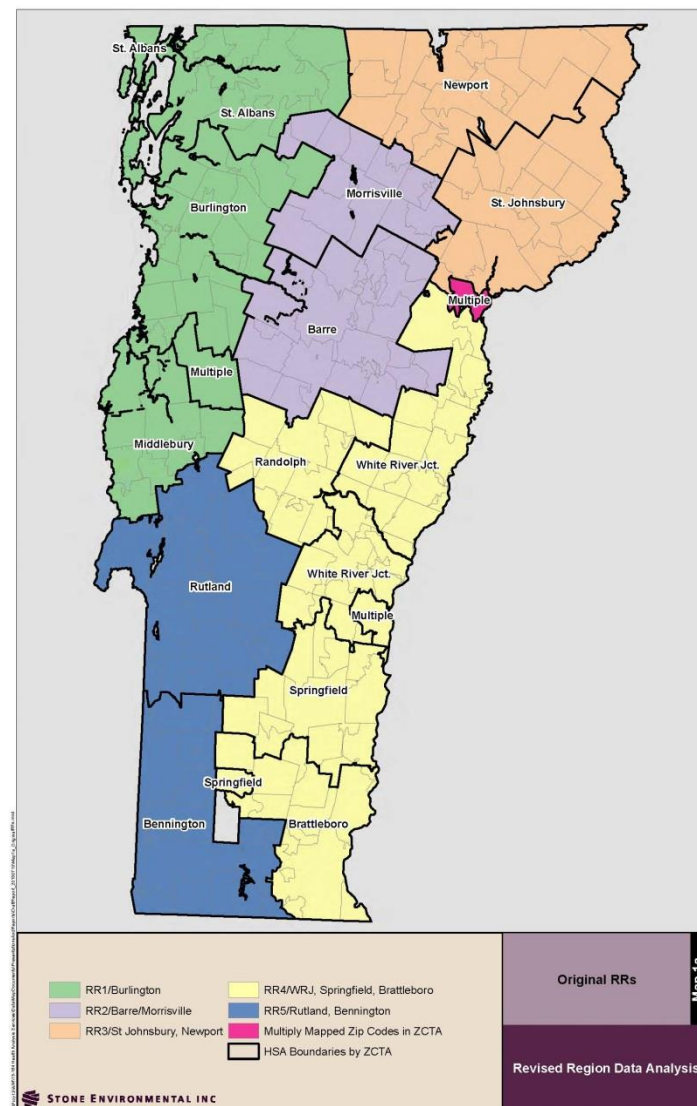
Defining risk scores for acute admissions

Risk scores are calculated as a proxy variable for severity of the health condition of the patient at the time of admission. This variable allows for investigating to what extent preference for out-of-area or out-of-state care is a function of the severity of the condition. The risk scores are estimated based on the full set of concurrent health conditions and comorbidities present on admission as reported in VHCURES hospital stay claims. The details of the calculation of the risk score can be found in Appendix B, and are also found within the dashboard user documentation.

Defining expected spending by DRG

Expected spending in this report reflects risk-adjusted acute inpatient hospitalization costs. The expected dollars are estimated using a set of regression models that are adjusted for payer/population differences, and are based in part on the patient hospital risk scores described above and services provided within the admission.   Details of the payer specific regression models that provide expected costs are found in Appendix B and in the documentation within the dashboard.

Defining excess spending

Excess spending (and therefore, opportunity for savings), is defined in one of two ways, which are both included as selections in the dashboard.

1. Expected spending per DRG, based on a risk scoring method (see Appendix B) comparing the average observed spending for the DRG grouping to the expected based on risk; or,

2. Spending in comparison to the median for the DRG at UVMMC. This hospital was selected as a comparator because UVMMC accounts for about 40 percent of Vermonter admissions within the state, and therefore it drives the median of all Vermont admissions. In rare cases where number of admission at UVMMC was small the median across all providers was used.

Results

In this section, we highlight the features of the dashboard, using examples as illustrations. Next, we show how the dashboard can be used to generate information that responds to an important policy question.

Feature 1: Identification of patterns of care for high cost / high priority admissions?

Table 1 shows the origin and destination for all of the 81 high cost /high priority admissions, for all payers. This table shows that most admissions stay within the general market area. However, a varying proportion of admissions occur out of the market region.   Dartmouth Hitchcock Medical Center draws patients particularly from the Upper Valley area, and St. Johnsbury/Newport, owing to its close proximity. For residents of the Upper Valley area, in particular, nearly half of residents' high priority admissions stay within the region (at Mt. Ascutney or Gifford Hospitals, for example), but a third (34 percent) seek care at DHMC. Both Upper Valley and St. Johnsbury/Newport areas lose about 10 percent of admissions to other hospitals in New England. Most resident admissions within the Burlington area, as expected, receive care within the area, mostly at University of Vermont Medical Center. It should be noted that sometimes when individuals travel outside of their region for care, that care is more expensive, but not always, and sometimes they are sicker (as measured in VHCURES risk scores), but not always. Further sections below address this in more detail.

Table 1: Number and percent of high priority admissions, Vermont residents to Vermont and other hospitals, all payers, 2011

Member_RR	In-RR1	In-RR2	In-RR3	In-RR4	In-RR5	DHMC	NH-MA-NY	Other	All providers
Number of admissions in and out of area									
RR1:Burlington	**6,955**	154	14	264	67	93	91	168	7,806
RR2:Barre	671	**1,759**	34	313	20	240	43	61	3,141
RR3:St. J/New	101	79	**1,162**	57	5	332	201	27	1,964
RR4:Upper Valley	72	90	15	**2,168**	147	1,597	500	99	4,688
RR5:Rutland	350	15	1	377	**3,192**	317	296	81	4,629
All RR regions	8,149	2,097	1,226	3,179	3,431	2,579	1,131	436	22,228
Percent of admissions in area and out of area									
Member_RR	In-RR1	In-RR2	In-RR3	In-RR4	In-RR5	DHMC	NH-MA-NY	Other	All providers
RR1:Burlington	**89%**	2%	0%	3%	1%	1%	1%	2%	100%
RR2:Barre	21%	**56%**	1%	10%	1%	8%	1%	2%	100%
RR3:St. J/New	5%	4%	**59%**	3%	0%	17%	10%	1%	100%
RR4:Upper Valley	2%	2%	0%	**46%**	3%	34%	11%	2%	100%
RR5:Rutland	8%	0%	0%	8%	**69%**	7%	6%	2%	100%
All RR regions	37%	9%	6%	14%	15%	12%	5%	2%	100%

Table 2 shows the preference of local market care over out-of-area care. These findings suggest that the tendency for staying local for hospital care is highest for Medicare beneficiaries. Commercial members on average have a higher use of care outside of local markets.

Table 2: Vermont resident local preference for admissions, by payer, 2011

	Percent of high priority admissions within local area				
Payer	RR1 Local Burlington	RR2 Local Barre	RR3 Local St J/Newport	RR4 Local Upper Valley (excluding DHMC)	RR5 Local Rutland
Commercial	92%	48%	53%	36%	62%
Medicare	91%	66%	61%	44%	77%
Medicaid	82%	52%	62%	57%	64%
All 3 Payers	89%	56%	59%	46%	69%

Table 3 shows the average acute costs for all DRGs by payer. At the global DRG level (all 81 DRGs combined) on average the in-state care tends to be less expensive than out-of-state admissions. Within the five markets, RR1 (Burlington area) and RR5 (Rutland area) are on average higher cost than other three markets, perhaps because they have more of the complex DRGs among the 81 selected ones. These patterns could be investigated further within the dashboard by choosing different combinations of DRGs within the dashboard, customized to specific policy questions.

Table 3: Average acute inpatient care unadjusted cost per admission for 81 high priority DRGs by payer

Origin	In-RR1	In-RR2	In-RR3	In-RR4	In-RR5	MHMH	NH-MA-NY	Other	All Providers
Commercial average $ per admission									
RR1	**13,615**	16,821	17,495	2,093	17,152	36,696	36,508	32,344	14,612
RR2	20,798	**10,884**	9,676	12,946	39,222	34,143	22,833	39,791	16,768
RR3	29,210	19,416	**10,934**	20,021	-	33,683	12,034	77,684	16,839
RR4	27,112	11,042	16,405	**11,039**	22,922	23,602	12,938	28,330	17,385
RR5	21,289	16,014	-	7,275	**17,636**	25,277	30,621	29,477	19,398
All	14,742	11,651	11,112	10,688	18,067	26,590	17,922	32,870	16,359
Medicaid average $ per admission									
RR1	**12,325**	8,989	8,127	10,941	8,549	15,817	36,187	12,340	12,186
RR2	18,235	**8,858**	8,531	9,340	20,525	14,030	25,856	3,913	11,527
RR3	14,262	10,941	**8,837**	13,469	15,878	18,251	7,420	3,185	10,679
RR4	16,182	8,890	6,042	**8,745**	8,249	12,615	4,880	3,678	9,388
RR5	17,061	11,964	-	9,876	**7,600**	18,036	13,694	8,158	9,510
All	13,243	9,023	8,785	9,452	7,746	14,212	9,812	7,674	10,682
Medicare average $ per admission									
RR1	**19,223**	11,637	10,223	11,257	21,211	23,364	24,675	15,695	19,077
RR2	28,473	**15,153**	21,427	10,791	14,209	28,653	21,795	14,491	18,296
RR3	21,690	14,304	**14,065**	6,839	11,876	29,267	13,780	14,879	17,470
RR4	21,332	13,143	14,803	**14,357**	18,525	25,594	19,049	15,340	19,242
RR5	23,136	14,685	16,900	16,437	**14,935**	29,184	23,047	14,313	16,894
All	19,995	14,871	14,210	14,191	15,134	26,722	20,410	15,160	18,335
All Payers average $ per admission									
RR1	**15,243**	12,238	10,883	9,806	13,235	30,188	31,770	22,314	15,498
RR2	21,982	**12,196**	13,318	10,936	25,793	27,825	23,218	25,342	15,860
RR3	19,945	14,193	**11,504**	14,154	13,477	27,677	11,502	20,991	14,993
RR4	20,417	10,620	12,630	**11,344**	15,578	21,947	12,131	19,316	15,471
RR5	20,551	13,858	16,900	9,842	**13,343**	25,174	22,168	21,725	15,127
All	16,130	12,219	11,566	11,048	13,509	23,925	16,648	21,866	15,421

Feature 2: Analysis at the hospital perspective

The dashboard allows for analysis from the hospital perspective as well, so each hospital can analyze the patient origin overall, or for particular types of admissions, and the average spending and average risk score per admission for any Vermont hospital. **Table 4** shows the profile for Dartmouth Hitchcock Medical Center as an example, with number of admissions from each market area. As indicated, DHMC pulls patients from all Vermont areas, as expected considering its status as a major medical center, and fewer from Burlington (RR1), as UVMMC is available to those residents. It is important to note though, that DHMC appears to be used by residents in the Upper Valley region at a much greater rate. This table

alone is illustrative, but does not indicate the extent to which Vermonters are seeking care at DHMC for services that cannot be provided elsewhere, or because they have a more severe condition. Analysis below drills down into patterns of care and level of risk for patients moving across regions, and to DHMC for admissions.

Table 4: Hospital perspective, number and percent of high priority inpatient admissions of Vermont residents to Dartmouth Hitchcock Medical Center

	Number of admissions, 2011					
Payer	Total	RR1	RR2	RR3	RR4	RR5
Commercial	901	51	89	85	539	137
Medicare	1111	36	104	165	692	114
Medicaid	567	6	47	82	366	66
All payers	2579	93	240	332	1597	317
	Percent of DHMC admissions from each area, 2011					
Payer	Total	RR1	RR2	RR3	RR4	RR5
Commercial	100.0%	5.7%	9.9%	9.4%	59.8%	15.2%
Medicare	100.0%	3.2%	9.4%	14.9%	62.3%	10.3%
Medicaid	100.0%	1.1%	8.3%	14.5%	64.6%	11.6%
All payers	100.0%	3.6%	9.3%	12.9%	61.9%	12.3%

Feature 3: Identifying the market for particular services

Maternity care is a market that for the most part involves patient choice. Patients without complex comorbidities or complications of pregnancy or delivery might prefer to remain in local hospitals for deliveries and post-delivery services. For those admissions that are not complex, there may be little reason to travel out-of-area for deliveries. Patterns of care and average spending for these services in and out of local area, by payer, for DRGs 766 (uncomplicated cesarean) and DRG 775 (uncomplicated vaginal delivery) are presented in **Table 5**.

Table 5 shows that spending per admission varies, depending on where basic maternity services are provided. For commercial payers, most expensive maternity admissions occur at DHMC, but this is clearly not the case for Medicaid. This may be related to a different mix of Cesarean vs vaginal births in each area, but this is one way to understand the cost implications including the different delivery methods within uncomplicated births. Each DRG can be viewed separately as well (although numbers may be small to support analyses). The area that appears to have the most expensive maternity admissions for commercial payers is the Rutland area (RR5), either Rutland Hospital or Southwestern Vermont. Individual statistics are available by hospital within the dashboard, though numbers may be small for some facilities, providing less stability in these numbers.

For Medicaid, hospital admissions are paid by DRG, and there is less variation across regions for uncomplicated deliveries. However, each hospital and admission has additional payments associated with the admission in VHCURES, beyond the DRG base, so average spending per admission, even within DRGs, varies. For Medicaid, DHMC is not always the most expensive location. It might be expected that admissions that leave the local community are of higher risk than others, and may be consistent with

higher admission spending. However, upon further inspection, the dashboard indicates that individual seeking care for uncomplicated maternity services outside of their local market, whether commercial or Medicaid, do not have higher risk profiles than those receiving care within their local area (not shown in table).

Table 5: Average 2011 spending for uncomplicated maternity services (DRGs 775 and 766) for Vermont residents, by resident region and region of service

Origin	Average 2011 unadjusted acute spending per admission for DRG group: Pregnancy, maternity and the puerperium services provided in:								
	In-RR1	In-RR2	In-RR3	In-RR4	In-RR5	DHMC	NH-MA-NY	Other	Average $ /admission for all providers
Commercial (n=1,960 admissions)									
RR1 Burlington	**$8,562**	$7,577	$9,774	$9,831	$9,019	-	$8,468	$13,171	$8,569
RR2 Barre	$9,182	**$8,861**	$7,143	$11,412	-	$12,231	$5,152	$10,243	$9,333
RR3 St.J/Newp	$8,320	$6,343	**$9,734**	-	-	$11,220	$6,858	-	$9,020
RR4 Upper Valley	$9,354	$8,058	$6,785	**$9,876**	$8,270	$11,778	$7,852	11,120	$9,956
RR5 Rutland	$8,520	-	-	$9,429	**$11,025**	$10,658	$9,342	$10,808	$10,475
All Vermont origin	$8,608	$8,757	$9,590	$10,166	**$10,948**	$11,585	$7,652	$11,466	$9,182
Medicaid (n=1,322 admissions)									
RR1 Burlington	**$8,380**	$8,096	$5,920	$7,504	$8,229	$6,214	$3,216	-	$8,350
RR2 Barre	$7,764	**$8,398**	$7,581	$6,555	-	$7,103	$4,248	-	$7,911
RR3 St.J/Newp	$7,418	$10,396	**$8,454**	$5,938	-	$11,311	$5,219	-	$8,138
RR4 Upper Valley	$7,313	$7,699	$7,401	**7,397**	$7,655	$7,882	$4,981	-	$7,026
RR5 Rutland	$8,263	$10,338	-	$6,720	**$7,883**	$5,087	$5,831	-	$7,774
All Vermont origin	$8,303	$8,415	$8,373	$7,214	**$7,877**	$7,854	$5,010		$7,843

Table 6 shows the amount of spending on uncomplicated deliveries for the commercial population, compared to the UVMMC median for the same DRGs, by region. As noted, $1.2 million total in excess spending is shown. It is interesting to note that patients receiving services in other NH, NY and MA are less expensive than the median, while those seeking care in the RR4 Upper Valley area (White river Junction, Randolph, Brattleboro, Springfield) are more expensive.

Table 6: Excess spending by region for uncomplicated deliveries

Resident Origin	Excess Spending $$ in region, commercial								
	In-RR1	In-RR2	In-RR3	In-RR4	In-RR5	MHMH	NH-MA-NY	Other	All Providers
RR1: Burlington	26,245	(13,180)	1,856	1,913	1,101		550	15,759	34,243
RR2: Barre	37,216	45,948	(8,837)	136,717		19,366	(2,766)	4,650	232,294
RR3: StJ/Newp	1,204	(3,150)	109,477			13,206	(44,830)		75,907
RR4: Upper Valley	1,436	(2,977)	(2,267)	196,646	1,408	300,344	(30,538)	3,148	467,198
RR5: Rutland	(6,428)			9,871	392,150	44,000	6,710	5,412	451,715
All Vermont origin	**59,671**	**26,641**	**100,229**	**345,146**	**394,658**	**376,916**	**(70,873)**	**28,969**	**1,261,358**

Feature 4: Calculating inpatient market and spending by major diagnostic category and payer

Figure 2 shows another view of patterns of total acute inpatient utilization and spending for Vermont residents, for commercial, Medicare, Medicaid, and by all payers combined. This view illustrates the proportion of spending, and potential for savings for each payer, and for all high priority admissions overall.   Viewing **Figure 2**, for each payer, the inner ring is the proportion of admissions accounted for by the diagnostic category, the middle ring is the proportion of all costs accounted for by the diagnostic category, and the outer ring is the total of what might be considered "excess spending," based on comparison of actual DRG cost to the median of UVMMC.

Patterns of spending and potential savings differ by payer, as expected due to the differences in covered populations. For commercial admissions (the left-most circle), pregnancy and newborns account for 57 percent of all admissions, but 28 percent of spending. Musculoskeletal admissions account for the largest portion of spending, at 27 percent, followed by pregnancy (20 percent of commercial inpatient spending for the high priority DRGs). The outer circle compares the total observed spending for commercial admissions to that of the commercial median for UVMMC. This indicates that for commercial payers, the greatest portion of excess spending (greater than the median) is in musculoskeletal (23 percent of excess spending), followed by newborns (18 percent of excess spending), and pregnancy (14 percent of excess spending). The results suggest that the greatest opportunity for savings in commercial inpatient admissions might be in the musculoskeletal category. The dashboard allows for analysis of further detail, such as specific DRGs and specific hospitals.

For Medicaid (non-duals), pregnancy and newborns dominate the admission count, at 56 percent combined, similar to that of commercial. These admission conditions together account for 47 percent of Medicaid inpatient acute spending, a proportion that is much higher than that of commercial payers. Mental condition related DRGs (see appendix list of DRGs) comprise 16 percent of inpatient admissions for Medicaid non-duals, and 20 percent of spending. However, the figure indicates that over half (55 percent) of Medicaid spending greater than median is in the "mental disease" MDC, at $1.8 million.

For Medicare, obviously the patterns are quite different, as there are only rare maternity admissions. Circulatory, respiratory, and musculoskeletal conditions together account for nearly all of the admissions, each at around one-fourth of the total. In terms of total dollars, circulatory (29 percent of total Medicare inpatient high priority DRG spending) and musculoskeletal conditions (30 percent) are the highest cost groupings. Regarding opportunities for savings on the Medicare side, circulatory

condition admissions are most often priced above the median (41 percent of above-median, or excess spending, for the payer), and might be important areas for further evaluation.

Figure 2: Vermont resident inpatient utilization and spending, by major diagnostic conditions and payer
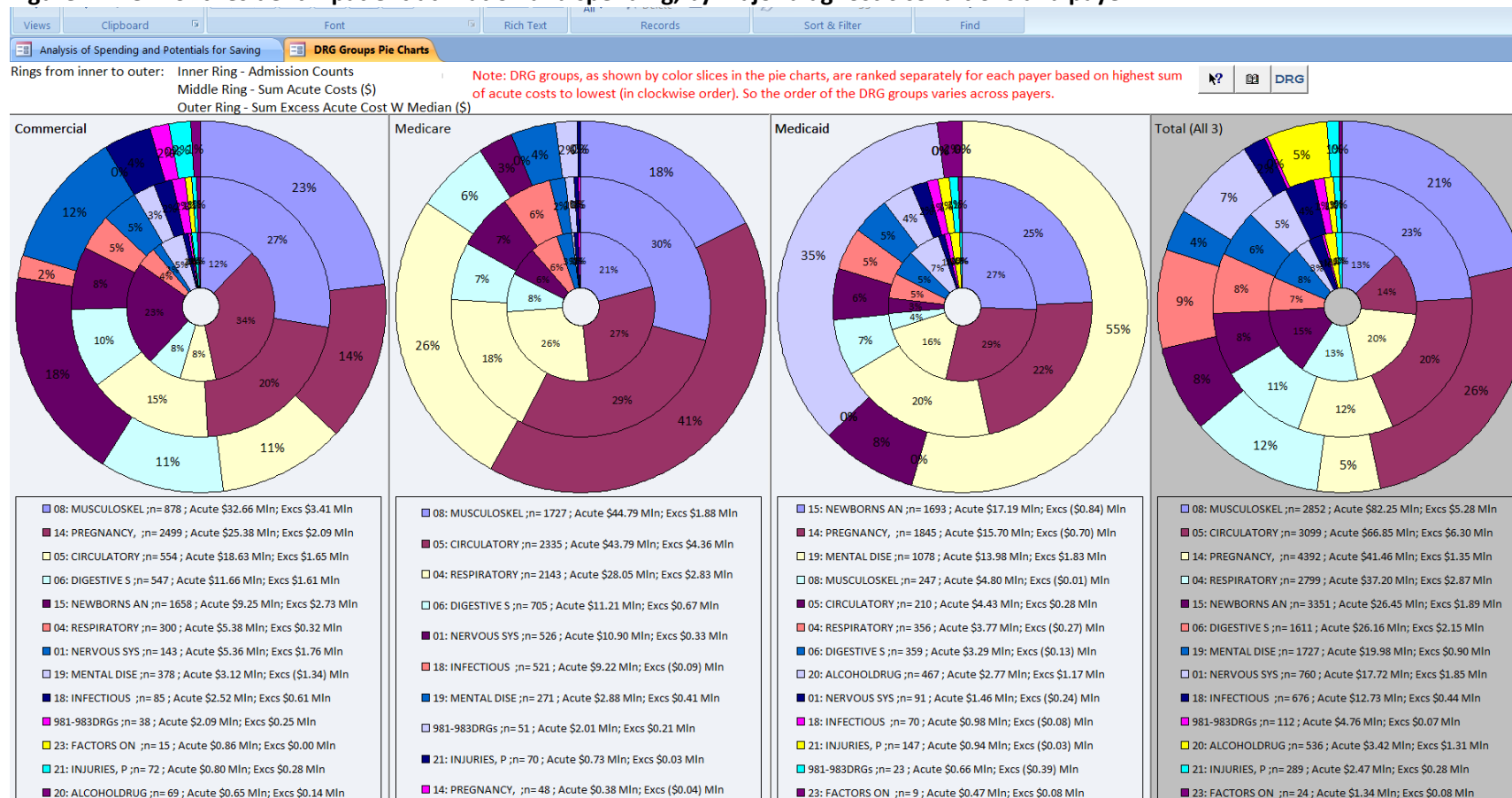
Policy question example

This section uses the dashboard analysis summarized earlier, to examine several policy questions. This report focuses separately on commercially insured admissions, Medicaid and Medicare:

- For insured patients, by major diagnostic categories, how much was spent in and out of patients' resident market area?
- What was the out-of-market portion of total dollars?
- For the MDCs where patients prefer to leave their own market area for other hospitals how much could be considered excess spending (greater than the median)?
- Do patients have a health condition requiring them to leave the area and/or incur higher costs?
- What are the MDCs of priority for savings where the health condition of those who leave is no worse than the patients who seek local care?

Figure 3 shows the following metrics:

Left side chart:

1) The sum of acute costs for the DRG grouping (green circle graph, scaled on the right axis)
2) The sum of acute costs spent outside patient resident's market area (yellow diamond graph, scaled on the right axis)
3) The portion of total acute care costs that are spent out-of-market (purple bar graph, scaled on the left axis)

Right side chart:

4) The sum of excess payments as calculated relative to UVMMC (formerly Fletcher Allen) median costs at the individual DRG level (purple bar graph, scaled on the left axis)
5) The average risk score for patients who stayed in their local market (green circle graph, scaled on the right axis)
6) The average risk score for patients who left their local market (yellow diamond graph, scaled on the right axis)

As shown in **Figure 3**, the top-three MDCs in terms of total commercial dollars for acute care (left chart) are:

- musculoskeletal system ($33 million)
- pregnancy-related ($26 million)
- circulatory system ($20 million)

It is useful to look at what services individuals seek out of their local region. The top-three MDCs with the highest portion of out-of-area spending (either outside of local hospital, or out of state, most often at DHMC) are: nervous system diseases (73% of spending for the DRG group); circulatory system (63% of spending for the DRG); and 981-983 (extensive OR procedure unrelated to principal diagnosis) (57%).

However, while much of nervous system services are provided at out-of-area hospitals, it is a relatively small dollar amount due to the low number of admissions. More important in terms of cost are the top three MDCs for which most money is spent at non-local hospitals (generally either other Vermont

hospitals, or at DHMC): musculoskeletal system ($15.5 million); circulatory system ($12 million); and pregnancy ($7 million).

Perhaps the most important component in this example is the "excess spending" by MDC, defined as the amount of spending by DRG within the MDC, compared to the median at UVMMC. As shown in the right hand side of **Figure 3**, the top-three with highest amount of excess spending are musculoskeletal system ($3.4 million), newborns ($2.8 million), and pregnancy ($2.1 million). In other words, these are the clinical areas in which the greatest amount of spending is higher than the state (UVMMC) median.

It is important to know whether individuals who are leaving their local hospitals are doing so because they have more complex conditions, or are higher risk, due to additional health conditions. If those who are traveling to other areas, to DHMC, or out of state for care are higher "risk" than those who stay at local hospitals, then this could be justifiable travel and increased spending. However, **Figure 3** also indicates that for the first and the third largest excess spending MDCs (musculoskeletal system and pregnancy), the average risk score for those who stayed local for their hospital care and those who left out of area are quite similar. This suggests that patient health condition is not likely a justification for significant excess payments or travel. It might be due to patient preference alone.

In the top-three list of excess spending categories, the only MDC where the out of area patients appear to be "sicker" is the newborn group. Other MDCs with significantly higher off-area risk scores (reading from the right side of **Figure 3**) are infectious disease, respiratory disease, nervous system conditions, and injuries. However, again, it appears that except for nervous system conditions, other MDCs are not introducing significant excessive costs to commercial insurers.

Figures 4 and 5 repeat the same analysis for Medicare and Medicaid respectively. The highest cost MDC groups vary across payers. For Medicare, the top-three highest total spending categories include musculoskeletal, circulatory, and respiratory left side graphs, yellow circles. While circulatory system admissions for Medicare are associated with highest excess spending ($4.4 million, right chart), patients seeking care out-of-area have a slightly lower risk profile than those that receive care within their local area. Respiratory out-of-area use alone is associated with higher risk profiles.

For Medicaid, newborn, pregnancy, and mental condition admissions are highest proportion of cost MDCs (left chart), as indicated earlier. For newborns and pregnancy, the average admission spending is lower than the average at UVMMC, so the excess cost is negative.   Excess spending for Medicaid lies in mental disease and alcohol and drug categories. Risk is similar for in and out-of-area services, though it should be noted that risk scoring systems do not reflect resource needs for mental health conditions as well as physical health conditions.

Figure 3: Example of side by side comparison charts with 6 user selected variables for investigating policy questions, commercial
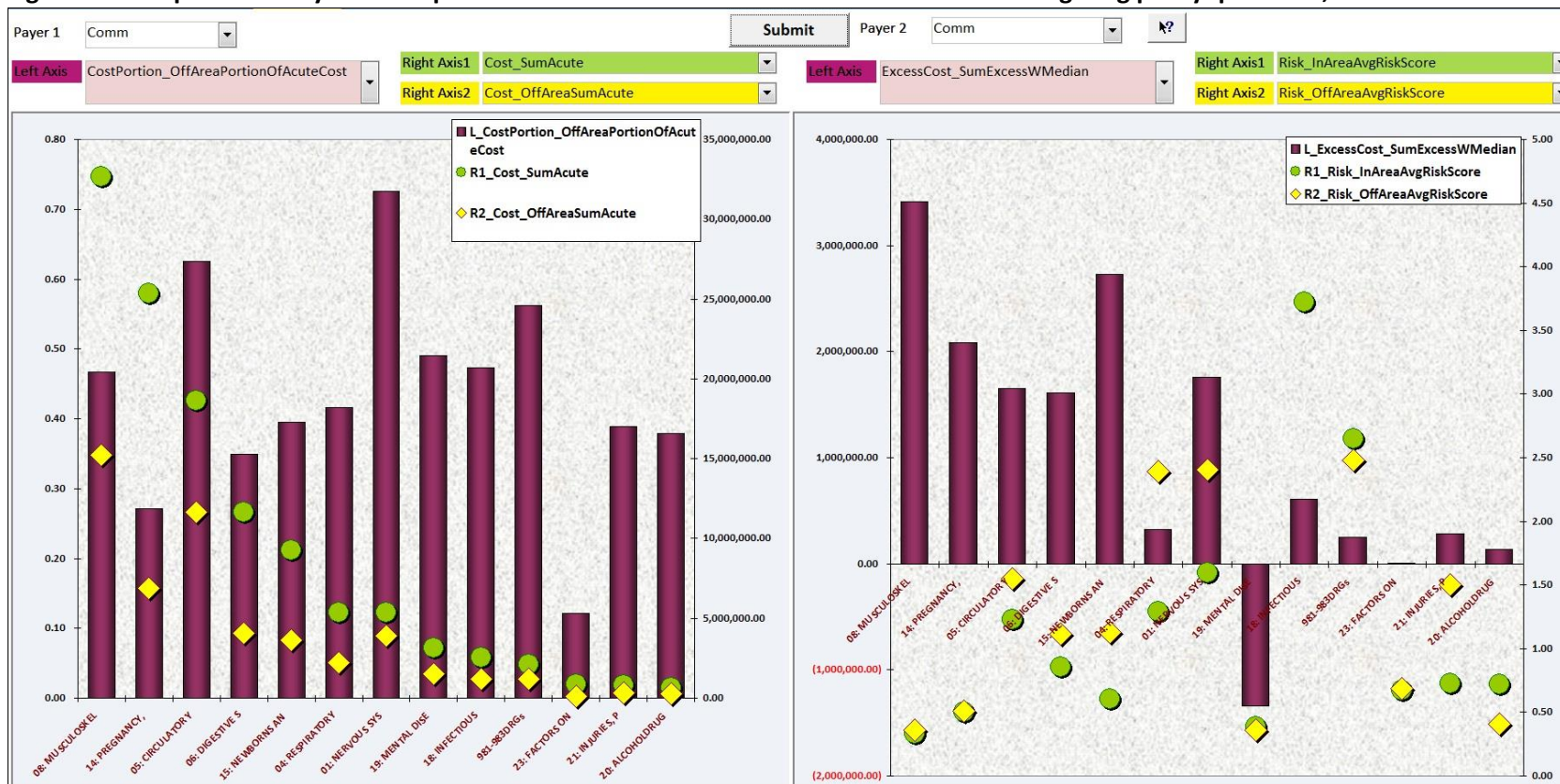
Figure 4: Example of side by side comparison charts with 6 user selected variables for investigating policy questions, Medicare
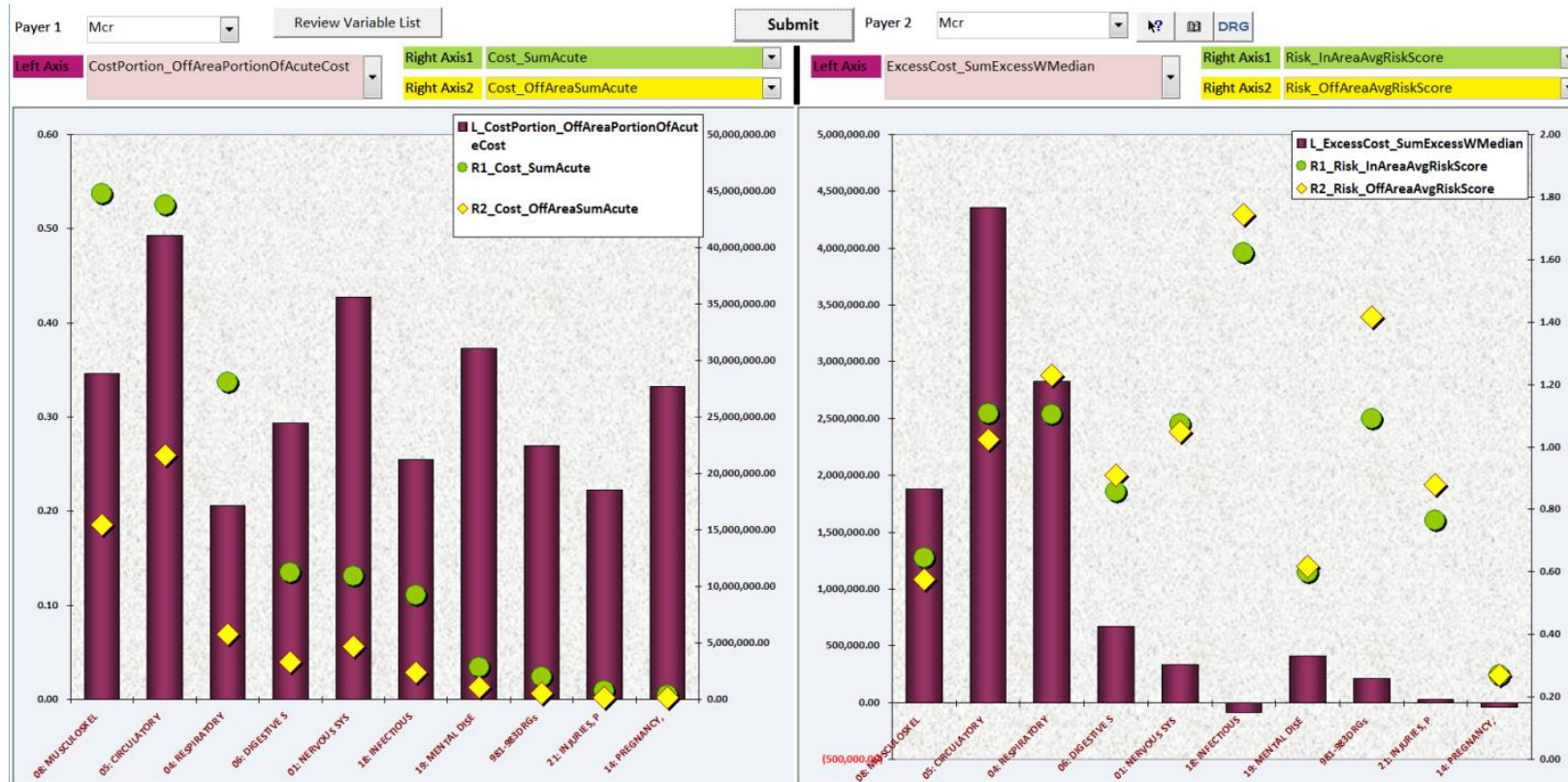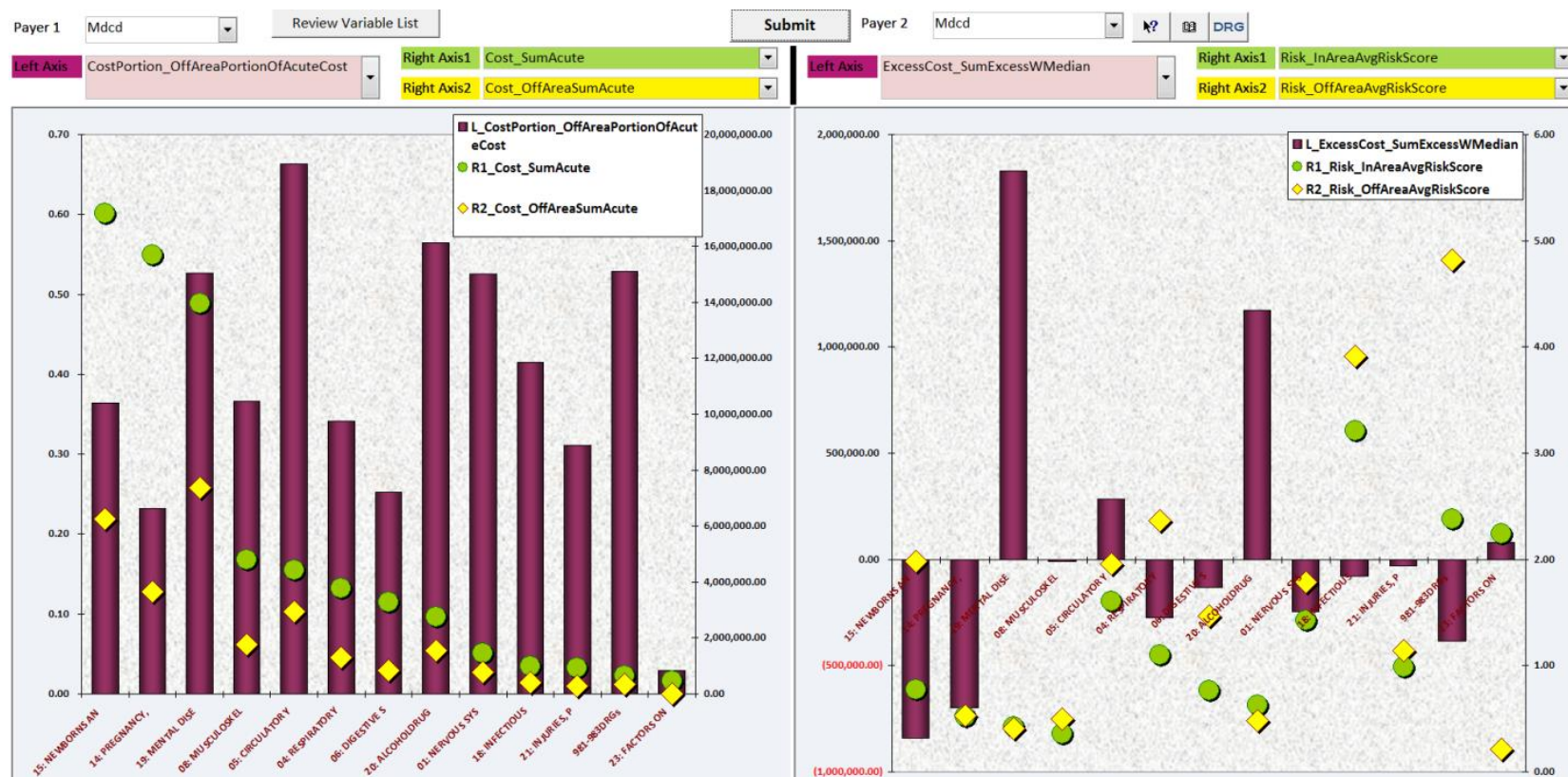
Figure 5: Example of side by side comparison charts with six user selected variables for investigating policy questions, Medicaid

Example of potential savings by DRG: DRG 470 - Major joint replacement, upper or lower

An additional example of an application of the dashboard can be demonstrated using a common procedure across all three payers: DRG 470, major joint replacement, without major complications. This procedure accounts for over 3,000 admissions for Vermonters across the three payers, for a total acute spending of $53 million in 2011 (excluding post-acute services). For commercial services, DRG 470 was the highest total spending DRG, accounting for $24 million in acute admission spending. **Table 7** shows results of the dashboard analysis of total excess spending. As shown in the table, when comparing uncomplicated major joint replacement spending to UVMMC median, nearly $6 million may be an opportunity for savings. The largest portion is commercial, but Medicare also presents savings potential. Medicaid remains close to the UVMMC median spending, so that little can be saved in this analysis.

Table 7: Total spending and excess spending for DRG 470 (major joint replacement), 2011

Payer	Number of admissions	Total acute spending	Total excess spending, as deviation from UVMMC median
Commercial	**711**	**$24.1 million**	**$4.1 million**
Medicaid	**145**	**$2.5 million**	**$20,000**
Medicare	**1157**	**$25.8 million**	**$1.8 million**
Total all payers	**2013**	**$52.4 million**	**$5.9 million**

Summary and conclusions

For Vermont residents, the proportion of high priority admissions leaving the local regions varies by resident location. For example only 11 percent of Burlington residents admissions leave the Burlington region but over half (54%) of Upper Valley residents admissions occur outside the Vermont's Upper Valley region. When care is provided out-of-state, it is more expensive, regardless of whether the patient condition reflects a higher risk score. Care received outside a local resident's area, but within Vermont, is sometimes, but not always, more expensive. Furthermore, higher spending outside a local area is only sometimes associated with patient higher risk profiles.

As measured by comparing DRG based admission costs to the median for the largest provider in the state (UVMMC), there is considerable excess spending that is not accounted for by differences in patient risk profiles. This differs by payer, and Medicaid has the lowest amount of excess spending, and therefore fewer opportunities for savings by seeking lower-cost providers within Vermont, beyond that of mental health conditions.

This study, therefore, suggests that there are potential opportunities for savings without significant risk to the health of the population.   In sum, there is close to $25 million worth of estimated excess spending if UVMMC median cost is used as a benchmark. The Medicare program alone accounts for $13.5 million, while Medicaid hospital care seems to be already well localized hence might not benefit from further localization.

There are significant variations in terms of average costs within payers when patients choose their target hospital areas, and also across payers within same local market area.   Focusing on each of these cost variations can lead to certain efficiencies and savings within the healthcare delivery system. This market analysis, and potential further work with the market analysis dashboard will be useful for the following Vermont priorities:

- To assess differences across payer by DRG admission and inform a strategy to reduce price variation across payers
- To understand the potential impact of investment in referral systems and/or efforts to localize care
- To examine detailed spending by hospital and by selected DRGs to inform the above priorities

Appendix A: High cost high priority Diagnostic Related Groups

Vermont GMCB staff selected a common list of high cost or high utilization DRGs for all payers (commercial, Medicaid and Medicare). These were included in the dashboard and allow for a comparison across payers for the common set of selected DRGs shown below:

Table A1: List of DRGs of Interest

DRG	MDC	TYPE	MS_DRG_TITLE
25	01	SURG	CRANIOTOMY & ENDOVASCULAR INTRACRANIAL PROCEDURES W MCC
26	01	SURG	CRANIOTOMY & ENDOVASCULAR INTRACRANIAL PROCEDURES W CC
27	01	SURG	CRANIOTOMY & ENDOVASCULAR INTRACRANIAL PROCEDURES W/O CC/MCC
64	01	MED	INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W MCC
65	01	MED	INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W CC
66	01	MED	INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W/O CC/MCC
163	04	SURG	MAJOR CHEST PROCEDURES W MCC
164	04	SURG	MAJOR CHEST PROCEDURES W CC
165	04	SURG	MAJOR CHEST PROCEDURES W/O CC/MCC
190	04	MED	CHRONIC OBSTRUCTIVE PULMONARY DISEASE W MCC
191	04	MED	CHRONIC OBSTRUCTIVE PULMONARY DISEASE W CC
192	04	MED	CHRONIC OBSTRUCTIVE PULMONARY DISEASE W/O CC/MCC
193	04	MED	SIMPLE PNEUMONIA & PLEURISY W MCC
194	04	MED	SIMPLE PNEUMONIA & PLEURISY W CC
195	04	MED	SIMPLE PNEUMONIA & PLEURISY W/O CC/MCC
207	04	MED	RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT 96+ HOURS
208	04	MED	RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT <96 HOURS
219	05	SURG	CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W/O CARD CATH W MCC
220	05	SURG	CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W/O CARD CATH W CC
221	05	SURG	CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W/O CARD CATH W/O CC/MCC
235	05	SURG	CORONARY BYPASS W/O CARDIAC CATH W MCC
236	05	SURG	CORONARY BYPASS W/O CARDIAC CATH W/O MCC
250	05	SURG	PERC CARDIOVASC PROC W/O CORONARY ARTERY STENT W MCC
251	05	SURG	PERC CARDIOVASC PROC W/O CORONARY ARTERY STENT W/O MCC
280	05	MED	ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W MCC
281	05	MED	ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W CC
282	05	MED	ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W/O CC/MCC
283	05	MED	ACUTE MYOCARDIAL INFARCTION, EXPIRED W MCC
284	05	MED	ACUTE MYOCARDIAL INFARCTION, EXPIRED W CC
291	05	MED	HEART FAILURE & SHOCK W MCC
292	05	MED	HEART FAILURE & SHOCK W CC
293	05	MED	HEART FAILURE & SHOCK W/O CC/MCC
308	05	MED	CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W MCC
309	05	MED	CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W CC

Table A1: List of DRGs of Interest[1]   CONTINUED

DRG	MDC	TYPE	MS_DRG_TITLE
310	05	MED	CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W/O CC/MCC
329	06	SURG	MAJOR SMALL & LARGE BOWEL PROCEDURES W MCC
330	06	SURG	MAJOR SMALL & LARGE BOWEL PROCEDURES W CC
331	06	SURG	MAJOR SMALL & LARGE BOWEL PROCEDURES W/O CC/MCC
338	06	SURG	APPENDECTOMY W COMPLICATED PRINCIPAL DIAG W MCC
339	06	SURG	APPENDECTOMY W COMPLICATED PRINCIPAL DIAG W CC
340	06	SURG	APPENDECTOMY W COMPLICATED PRINCIPAL DIAG W/O CC/MCC
341	06	SURG	APPENDECTOMY W/O COMPLICATED PRINCIPAL DIAG W MCC
342	06	SURG	APPENDECTOMY W/O COMPLICATED PRINCIPAL DIAG W CC
343	06	SURG	APPENDECTOMY W/O COMPLICATED PRINCIPAL DIAG W/O CC/MCC
391	06	MED	ESOPHAGITIS, GASTROENT & MISC DIGEST DISORDERS W MCC
392	06	MED	ESOPHAGITIS, GASTROENT & MISC DIGEST DISORDERS W/O MCC
459	08	SURG	SPINAL FUSION EXCEPT CERVICAL W MCC
460	08	SURG	SPINAL FUSION EXCEPT CERVICAL W/O MCC
469	08	SURG	MAJOR JOINT REPLACEMENT OR REATTACHMENT OF LOWER EXTREMITY W MCC
470	08	SURG	MAJOR JOINT REPLACEMENT OR REATTACHMENT OF LOWER EXTREMITY W/O MCC
480	08	SURG	HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W MCC
481	08	SURG	HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W CC
482	08	SURG	HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W/O CC/MCC
765	14	SURG	CESAREAN SECTION W CC/MCC
766	14	SURG	CESAREAN SECTION W/O CC/MCC
774	14	MED	VAGINAL DELIVERY W COMPLICATING DIAGNOSES
775	14	MED	VAGINAL DELIVERY W/O COMPLICATING DIAGNOSES
789	15	MED	NEONATES, DIED OR TRANSFERRED TO ANOTHER ACUTE CARE FACILITY
790	15	MED	EXTREME IMMATURITY OR RESPIRATORY DISTRESS SYNDROME, NEONATE
791	15	MED	PREMATURITY W MAJOR PROBLEMS
792	15	MED	PREMATURITY W/O MAJOR PROBLEMS
793	15	MED	FULL TERM NEONATE W MAJOR PROBLEMS
794	15	MED	NEONATE W OTHER SIGNIFICANT PROBLEMS
795	15	MED	NORMAL NEWBORN
870	18	MED	SEPTICEMIA OR SEVERE SEPSIS W MV 96+ HOURS
871	18	MED	SEPTICEMIA OR SEVERE SEPSIS W/O MV 96+ HOURS W MCC
872	18	MED	SEPTICEMIA OR SEVERE SEPSIS W/O MV 96+ HOURS W/O MCC
881	19	MED	DEPRESSIVE NEUROSES
882	19	MED	NEUROSES EXCEPT DEPRESSIVE
885	19	MED	PSYCHOSES
894	20	MED	ALCOHOL/DRUG ABUSE OR DEPENDENCE, LEFT AMA
895	20	MED	ALCOHOL/DRUG ABUSE OR DEPENDENCE W REHABILITATION THERAPY
896	20	MED	ALCOHOL/DRUG ABUSE OR DEPENDENCE W/O REHABILITATION THERAPY W MCC
897	20	MED	ALCOHOL/DRUG ABUSE OR DEPENDENCE W/O REHABILITATION THERAPY W/O MCC

Table A1: List of DRGs of Interest[1]   CONTINUED

DRG	MDC	TYPE	MS_DRG_TITLE
917	21	MED	POISONING & TOXIC EFFECTS OF DRUGS W MCC
918	21	MED	POISONING & TOXIC EFFECTS OF DRUGS W/O MCC
945	23	MED	REHABILITATION W CC/MCC
946	23	MED	REHABILITATION W/O CC/MCC
981		SURG	EXTENSIVE O.R. PROCEDURE UNRELATED TO PRINCIPAL DIAGNOSIS W MCC
982		SURG	EXTENSIVE O.R. PROCEDURE UNRELATED TO PRINCIPAL DIAGNOSIS W CC
983		SURG	EXTENSIVE O.R. PROCEDURE UNRELATED TO PRINCIPAL DIAGNOSIS W/O CC/MCC

1.DRGs 945 and 946 are rehab DRGs. Given that market analysis focused on patterns of acute inpatient care, these two rehab DRGs were excluded from the Medicare market analysis.

Appendix B: Methods for analysis

This document describes the methodology used in the market analysis. Specifically, the following aspects are described in this document:

- Analysis time frame
- Defining acute and post-acute phases of care
- Defining the population: exclusion criteria by payers
- Defining the market areas within and outside Vermont
- Severity adjustment of acute admission spending to calculate expected costs

Analysis time frame

For commercial and Medicaid, the analysis time frame was January 1, 2011 – December 31, 2011. For Medicare, the time frame used was October 1, 2010 – September 30, 2011. The reason for using this time frame for Medicare was that at the time the data analysis was done, the Brandeis team did not have Medicare 2012 data and the data for the 90-day post-acute period for stays with admit date of October 1, 2011 or later was incomplete. As a result, we shifted the Medicare market analysis time frame accordingly.

Defining acute and post-acute phases of the care

Commercial and Medicaid

Facility and professional claims used for defining acute and post-acute phases of care satisfied the following criteria:

Claims where useflag=0 (VT residents, under 65 years old) and the member was not dual eligible in the month in which the claim occurred. The dual eligibility in a given month for a member was determined using the flag med_mdcd_dual_cov_flag in the eligibility file. In other words, only claim lines from eligible member months (non-dual, under-65, member's payer-specific USEFLAG value=0) were included.

Claims for acute phase of care were identified using the facility claims and the following:

a) Bill type
b) Room and board revenue codes
c) Hospital taxonomy

Specifically, the following specifications were used for bill type:

Bill type = 11 Hospital-inpatient (including Part A)   OR
Bill type= 85 Critical Access Hospital

Specifically, the following specifications were used for revenue codes:

Revenue code = 010x (x=0,1,2,3,4,5,6,7,8,9)   All Inclusive Rate   OR
Revenue code = 011x (x=0,1,2,3,4,5,7,9)   Private Room OR
Revenue code = 012x (x=0,1,2,3,4,5,7,9)   SemiPrivate 2 beds OR
Revenue code = 013x (x=0,1,2,3,4,5,7,9)   SemiPrivate 3-4 beds OR
Revenue code = 014x (x=0,1,2,3,4,5,7,9)   Deluxe Private OR
Revenue code = 015x (x=0,1,2,3,4,5,7,9)   Ward OR
Revenue code = 016x (x=0,1,2,3,4,5,6,7,8,9)   Other (sterile)   OR

Revenue code = 017x (x=0,1,2,3,4,5,6,7,8,9)   Nursery   OR
Revenue code = 020x (x=0,1,2,3,4,5,6,7,8,9)   Intensive Care   OR
Revenue code = 021x (x=0,1,2,3,4,5,6,7,8,9)   Coronary Care   OR
Revenue code = 072x (x=0,1,2,4)   Labor/Delivery

Specifically, the following specifications were used for hospital taxonomy to capture acute hospitals or psychiatric hospitals:
Provider id = (282N00000X, 282NC0060X, 283Q00000X, 324500000X, 276400000X)   OR
provider Id greater than 9000000000000

282N00000X - acute care hospital
282NC0060X - North Country hospital, Northeastern VT regional hospital
283Q00000X - Brattleboro Retreat, Seneca center psych, Vermont state hospital
324500000X - substance abuse rehab
276400000X - substance abuse rehab

Claims for <u>post-acute phase</u> care were identified using a 90-day time frame after the discharge date for acute care. These included:

   a. All claims for a readmission within 90 days of the index admission – In this context, if the readmission after an index admission with a DRG of interest was also a DRG admission of interest, the readmission was not allowed to be an index admission on its own in the market analysis.
   b. All claims within 90 days with bill type for SNF, swing bed and home health – bill type = (21-29, 31-39, 61-69, 18, 75, 76, 81, 82, 83, 86, 89)
   c. All other claims with a service date within 90 days after the index admission.

<u>Medicare</u>

While in commercial and Medicaid, useflag=0 filtered claims where commercial (or Medicaid) was a primary payer, for Medicare, we could not use useflag as a criterion for filtering primary payer claims because it was applicable only to commercial or Medicaid. As a result, for including claims for stays where Medicare was a primary payer, we used the field line_primary_payer_paid_amt. If this field was greater than $0 it indicated a primary payer other than Medicare. In this case, the stay and its claims were excluded from the analysis.

Claims for dual eligible individuals were included in the Medicare market analysis.

Specifically, the following specifications were used for hospital taxonomy to capture acute hospitals or psychiatric hospitals and to exclude rehab facilities:

Hospital taxonomy class 'Rehabilitation Hospital' with the following taxonomy codes were excluded: 283X00000X, 283XC2000X

Hospital taxonomy specialty 'Rehabilitation' with the following taxonomy codes were excluded: 103TR0400X, 111NR0400X, 163WR0400X, 261QR0400X, 3645R0400X

Hospital taxonomy type 'Nursing & Custodial Care Facilities' with the following taxonomy codes were excluded: 310400000X, 104A0630X, 3104A0625X, 310500000X, 311500000X, 311ZA0620X, 313M00000X, 314000000X, 3140N1450X, 315D00000X, 315P00000X, 317400000X

<u>Defining the population: exclusion criteria by payers</u>

<u>Commercial</u>

25

In the eligibility file, the following criteria were used for identifying a commercial member with eligible months:

Med_comm_elig_flag = 1 and
med_mdcd_dual_cov_flag not equal to blank and
year – DOBYR < 65 and
zip_code not equal to blank   and
med_comm_Payerid not equal to (1061, 1221, 1251, 1278).

Medicaid

In the eligibility file, the following criteria were used for identifying a Medicaid member with eligible months:

Med_mdcd_elig_flag = 1 and
med_mdcd_dual_cov_flag not equal to blank and
year – DOBYR < 65 and
zip_code not equal to blank .

Medicare

In the eligibility file, the following criteria were used for identifying a Medicare member with eligible months:

Med_mdcr_elig_flag = 1 and
MED_MDCR_MEDICARE_ADVANTAGE not in ('1','2','4','9','A','B','C') and
Zip_code not equal to blank

Defining the market areas within and outside Vermont

Brandeis proposed a reduced set of service areas (Revised Regions or RRs) after reviewing the existing Vermont Hospital Service Areas (HSAs), which have been defined using inpatient discharge data (VUHDDS) for all state residents, and include data from Vermont, New Hampshire, Massachusetts, and New York hospitals. The Brandeis methodology used for creating the proposed RRs is described in detail in the report, by Truven Health and Brandeis, titled "Assessing the feasibility of using localized Vermont Hospital Service Areas (HSAs) as the basis for forming reduced service regions".

The resulting five revised regions are shown in the table below with the corresponding HSAs and hospitals.

Table 2: HSAs Re-mapped into Revised Regions

Revised Region (RR)	HSA	Hospital
RR1 – Burlington	Burlington	Fletcher Allen/UVMMC
	Middlebury	Porter Medical Center
	St. Albans	Northwestern Medical Center
RR2 – Barre	Barre	Central Vermont Medical Center
	Morrisville	Copley Hospital
RR3 - St. J/Newport	St. Johnsbury	Northeastern Vermont Regional Hospital
	Newport	North Country Hospital Newport
RR4 – Upper Valley	White River Junction	Dartmouth Hitchcock Medical Center
	Randolph	Mt. Ascutney Hospital
		Gifford Medical Center
	Brattleboro	Brattleboro Memorial Hospital

		Grace Cottage Hospital
	Springfield	Springfield Hospital
RR5 - Rutland/Benn	Rutland	Rutland Regional Medical Center
	Bennington	Southwestern Vermont Health Care

For incorporating out of state hospitalizations in the market analysis, the following expanded set of regions was used:

1. RR1
2. RR2
3. RR3
4. RR4
5. RR5
6. NH – Dartmouth Hitchcock Memorial Hospital
7. NH – rest of NH
8. NY
9. MA
10. Other states
11. Unknown

Brandeis Severity Adjustment Approach to Calculate Expected Costs

The Brandeis team calculated expected costs for each stay after adjusting for severity of acute admission spending using the following:
a) Patient health risk - measured using age, gender and diagnoses documented during admission
b) DRG weights
c) Medical or surgical DRG admission indicator

Brandeis chose to use the DRG weights and type of DRG indicator along with a "pure" measure of patient health risk (which is based only on using age, gender and diagnoses) because the purpose here is not to check if a person should have presented at the hospital given his/her health risk but the purpose is to adjust the acute admission spending for severity after the patient got treated at the hospital. In this context, admission severity is a combination of health risk and mix of services and as such, age, gender and diagnoses-based health risk alone does not capture admission severity.

Another rationale behind the hybrid approach (of combining a measure of patient health risk with DRG-based measures of resource use) was that, to the extent possible, we would like to adjust for severity within a set of admissions for a given DRG where the DRG weight is the same for all admissions. Using this approach, we found that the patient health risk (as defined above) added significantly to the model's ability to explain the wide variation in admission costs. The medical/surgical indicator was used to acknowledge that the relationship between the DRG weights and acute admission spending is different depending on whether an admission is medical or surgical.

For each of the three payers (commercial, Medicaid and Medicare), a measure of diagnosis-based health risk was created for each admission using principal and other diagnoses recorded during the admission, as described below.

For commercial and Medicaid, the measure of patient health risk was based on a public domain model developed in the context of the Affordable Care Act (ACA). The model is called "HHS-HCC risk adjustment model" and was developed by CMS to be used for risk adjustment in the context of health insurance exchanges and the ACA. The calibration data for this model consists of 2010 Truven MarketScan® Commercial Claims and Encounter data with over 20 million individuals with no payments made on a capitated basis, with prescription drug coverage, and with

integrated mental health/substance abuse coverage.   The HHS-HCC risk adjustment model is a plan liability risk adjustment model and predicts health care expenditures (inpatient, outpatient and drug) for which plans are liable, which exclude enrollee cost sharing.

The model uses age, gender and diagnoses to create a risk score which predicts plan liability (including all medical and pharmacy costs and not just admission costs) and reflects health status (risk) from this perspective.   To create a diagnosis-based health risk for a Vermont commercial or Medicaid admission incorporated in the market analysis, age and gender from the eligibility file and diagnoses recorded during the admission from the Vermont Health Care Uniform Reporting and Evaluation System (VHCURES) claims data were input to the HHS-HCC methodology. The risk score thus created reflects the health risk of the individual for all costs (not just admission costs) assuming only the diagnoses recorded for the admission were known.

Note that for Medicaid, a Medicaid-specific public domain methodology, developed by researchers at University of California San Diego, was tried for creating a risk score for the Medicaid admissions incorporated in the market analysis. The Chronic Illness and Disability Payment System (CDPS) is a diagnostic classification system that Medicaid programs can use to make health-based capitated payments for Temporary Assistance for Needy Families (TANF) and disabled Medicaid beneficiaries. However, this system produced a risk score that had a lower correlation to the Vermont Medicaid admit costs compared with the HHS-HCC based risk score (based on the commercial population). One reason for this finding could be that the calibration data used for the public domain Medicaid model was from the 1990's and is out of date. As a result, the HHS-HCC risk score, used for commercial, was also used for Medicaid.

For Medicare, to measure patient health risk, the Brandeis team used the CMS HCC risk score, developed to adjust capitation payments to Medicare Advantage plans for the health expenditure risk of their enrollees. This approach is available in the public domain. This risk score uses age, gender and disease categories that are specific to the Medicare population and is more appropriate for use with the Medicare data. A reference is provided below for the public domain CMS HCC methodology.

See references below for the public domain methodologies considered or used in the market analysis.

References:

HHS-HCC Model

The link below leads to the mapping of diagnoses and risk weights used by the HHS-HCC public domain model.
http://www.cms.gov/CCIIO/Resources/Regulations-and-Guidance/index.html

The link below leads to a paper by Kautter, Pope, Ingber et al in Medicare & Medicaid Research Review 2014 volume 4, number 3, a CMS publication. The title of the paper is "The HHS-HCC Risk Adjustment Model for Individual and Small Group Markets under the Affordable Care Act".
http://www.cms.gov/mmrr/Downloads/MMRR2014_004_03_a03.pdf

CDPS Model

The link below leads to the mapping of diagnoses and risk weights used by the CDPS system.
http://cdps.ucsd.edu/

The link below leads to a paper by Kronick, Gilmer, Dreyfus et al in Health Care Financing Review Spring 2000/Volume 21, Number 3. The title of the paper is "Improving Health-Based Payment for Medicaid Beneficiaries: CDPS".

http://cdps.ucsd.edu/cdps_hcfr.pdf

DRG Weights

Table 5 at the link below gives a list of MS-DRGs and the corresponding weights associated with each DRG.
http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/FY-2013-IPPS-Final-Rule-Home-Page-Items/FY2013-Final-Rule-Tables.html

CMS HCC model

http://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors.html