

December 23, 2015

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Re: Docket No. GMCB-010-15con, Proposed Ambulatory Surgery Center
Response to Questions 1-21, posed 8.28.2015

Dear Donna:

Thank you for the questions in your letter of August 28, 2015. As requested, we have restated the questions in **bold** font and answered the questions in un-bolded font.

1. Please complete the Capacity/Projected Volumes table below.

TABLE 1 - CAPACITY AND PROJECTED VOLUMES SUMMARY

	Capacity				Projected Volumes			
	Year 1	Year 2	Year 3	Year 4	Year 1	Year 2	Year 3	Year 4
Operating Room								
OR 1	1,287	1,287	1,287	1,287	569	657	663	670
OR 2	<u>1,287</u>	<u>1,287</u>	<u>1,287</u>	<u>1,287</u>	<u>569</u>	<u>657</u>	<u>663</u>	<u>670</u>
Total OR	2,574	2,574	2,574	2,574	1,138	1,313	1,326	1,340
Procedure Room								
PR 1	1,914	1,914	1,914	1,914	998	1,153	1,164	1,176
PR 2	<u>1,914</u>	<u>1,914</u>	<u>1,914</u>	<u>1,914</u>	<u>998</u>	<u>1,153</u>	<u>1,164</u>	<u>1,176</u>
PR 3	1,914	1,914	1,914	1,914	998	1,153	1,164	1,176
PR 4	<u>1,914</u>	<u>1,914</u>	<u>1,914</u>	<u>1,914</u>	<u>998</u>	<u>1,153</u>	<u>1,164</u>	<u>1,176</u>
Total PR	7,657	7,657	7,657	7,657	3,994	4,611	4,657	4,703
Grand Total OR+PR	10,231	10,231	10,231	10,231	5,132	5,924	5,983	6,043
								59.1%

TABLE 2 - CAPACITY CALCULATION

	Operating Rooms	Procedure Rooms
ROOMS	2	4
YEAR 1		
Days/Year	250	250
Daily Hours	7	7
Total Available Hours (All Rooms)	3,500	7,000
Average Length of Procedure (Minutes)	82	55
Annual Utilization	1,138	3,994
Annual Utilization/Room	569	998
Total Capacity (Cases)	2,574	7,657
% of Total Used	44.2%	52.2%
YEAR 2		
Days/Year	250	250
Daily Hours	7	7
Total Available Hours (All Rooms)	3,500	7,000
Average Length of Procedure (Minutes)	82	55
Annual Utilization	1,313	4,611
Annual Utilization/Room	657	1,153
Total Capacity (Cases)	2,574	7,657
% of Total Used	51.0%	60.2%
YEAR 3		
Days/Year	250	250
Daily Hours	7	7
Total Available Hours (All Rooms)	3,500	7,000
Average Length of Procedure (Minutes)	82	55
Annual Utilization	1,326	4,657
Annual Utilization/Room	663	1,164
Total Capacity (Cases)	2,574	7,657
% of Total Used	51.5%	60.8%
YEAR 4		
Days/Year	250	250
Daily Hours	7	7
Total Available Hours (All Rooms)	3,500	7,000
Average Length of Procedure (Minutes)	82	55
Annual Utilization	1,340	4,703
Annual Utilization/Room	670	1,176
Total Capacity (Cases)	2,574	7,657
% of Total Used	52.1%	61.4%

Note: Average length of procedure includes turnaround time.



2. Please complete the Utilization table below.

TABLE 3 - OPERATING ROOM UTILIZATION

	Operating Room Utilization			
	Year 1	Year 2	Year 3	Year 4
Operating Room Utilization				
OR 1	569	657	663	670
% Change from Previous Year		15.4%	1.0%	1.1%
OR 2	569	657	663	670
% Change from Previous Year				
Total OR Utilization	1,138	1,313	1,326	1,340
Total % Change		15.4%	1.0%	1.1%

TABLE 4 - PROCEDURE ROOM UTILIZATION

	Procedure Room Utilization			
	Year 1	Year 2	Year 3	Year 4
Procedure Room Utilization				
PR 1	998	1,153	1,164	1,176
% Change from Previous Year		15.5%	1.0%	1.0%
PR 2	998	1,153	1,164	1,176
% Change from Previous Year		15.5%	1.0%	1.0%
PR 3	998	1,153	1,164	1,176
% Change from Previous Year		15.5%	1.0%	1.0%
PR 4	998	1,153	1,164	1,176
% Change from Previous Year		15.5%	1.0%	1.0%
Total PR Utilization	3,994	4,611	4,657	4,703
Total % Change		15.5%	1.0%	1.0%
Total OR and PR Utilization	5,132	5,924	5,983	6,043
Total Average % Change		15.4%	1.0%	1.0%

3. Provide a detailed explanation and full set of assumptions supporting the need for two ORs, 4 procedure rooms and 14 pre- and post-op beds. Also provide the full set of utilization assumptions for each year 1-4.

Consistent with facility sizing trends in healthcare, Green Mountain Surgery Center was designed to reflect the continued migration from inpatient to outpatient services, specifically outpatient surgery.¹ As patient deductibles increase each year and price transparency leads to

¹ <https://avanzastrategies.com/right-sizing-healthcare/>

a more value based health care decision making process, patients will be seeking surgical services in an outpatient setting. Furthermore, physicians want to be performing procedures in a more efficient and friendly environment. Physicians anticipate that scheduling procedures at the ASC will be easier and that their patients will be able to receive outpatient surgical services in a timelier manner than is presently possible.

Additionally, Green Mountain Surgery Center is in the unique position where it will be the only multi-specialty surgery center in the state. While we were conservative in our utilization and financial projections, we believe there will be significant additional demand since we will be the only ambulatory surgery center option in the state of Vermont. Because of the aforementioned reasons, a strategic decision was made to size the facility to accommodate the above-referenced factors as well as growth beyond the four year projection horizon.

OPERATING AND PROCEDURE ROOM UTILIZATION AND CAPACITY ASSUMPTIONS

The surgery center will be open Monday through Friday from 6:00 AM to 5:00 PM for approximately 250 days a year. Surgeries will be performed 7 hours a day in 2 operating rooms and 4 procedure rooms.

The vast majority of General Surgery, Orthopedic, and OB/GYN procedures will be performed in the operating rooms. Conversely, a significant percentage of the GI and Pain Management cases will be performed in the procedure rooms. The assumption utilized was that the average operating room case would require 82 minutes while procedure room cases would require 55 minutes. These assumptions are in line with data from the National Survey of Ambulatory Surgery, which indicates that the average time for ambulatory surgical visits was 83 minutes in 2014.² Please note that these procedure times include room turnaround time. By projection year 4, the Green Mountain Surgery Center operating and procedure rooms will be conservatively operating at 60 percent occupancy.

The 14 pre- and post-op beds were based on the latest Facility Guidelines Institute (FGI) requirements of 1 pre-operative bed and 1.5 post-operative bed per operating room, and 1 pre-operative bed and 1 post-operative bed per procedure room for ambulatory surgery centers. This equates to 13 beds based on 2 operating rooms and 4 procedure rooms. An additional room was provided for exam/consultation and back-up.

UTILIZATION ASSUMPTIONS

As stated in the certificate of need application, in year one, we are projecting 5,132 total cases will be performed at the ASC. The projections are based on actual historical outpatient cases (based on average 2014 monthly volumes) performed by the physicians who have expressed interest in the project, as reported by those physicians. Based on physician input, we

² MedPac Report to the Congress, at 118.

determined a separate capture rate based on the percentage of surgical cases that each physician expects to perform at the proposed ASC. While these capture rates ranged from 12-100%, in aggregate, the projections assume that 67% of the physician's projected cases will be performed at the ASC. The remaining 33% will continue to be performed at local hospitals. The determination of whether procedures will be scheduled at the ASC or a local hospital would be driven by the acuity of the patient, the type of procedure, and patient preference. We have also discounted the cases projected in year one to reflect a six month ramp-up period which is typical when opening a new facility. Our projections show a very conservative annual rate of case growth at 1%, an estimate typically used for ASC financial modeling. Year two cases were projected assuming that year one was fully stabilized. This equates to 5,924 cases in year two, 5,983 cases in year three and 6,043 cases in year four.

Further detail of historical physician procedures (which served as the basis for the utilization projections) is projected in the response to Question # 4.

4. The table on page 27 of the application shows the number of procedures that will be performed by Physician A-P by specialty in year 1-4 of operation. In a table format, for Physician A-P (include specialty), provide the most recent two years of data (noting the year for each) showing the number of surgeries, procedures performed, and the location where they were performed.

Confidentiality requested for this response December 11, 2015.

5. Chittenden County is identified as the primary service area for this project. Identify the secondary service area(s).

As noted, we anticipate that the vast number of patients utilizing the Green Mountain Surgery Center will be from Chittenden County. Based on the physicians who have expressed interest in utilizing the Green Mountain Surgery Center, we expect that a smaller portion of patients will come from Franklin County, which is the closest county to the location of the proposed ASC. The physicians that we have identified as having interest in utilizing the GMSC do not separately track their patients who have undergone outpatient surgery by zip code. Thus, our determination that the ASC will have a secondary service area of Franklin County is based on the location of surgeries presently performed by the interested physicians, coupled with the proposed center's geographic proximity to Franklin County. All of the physicians that have expressed interest in utilizing the ASC, except for four, perform surgeries exclusively in Chittenden County. Of the four who do not, one does twenty percent of his/her surgeries in New York State, and we do not expect that any of the surgeries that this physician presently conducts in New York State would migrate to the ASC. The remaining three physicians presently perform at least a portion of their surgeries at Northwest Medical Center. Of the three, one performs twenty percent (20%) of his/her surgeries at the hospital and another performs fifty percent (50%) of his/her procedures there, for a combined annual total of 68

procedures that may migrate to the ASC.³ The third physician performed all of his/her surgeries at Northwest Medical Center during 2013-2014, and anticipates that 100 of these procedures would migrate to the ASC. Thus, while we expect that Franklin County will be the secondary service area for the Green Mountain Surgery Center, we anticipate that the great majority of patients (96.7%) would otherwise have had their surgeries performed at the medical center in Chittenden County. We do not expect to draw patients significantly from other counties in Vermont or from outside of Vermont.

6. Page 11 of the application states that there is “an identifiable need for expanded outpatient surgery capacity in Chittenden County.” Please provide: 1) a more detailed explanation of the unmet need for the surgeries and procedures that GMSC will offer; 2) specific data to support the need in the primary and secondary services areas; and 3) the need for additional operating and procedure rooms.

In preparing our Application, we have not had direct access to data regarding unmet need for surgeries and procedures that Green Mountain Surgery Center will offer, the need for surgeries and procedures in the Green Mountain Surgery Center’s primary and secondary service areas, and the need for additional operating and procedure rooms. Because area hospitals, primarily the University of Vermont Medical Center (“UVMHC”), are presently the exclusive site of care for outpatient surgeries in the Green Mountain Surgery Center’s proposed service area, data on utilization of outpatient surgical services is held by the hospitals and, to our knowledge, is not publicly available. Accordingly, we have relied on the following data and anecdotal support regarding need for surgical capacity:

- The statement in UVMHC’s certificate of need application that “[c]linical capacity in the Ambulatory Care Center has been reached (and in many areas exceeded).” CON Application by Fletcher Allen Healthcare, Inc. to Acquire Real Estate in South Burlington, Dated June 2, 2014.
- The recommendation of Halsa Advisors to UVMHC to create an off-campus surgical center, noting that doing so would free capacity on the main campus. Halsa Advisors, Ambulatory Clinics Master Plan Final Report, dated July 12, 2013, pp. 54-55 on file with the Green Mountain Care Board.
- ACO Quality Data, showing that the only measure for which patients attributable to the Accountable Care Coalition of the Green Mountains rated their healthcare experience as below the national average was access to specialists. The patient rating for this measure was below the 30th percentile. Accountable Care Organization (ACO) 2012, Quality Performance Report, Prepared for: Accountable Care Coalition of the Green Mountains, LLC, ACO ID: A1272, Source: CMS.

³ Based on average surgery volume from 2013-14.

- Anecdotal evidence from physicians that we have interviewed indicating that:
 - Their patients are putting off colonoscopies due to their high cost and slow scheduling times.
 - Primary care physicians practicing in Chittenden County and the surrounding areas have reported difficulties scheduling their patients in timely appointments with area specialists at the UVMHC.
 - The UVMHC has indicated to a gastroenterology practice that it cannot offer the practice any additional operating room time, notwithstanding the practice's desire to employ another physician.
 - The UVMHC has not permitted a physician to perform interventional pain procedures at the hospital, notwithstanding his patients' desire for such treatments and evidence that the treatments can prevent or delay costly surgeries, particularly in elderly patients.
 - Primary care physicians seeking to refer their patients to specialists at UVMHC having been told by hospital-employed specialists that in order to get a timely appointment, they should send their patients to the hospital emergency room for a work-up, and the patient will be able to get on the specialists' schedule if an urgent referral is made from the hospital's emergency room.
- Demographic data regarding Chittenden County indicate that Chittenden County is the fastest growing county in Vermont, projects to have a population exceeding 250,000 by 2035, and will have an increasingly older population over the next twenty years. See ECONOMIC & POLICY RESOURCES, INC., ECONOMIC AND DEMOGRAPHIC FORECAST: NORTHWEST VERMONT AND CHITTENDEN COUNTY 2000 TO 2035 AND BEYOND, 33 (2000), which is attached as Exhibit 1.

Perhaps more importantly, however, we have not solely identified a need for new outpatient surgical capacity in our Application, but additionally a need for an alternative to hospital-based outpatient surgery. Presently, Vermont has no alternatives for outpatient surgery, other than for eye surgery. If an otherwise healthy patient requires a simple surgical procedure, that patient's only option is going to a hospital outpatient surgical department. A multi-specialty ambulatory surgery center is not just another hospital outpatient surgery department, but rather an entirely different concept that can be distinguished from a hospital surgery program in several ways:

- Lower Reimbursement and Lower Cost: ASCs are reimbursed at a lower rate than hospital outpatient surgery departments. For instance, in 2014, the Medicare rates

were 82 percent higher in hospital outpatient surgery departments than in ASCs.⁴ In addition, available evidence supports the conclusion that ASCs offer lower costs than hospital outpatient surgery departments. For instance, the Government Accountability Office has compared ASC cost data from 2004 with hospital outpatient department costs and found that costs are, on average, lower in ASCs.⁵ Data also indicates that for most procedures covered under the ASC payment system, beneficiaries' coinsurance is lower in ASCs than in hospital outpatient departments.⁶

- Patient Experience: ASCs can offer more convenient locations, shorter waiting times, and easier scheduling relative to hospital outpatient departments.⁷ Furthermore, ASCs typically offer a smaller, less institutional environment than hospitals, and more personalized care, which for many patients may translate to a less intimidating, less stressful experience.⁸ As noted by Matthew DeCamp, Assistant Professor at the Johns Hopkins Berman Institute of Bioethics and the Johns Hopkins Division of General Internal Medicine,⁹ in a recent article, “[t]here is no doubt that [outpatient surgery centers] can be more convenient and valuable for patients [and offer] a pleasant experience of care.”¹⁰
- Efficiency. Freestanding ASCs generally are able to operate more efficiently than hospitals, reducing physician and staff idle time, while improving the use of medical resources. As noted by Munnich and Parente, “compared to the situation in hospitals, in ASCs surgeons are more likely to be assigned to a single operating room for all cases, which reduces delays; the operating room is often closer to the preoperative and recovery rooms, because facilities are smaller; teams of staff have clearer and more consistent roles, with less personnel turnover; and staffing is not done by shifts—that is, staff members go home only after all cases are finished, which creates incentives to work quickly. In addition, hospitals may be more likely to have emergency add-on and bring-back cases for more complex cases that compete with outpatient procedures for operating room time.”¹¹ Data from the National Survey of Ambulatory Surgery indicating that the average time for ambulatory surgical visits was 39 percent lower in ASCs than hospital outpatient departments (83 minutes vs. 135 minutes) supports the conclusion that the inherent operational advantages of ASCs result in valuable efficiencies.¹²

⁴ MedPac Report to the Congress: Medicare Payment Policy, March 2015, p. 115.

⁵ *Id.* at 118.

⁶ *Id.* at 122.

⁷ *Id.* at 119.

⁸ Sandra G. Boodman, Kaiser Health News, “Popularity of Outpatient Surgery Centers Leads to Questions About Safety”, Dec. 18, 2014, available at <http://www.medpagetoday.com/PublicHealthPolicy/PublicHealth/49213> (“Patients say the centers are cheaper, require less waiting, and offer more personalized care.”).

⁹ Dr. DeCamp’s bio is available at <http://www.bioethicsinstitute.org/people/faculty/matthew-decamp>.

¹⁰ Boodman, *supra*.

¹¹ Elizabeth L. Munnich & Stephen T. Parente, Procedures Take Less Time at Ambulatory Surgery Centers, Keeping Costs Down and Ability to Meet Demand Up, 33(5) HEALTH AFF. 764, 767 (May, 2014).

¹² MedPac Report to the Congress, at 118.

- Price Transparency: ASCs charge a global facility rate for surgery, which means that the facility fee a patient is told they will be charged in advance is the only facility charge that will appear on their bill. Conversely, hospital outpatient departments can and do charge for ancillary facility costs on patients' bills. These ancillary charges may include charges for pain pills, suture supplies, and temporary braces, among other things. Although these ancillary charges are allowable under Medicare rules, the lack of knowledge of ancillary facility charges in advance contributes to surprise items on patient bills from surgeries performed in outpatient surgery departments. Typically ASCs make pricing information available to their patients in advance of surgery and the ambulatory surgery center industry has been supportive of increased price transparency across health care sectors.¹³ In particular, the Ambulatory Surgery Center Association recommends that all patients receive written disclosures prior to surgery that outline the total price of the planned surgical procedure, as well as the portion of such cost that the patient would be responsible for.¹⁴ The Green Mountain Surgery Center intends to prioritize price transparency by providing such disclosures to patients in advance of surgery. The price for self-pay patients will also be made available, although the percentage of Vermonters without insurance coverage is very small (3.7%).
- Appropriate Scaling to Needs of Patient. ASCs offer services that are appropriately scaled with the patient populations that they serve. ASCs restrict outpatient procedures to patients who do not require an overnight stay after the procedure.¹⁵ Accordingly, ASC patients are typically healthier than the typical hospital outpatient and do not present other, more complex medical conditions, which are typically treated in hospital outpatient departments ("HOPDs").¹⁶ The close match between the resources and services offered by the ASC and the health care needs of the typical ASC patient mean that an ASC can provide outpatient services in an efficient, cost-effective way, as compared to hospital outpatient departments, which necessarily must focus on a much wider range of patient needs.
- Physician Recruitment. The lack of a multi-specialty freestanding ambulatory surgery center in the greater Burlington area has a deleterious effect on physician recruitment. It has been a major factor reported by several private practice specialty groups in their failed attempts to attract new physicians to the area over the past several years. Physician recruiters who are actively recruiting even hospital-employed Burlington-based specialists often cite the ability to operate at a freestanding surgery center as an

¹³ *Ambulatory Surgery Centers: A Positive Trend in Health Care*, AMBULATORY SURGERY CENTER ASSOCIATION (last visited Nov. 30, 2015), available at <http://www.ascassociation.org/advancingsurgicalcare/aboutasc/industryoverview/apositivetrendinhealthcare>.

¹⁴ *Id.*

¹⁵ MedPac Report to the Congress, at 117.

¹⁶ *Id.* at 120 (noting that patients treated in HOPDs in 2010 were, on average, more medically complex than patients treated in ASCs, as measured by differences in average patient risk scores).

attractive feature of almost every other similar-sized metropolitan area in the country where these specialists may go instead.

Vermont presently has no multi-specialty ambulatory surgery centers within its borders, which makes us unique among all other states. Vermont's outlier status in this respect is discussed at length in our Application. The need, then, is not just a need for additional surgical capacity, but more fundamentally, a need for an alternative model to hospital-based surgical care that is presently not available anywhere in the State.

7. Page 12 states: "There is a particular need to add operating capacity for affordable GI procedures (e.g., diagnostic, preventive and screening colonoscopies...). Please provide the data to support this statement.

Adding more affordable options for colorectal cancer is critical for Vermont to achieve its goals around wellness and prevention for all members of the state population, including those on state or federal insurance programs and/or with limited means to pay for co-pays and deductibles out of pocket. Colorectal cancer screening is one of the few cancer screenings with an "A" rating from the US Preventive Services Task Force. Colonoscopies are generally regarded as the most effective screenings because they are the most thorough, allowing the physician to view the entire length of the colon and remove suspicious polyps as they are encountered. Recent peer-reviewed literature suggests that high-cost is a known barrier to access for colonoscopy screening. As Mary K. Hamman and Kandice A Kaponos conclude in their study: "Affordable Care Act Provision Lowered Out-Of-Pocket Cost And Increased Colonoscopy Rates Among Men In Medicare," which appeared in the December 2015 of Health Affairs, "our research indicates that cost may be an important barrier to colorectal cancer screening, at least among men."¹⁷

The facility fee charged by UVMMC for colonoscopies provided to commercially insured patients is not competitive when compared to national Medicare rates and commercial rates for colonoscopies in other New England states. A recent survey of the facility fee paid to UVMMC by Cigna, MVP, and UnitedHealthcare for colonoscopy CPT code 45380 ranges from \$2,100 - \$3,700. This fee is approximately 3x to 5x the price paid by Medicare (\$717.43) for the same procedure. A 5x multiple of the Medicare price cannot be considered affordable when national experts are testifying that rates of up to 3x what Medicare reimburses for outpatient procedures are cause for concern around pricing power at certain hospitals.¹⁸ It is important to remember that this discussion of charges relates to facility fees only. There is also fee inflation on the professional fee side when surgeries are performed by hospital employed physicians versus independent physicians. For example, professional fees paid to UVMMC by Blue Cross Blue Shield of Vermont for procedures performed by employed-physicians in 2014 were 275%

¹⁷ <http://content.healthaffairs.org/content/34/12/2069.abstract?=&right>

¹⁸ [http://medpac.gov/documents/congressional-testimony/testimony-hospital-policy-issues-\(ways-and-means\).pdf?sfvrsn=0](http://medpac.gov/documents/congressional-testimony/testimony-hospital-policy-issues-(ways-and-means).pdf?sfvrsn=0)

higher on average than fees paid to independent physicians for performing the identical procedure.¹⁹

We have also included facility fees charged to commercial insurers for other common outpatient procedures that will be provided at the Green Mountain Surgery Center. UVMHC, for instance, routinely charges 3 times to over 5 times the HOPD Medicare rates across common outpatient procedures.

Facility Fees Paid to UVMHC for Selected Procedures - October 2015*

CPT Code	Description	MVP	United	Cigna	Multiple of Medicare HOPD Rate	Multiple of Medicare ASC Rate
45380	Colonoscopy w/polyp removal	\$3,734	\$3,511	\$2,108	2.9x – 5.2x	5.2x – 9.3x
58558	Hysteroscopy of uterus w/biopsy	\$6,306	\$13,501	\$3,724	2.2x – 7.9x	3.9x – 14x
58571	Total abdominal hysterectomy	\$11,777	\$14,626	\$13,134	3.3x – 4.1x	5.9x – 7.4x

Source: Pricing tools available to insured members on each commercial insurers' website

* BCBS did not have payments for these procedures accessible on their member website

Additionally, Vermonters on high-deductible plans, such as those being offered on Vermont Health Connect, are often forced to pay for this procedure out-of-pocket (if the colonoscopy is considered diagnostic or for follow-up purposes), which underscores the need to bring on more affordable capacity. In this day and age, Vermonters who wish to consider their options and shop around before paying for such expensive procedures out-of-pocket can easily search and compare commercial prices for colonoscopies in other New England cities that are not so far away, such as Portland, ME, Boston, MA, or Schenectady, NY.²⁰

Furthermore, colonoscopies are high-volume procedures and thus should be able to be provided more affordably on a per unit basis. If UVMHC performs 40-50 colonoscopies a day,

¹⁹ Amy Cooper, Testimony to Senate Finance Committee on 1/6/2015, 'Physician Practices Reimbursement Report' slide deck, page 4.

http://www.leg.state.vt.us/ifo/healthcare/Health%20Reform%20Oversight%20Committee/2015_01_06/2015_01_06_Physician%20Practices%20Report%20-%20Healthfirst%20presents.pdf

²⁰ New Choice Health is a website that shows average facility fee prices for a colonoscopy in these other cities range from \$750 - \$1250. <http://www.newchoicehealth.com/>

or 10,000 – 12,000 per year, then this procedure is surely one of the highest-volume on offer by the hospital.²¹ If one assumes that UVMMC is operating under a normal fixed-cost business model where costs are shared based on each unit of the procedure provided, then the cost of high-volume procedures should be able to be offered at comparatively lower prices (i.e., relatively closer to the price paid by Medicare).

The Green Mountain Surgery Center will have the opportunity to offer this high-volume procedure in a smaller, more specialized setting, and will be in a better position to take advantage of efficiencies with regard to scheduling, patient flow, and standardization of supplies that will enable the Green Mountain Surgery Center to offer high-quality colonoscopies in the future at a much more affordable rate for Vermonters when compared to national Medicare payment rates and regional commercial rates offered in neighboring states.

Finally, health care consumer advocates in other states are beginning to recommend against going to large academic medical centers for common gastroenterological procedures such as a colonoscopy, which underscores the need to offer an alternative option to UVMMC in the Burlington metropolitan area. For example, Dena Mendelsohn, a health policy analyst with Consumers Union in San Francisco, recommends avoiding a large university medical center for a colonoscopy. “Large universities are tailored toward more complicated procedures,” she says. “Since a screening colonoscopy is more routine, it’s not necessarily the case that going to a large university will get you a better colonoscopy.”²²

8. Provide a more detailed explanation of public transportation that will stop at 535 Hercules Drive in Colchester for residents of your primary and secondary services areas. (See page 73.)

As noted on Page 73 of our application, at present, the Chittenden County Transportation Authority’s (CCTA) 56 Milton Commuter bus stops at nearby Mountain View Drive, across the street from the Shaw’s Supermarket. Please see the 56 Milton Commuter stop list attached as Exhibit 2, available at <http://cctaride.org/wordpress/wp-content/uploads/56stoplist.pdf> (last accessed September 23, 2015). According to Google Maps, the closest bus stop at Shaw’s on Mountain View Drive is 0.5 miles from the site of the proposed ASC, an approximate 9 minute walk. See Exhibit 3. The 56 Milton Commuter Bus originates from downtown Burlington, the hub of CCTA’s bus system, which has bus service extending throughout Chittenden and certain adjacent counties. See <http://cctaride.org/bus-routes-schedules/system-map/> for a system map.

In addition to CCTA transportation, the site of the proposed ASC lies within the service area of the Special Services Transportation Agency (SSTA), for patients who are eligible for SSTA transportation.

²¹ <http://www.sevendaysvt.com/vermont/hospitals-oppose-proposal-for-an-independent-surgical-center/Content?oid=2884529>

²² <http://ww2.kqed.org/stateofhealth/2015/05/27/pricecheck-how-much-does-a-colonoscopy-cost/>

It should also be noted that for many outpatient procedures including colonoscopies and other GI procedures, the standard of care post-procedure in order to ensure patient safety, is that someone else (a family-member, care-giver, friend, etc.) pick a patient up and drive them home. This is the currently standard practice locally and will also be standard practice at the Green Mountain Surgery Center.

9. The applicant states that 67% of interested physician cases will be performed at GMSC, leaving 33% to be performed by the same physicians in a hospital setting. (See page 26). For Physician A-P on page 27 of the application, please explain whether each physician continuously accepts new Medicaid patients, has a cap or quota on the number of Medicaid patients in his/her practice at a given time, or does not see any Medicaid patients. **

Physician Identifier	Specialty	Do you see Medicaid patients?	Are you currently accepting new Medicaid patients?	Do you have a cap or quota on the number of Medicaid patients?
Physician A	GI	Yes	Yes	No
Physician B	GI	Yes	Yes	No
Physician C	GI	Yes	Yes	No
Physician D	OB/GYN	Yes	Yes	No
Physician E	OB/GYN	Yes	Yes	No
Physician F	OB/GYN	Yes	Yes	No
Physician G	OB/GYN	Yes	Yes	No
Physician H	OB/GYN	Yes	Yes	No
Physician I	OB/GYN	Yes	Yes	No
Physician J	OB/GYN	Yes	Yes	No
Physician K*	OB/GYN	NA	NA	NA
Physician L	ORTHO	Yes	Yes	No
Physician M	PAIN MGT	No	No	No
Physician N	PAIN MGT	Yes	Yes	No
Physician O	GEN SURG	Yes	Yes	No
Physician P	GEN SURG	Yes	Yes	No

Note: * No longer practices in the area so we could not respond with information; however the remaining partners in the practice are recruiting a replacement

****Independent physicians have a long history of serving the Medicaid population in Vermont and continue to do so in great numbers. 14 out of the 15 specialists surveyed who plan to**

perform outpatient procedures at the Green Mountain Surgery Center currently see Medicaid patients, and are accepting new Medicaid patients without quotas. One specialist with a small solo practice does not accept Medicaid as a payer because reimbursements are too far below overhead costs to keep the practice open and viable.

While we may not have reached the tipping point yet in specialty care in Chittenden County, it is important to note that underfunding Medicaid payments to medical providers can have disastrous consequences with regard to patient access. In Franklin County in 2015, at least four pediatricians have left the area due primarily to underpayment by Medicaid.²³

10. According to the application, GMSC will provide “elective, non-emergent ambulatory surgeries and procedures.” Provide a detailed explanation of protocols that will be in place to ensure that over-utilization, unnecessary or inappropriate surgeries and procedures are not encouraged or performed.

Over-utilization is one of the unfortunate side-effects of the fee-for-service payment model, which encourages more care. Many of the Green Mountain Surgery Center’s investors are involved with Vermont’s health reform initiatives, including the Green Mountain Care Board’s efforts to rein in health care spending by testing new ways to pay for health care. The Green Mountain Surgery Center will adopt the statewide payment reform initiatives developed by the GMCB, which will address paying for the quality, not just the quantity, of care provided. Regardless of whether new OR capacity is added to our community in a freestanding low-cost ASC, or whether more OR capacity is added by the local hospital, the concern about unnecessary care and over-utilization will exist until the fee-for-service payment model is replaced with payments aimed at keeping patients well.

The Green Mountain Surgery Center will also have a peer review policy as part of its quality monitoring and reporting program that will specifically target incidences or patterns of overutilization and unnecessary or inappropriate surgeries for review. A copy of the draft peer review policy is attached as Exhibit 4. As stated in our response to CON Standard 1.6, GMSC will have an overarching quality improvement strategy that continuously monitors surgeries and procedures performed on site to ensure delivery of the right amounts of high quality care as well as compliance with legal requirements regarding referrals.

Finally, it is also important to understand the role of the accountable care organization (“ACO”) network in curbing unnecessary surgeries. These networks have strong financial incentives to ensure that additional surgeries of questionable necessity do not take place. All of the surgeons who plan to operate at the Green Mountain Surgery Center are participating in HealthFirst ACOs through signing the Collaborative Care Agreement that commits them to supporting the goals of the ACO and reducing unnecessary care. ACO networks also have data to compare the utilization and value of specialists whom primary care physicians within the

²³ <http://vtdigger.org/2015/12/12/four-pediatricians-leave-franklin-county-blame-medicaid/>



network refer to. Green Mountain Surgery Center will use the data to inform its peer review and other quality policies to make sure the Green Mountain Surgery Center's surgeries are well within the community norm.

The positioning of primary care doctors at the center of a re-envisioned health care system is also well aligned with how the Green Mountain Surgery Center will operate because the vast majority of GI procedures, which will account for the bulk of procedures performed at the center, are already "open access" meaning that they are ordered by primary care physicians and not by the GI physician who performs the procedure. This is in contrast to orthopedic or ophthalmology procedures, which are typically ordered by the specialist after a consult.

11. Clarify whether the Applicants will pursue Joint Commission accreditation, accreditation from Accreditation Association for Ambulatory Health Care, or both. Explain fully.

Accreditation Association for Ambulatory Health Care ("AAAH") and the Joint Commission are the two most popular Medicare-approved accreditation programs for ambulatory surgery centers. AAAHC has been surveying and accrediting ambulatory surgery centers that are eligible to participate in the Medicare program with "deemed" status since its founding in 1979. The Joint Commission's ambulatory care accreditation requirements for surgical centers received "deemed" status from the Medicare program much later, in 1996. While accreditation has been outsourced to these private non-profit organizations, CMS retains the authority to conduct random validation surveys and complaint investigations. CMS also requires that all accreditation surveys used for deemed status purposes be unannounced.

Although there is no comprehensive tracking of which accreditation ASCs hold throughout the country, industry experts estimate that approximately 75% of surgery centers hold AAAHC accreditation and approximately 25% hold accreditation from the Joint Commission. Both accreditations are honored and respected in the industry. Most centers coming online solicit quotes from both organizations and decide between the two based on total cost and speed with which the survey can be accomplished. The all-in cost of becoming accredited ranges from approximately \$15,000 - \$20,000. As both accreditations serve the same purpose, there is no reason to do both.

The Joint Commission's accreditation program has gained popularity particularly as more hospitals, which are familiar with Joint Commission accreditation for their in-patient operations, have begun to partner with or even own freestanding outpatient surgery centers. In Vermont, where nearly all outpatient surgery is currently performed at hospitals, there may be a higher level of comfort with the Green Mountain Surgery Center pursuing Joint Commission accreditation to maintain some consistency around accreditation procedures, although the choice of accreditation programs does not need to be finalized until much later in the process, perhaps even after construction begins. All other factors being equivalent, in keeping with its high-value/low cost mission, the Green Mountain Surgery Center prefers using

whichever accreditation route proves least costly. However, if the GMCB prefers one accreditation route over another, we are flexible in this regard.

12. The Application relies on a single peer-reviewed citation for information regarding cost, quality, and patient experience at ASCs. Provide additional peer-reviewed literature to support claims in these areas.

I. Our Application cites the following three peer-reviewed articles to support claims regarding cost, quality and patient experience at ASCs:

1. **Elizabeth L. Munnich & Stephen T. Parente, Procedures Take Less Time at Ambulatory Surgery Centers, Keeping Costs Down and Ability to Meet Demand Up, 33(5) HEALTH AFF. 764, 765 (May, 2014).** See, for example:
 - Page 766: “Our estimates of the time savings for ASC treatment suggest that ASCs are substantially faster than hospitals at performing outpatient procedures, after procedure type and observed patient characteristics are controlled for.”
 - Page 767: “The findings presented here provide evidence that ASCs are a lower-cost alternative to hospitals for outpatient surgical procedures.”
 - Page 768: “In combination with research on the quality of care in ASCs, the findings in this article indicate that ASCs are a high-quality, lower-cost substitute for hospitals as venues for outpatient surgery.”
2. **Jed Grisel & Ellis Arjmand, Comparing Quality at an Ambulatory Surgery Center and a Hospital Based Facility: Preliminary Findings, 141(6) OTOLARYNGOLOGY-HEAD AND NECK SURG. 701 (Dec. 2009).** See, for example:
 - Page 705: “The quality of outpatient surgery at the ASC was at least equal and in some cases superior to the HBF. These results confirm those found elsewhere.”
 - Page 706: “Patient satisfaction surveys demonstrated that the experience was equally positive at both the ASC and the HBF.”
 - Page 707: “The ASC appeared to outperform the HBF in timeliness.... For nearly all procedures, the ASC performed the same procedures more efficiently than the HBF. These differences in resource utilization represent cost savings for the ASC and support other findings.”
3. **Gabor Mezei & Frances Chung, Return Hospital Visits and Hospital Readmissions After Ambulatory Surgery, 230(5) ANNALS OF SURGERY 721, 726 (Nov. 1999).** See, for example:

- Page 725: “We observed extremely low readmission rates after ambulatory surgery: 1.1% of the patients were readmitted, and only 0.15% of the patients were readmitted as a result of complications within 30 days after ambulatory surgery.”

II. Our Application additionally cites the **Medicare Payment Advisory Commission’s Report to Congress: Medicare Payment Policy, March 2014**. Though not an academic peer-reviewed article, the report was issued by MedPAC, an independent congressional agency established by the Balanced Budget Act of 1997 to advise the U.S. Congress on issues affecting the Medicare program. The report includes MedPAC’s recommendations to Congress to improve access to and quality of care, and relating to other issues affecting Medicare and is based on extensive research and analysis.

MedPAC is comprised of 17 members with expertise in financing and delivery of health care services. The present members include highly qualified representatives from hospitals and hospital associations, academia, insurers and other industries. For additional information on MedPAC, please visit: <http://www.medpac.gov/>.

The cited MedPAC report states, for example:

- Page 123: “Although the ASC payment system is linked to the OPPS, payment rates for all services covered under both systems are lower in the ASC system for two reasons. First, the relative weights are lower in the ASC system because CMS makes proportional adjustments to the relative weights from the OPPS to maintain budget neutrality in the ASC system. In 2014, this adjustment reduced the ASC relative weights by 7.7 percent below the relative weights in the OPPS. Second, for most procedures covered under the ASC system, the payment rate is the product of its relative weight and a conversion factor, set at \$43.47 in 2014, which is lower than the OPPS conversion factor (\$72.67 in 2014).”
- Page 124: “Because Medicare pays ASCs less than HOPDs for procedures, movement of surgical services from HOPDs to ASCs can reduce aggregate program spending and beneficiary cost sharing.... Although we do not have recent ASC cost data that would allow us to quantify cost differences between settings, some evidence suggests that ASCs are a lower cost setting than HOPDs.”
- Page 124-25: “Increases in the number of Medicare-certified facilities and volume of services provided to Medicare beneficiaries suggest growing access to ASCs. This growth may be beneficial to patients and providers because ASCs can offer them greater convenience and efficiency than HOPDs, the type of provider with the greatest similarity to ASCs. For patients, ASCs can offer more convenient locations, shorter waiting times, and easier scheduling relative to HOPDs; for physicians, ASCs may offer more control over their work environment and specialized staff.”

- Page 129: “We believe it is desirable to maintain beneficiaries’ access to ASCs because services provided there are less costly to Medicare and beneficiaries than services delivered in HOPDs.... Moreover, ASCs offer patients additional advantages over HOPDs, such as more convenient locations and shorter waiting times.”

MedPAC also issued a report to Congress in March 2015, containing similar recommendations and conclusions, which is available at:

http://www.medpac.gov/documents/reports/mar2015_entirereport_revised.pdf?sfvrsn=0

III. In addition, our Application cites the following academic working paper:

Elizabeth L. Munnich & Stephen T. Parente, Returns to Specialization: Evidence from the Outpatient Surgery Market, 24 (Apr. 2014) (unpublished paper), http://louisville.edu/faculty/elmunn01/research/Munnich_Parente_ASC_Quality.pdf. While the paper has not yet been published to our knowledge, the underlying research has been presented and vetted at numerous academic conferences and meetings including the NBER Hospital Organization and Productivity Conference, the Kellogg School of Management Conference on Healthcare Markets, the Midwest Health Economics Conference, and the Southern Economic Association Annual Meeting, as noted in the footnote on the cover page of the paper. The note also indicates that authors presented their work to seminar participants at the University of Notre Dame, University of Kentucky, Cornell University, Vanderbilt University, Bryn Mawr College, Indiana University School of Public and Environmental Affairs, University of Wisconsin-Milwaukee, Abt Associates, University of Minnesota, University of Louisville, W.E. Upjohn Institute for Employment Research, and Chicago Federal Reserve Bank. This paper includes support for claims relating to quality, cost and patient experience, including:

- Page 5: “We find that ASC treatment reduces the probability of same day ER visits and 7-day inpatient admission for patients with the greatest morbidity. This suggests that ASCs provide higher quality care than hospital outpatient departments, even for high-risk patients.”
- Page 10: “In general, reimbursements for outpatient procedures in hospitals are set higher than in ASCs because hospitals must meet additional regulatory requirements and treat patients who are more medically complex (MedPAC, 2003).”
- Page 30: “Our findings indicate that ASCs provide efficient, high quality care for high volume outpatient surgeries.”

IV. Finally, in addition to the above-listed sources, and the other sources cited in our Application, we submit with this response the following additional peer-reviewed sources supporting claims as to cost, quality and/or patient satisfaction as Exhibit 5:

1. S. Askar, Chukmaitov, Nir Menachemi, L. Steven Brown, Charles Saunders, and Robert G. Brooks, A Comparative Study of Quality Outcomes in Freestanding Ambulatory Surgery Centers and Hospital-Based Outpatient Departments: 1997-2004, 43(5) HSR: HEALTH SERVICES RESEARCH 1485 (Oct. 2008) (concluding that neither ASCs nor HOPS performed better overall).
2. Kathleen Cary, Price Increases Were Much Lower In Ambulatory Surgery Centers Than Hospital Outpatient Departments In 2007–12, 34(10) HEALTH AFFAIRS 1738-1744 (Oct. 2015) (finding that for the surgical procedures examined, prices paid to ASCs taken as a whole have grown roughly in line with increases in medical care prices, while overall prices paid to hospital outpatient departments for the same procedures have climbed sharply). (Ordered and to be submitted later when it arrives.)
3. L. A. Fleisher, L. R. Pasternak, R. Herbert, and G. F. Anderson, Inpatient Hospital Admission and Death after Outpatient Surgery in Elderly Patients: Importance of Patient and System Characteristics and Location of Care, 139(1) ARCHIVES OF SURGERY: 67 (2004) (finding that ASCs have among the lowest adverse outcome rates among HOPDs, physician offices, and ASCs, even after controlling for factors associated with patients with higher risk).
4. Brionna Hair, Peter Hussey, and Barbara Wynn, A comparison of ambulatory perioperative times in hospitals and freestanding centers, 204(1) THE AMERICAN JOURNAL OF SURGERY 23 (2012) (finding that the mean total perioperative time for all procedures examined was 39% shorter in freestanding ASCs than in hospital-based ASCs, surgery time was 37% shorter, operating room time was 37% shorter, and postoperative time was 35% shorter).
5. John M. Hollingsworth, Chris S. Saigal, Julie C. Lai, Rodney L. Dunn, Seth A. Strobe, Brent K. Hollenbeck and the Urologic Diseases in America Project, Medicare Payments for Outpatient Urological Surgery by Location of Care, 188 THE JOURNAL OF UROLOGY 2323 (Dec. 2012) (finding that for all but two urological procedure groups, ambulatory surgery centers and physician offices were associated with lower overall episode payments than hospitals).
6. Ian M. Paquette, Douglas Smink, and Samuel R.G. Finlayson, Outpatient Cholecystectomy at Hospitals Versus Freestanding Ambulatory Surgical Centers, 206(2) JOURNAL OF THE AMERICAN COLLEGE OF SURGEONS, 301 (2008) (concluding that in a population of slightly younger, healthier patients, laparoscopic cholecystectomy in freestanding ASCs appears to be performed safely and with substantially lower charges than in hospitals).
7. James C. Robinson, Timothy T. Brown, Christopher Whaley and Kevin J. Bozic, Consumer Choice Between Hospital-Based and Freestanding Facilities for Arthroscopy: Impact on Prices, Spending, and Surgical Complications, 97-A(18) J. BONE JOINT SURG. AM. 1473 (Sept.



16, 2015) (finding that negotiated rates for hospital-based outpatient departments exceeded those charged by freestanding surgery centers by a mean of 73% (\$2714) for knee arthroplasty and 48% (\$2262) for shoulder arthroplasty and that Medicare also pays substantially more for ambulatory procedures if they occur in a hospital outpatient department than if they occur in a freestanding ambulatory surgery center).

8. Terrance L. Trentman, Jeff T. Mueller, Richard J. Gray, Barbara A. Pockaj and Daniel V. Simula, Outpatient Surgery Performed in an Ambulatory Surgery Center versus a Hospital: Comparison of Perioperative Time Intervals, 200(1) AM. J. OF SURG. 64 (Jul. 2010) (finding that complications were negligible at both ASC and HOPD, but that the ASC had significantly shorter perioperative time intervals).

13. Explain all manners in which GMSC prices and policies will be made available to the public.

The Green Mountain Surgery Center believes that greater price transparency for patients is critical to successful reform of the health care system. Since the implementation of the Affordable Care Act, Vermonters are paying an increasingly greater proportion of their health care costs out of pocket, which means that consumer demand for meaningful and transparent price information will only continue to grow in the future. The Green Mountain Surgery Center aims to be a key partner with employer and consumer groups helping to make price information transparent and available to consumers. For evidence of the efforts that the Green Mountain Surgery Center has already made to reach out to employer and consumer groups to discuss issues of patient choice and price transparency, please see our original application, Section IV Letters of Support, which includes letters from AARP Vermont, Burton Snowboards, Vermont Campaign for Healthcare Security, the Vermont State Employees Association, the Vermont Education Initiative, and the Vermont State Troopers Association. The Green Mountain Surgery Center has additionally secured letters of support from Seventh Generation and the town of Colchester at the time of this submission.

The Green Mountain Surgery Center recognizes that communicating price information satisfactorily and usefully to consumers is not always a straightforward task, however it believes that strong commitment on the part of providers is a necessary first step to start to empower consumers with access to price information.

At minimum, upon opening, The Green Mountain Surgery Center intends to:

- Have a dedicated staff person who provides price estimates to patients on request. The Green Mountain Surgery Center will also ensure that physicians and other clinical staff know how to connect patients with this dedicated staff person.
- Make health plan-specific negotiated fees - sometimes referred to as 'Allowable' amounts by Medicare and commercial insurers - available at the point of care by distributing plan-specific payment rates for common procedures to the offices of

- each physician who performs procedures at the center, thereby helping providers incorporate relevant price information into clinical decisions.
- Help patients identify which other separately billed services could be involved in their care, for example the surgeon's fee and the anesthesiologist's fee (if indicated), and help direct consumers to resources that have information on the price of these additional health care services.

Finally, the Green Mountain Surgery Center intends to offer price-transparency tools on its website. The form that these tools take will need to be further developed throughout the planning phase of the project. In devising the most appropriate tools with which to communicate price information, the Green Mountain Surgery Center intends to follow the recommendations from the Healthcare Financial Management Associations' 2014 Report of the Price Transparency taskforce, whose recommendations can be found here:

<http://www.hfma.org/Content.aspx?id=22305>

<http://www.hfma.org/transparency/>

14. Explain whether GMSC patients will be able to apply for free or discounted care prior to treatment.

Yes. See the response to question 18.

15. Identify the Electronic Health Record (EHR) that GMSC will use and explain whether its cost is included in the total project cost. Also address its compatibility with and ability to communicate with EHR systems at the University of Vermont Medical Center, Northwestern Medical Center, and all other hospitals in GMSC's primary and secondary service areas.

While electronic communication with EHR systems at UVMHC, Northwestern Medical Center, and other area hospitals is important, effective electronic communication between the Green Mountain Surgery Center and primary care providers is of primary importance to support improved population health management and the principles of the Blueprint Patient Centered Medical Home. The primary goal of population health management IT strategies is to encourage seamless electronic communication among the different levels of care (e.g., primary care, specialty care, acute care, etc.) so that patients' transitions from one level of care to the other may be managed more conveniently for the patient and more cost-effectively. Connecting all providers that offer the same level of care (i.e. all providers offering outpatient surgical services) may be beneficial as well for quality measure tracking and other reasons, but is not necessarily as critical to improving the patient experience.

The best way for the Green Mountain Surgery Center to integrate electronically with primary care providers *and* area hospitals is to ensure that its EHR is interoperable with the state's

health information exchange (HIE), hosted by Vermont Information Technology Leaders (VITL). Using the new VITL Access system, providers within the emergency and other departments of Vermont's hospitals can log-in to VITL Access to see all clinical history on patients from community offices and other sites of care that is stored in the VHIE. Blueprint primary care providers also have access to clinical history on patients stored in the HIE through VITL Access.

While The Green Mountain Surgery Center has not yet selected a vendor for its EHR, it has built an expected cost of \$200,000 into its operating model based on comparing national average costs of implementation from three major national ASC EHR vendors: HST Pathways, Amaki, and Source Medical. The Green Mountain Surgery Center has already engaged with leaders at VITL to begin to review the interoperability capabilities of two of these national vendors, and expects to engage more formally with VITL on an evaluation project before choosing an EMR vendor, if approval of the CON is granted.²⁴ Management at the Green Mountain Surgery Center will not implement an EHR solution that is not capable of sending electronic information seamlessly back and forth to the HIE, without added costs and other barriers.

Conversely, the system currently in place at the local medical center (Epic) has had major challenges sending continuity of care information back and forth through the HIE and has not yet resolved those issues per VITL's 11/18/2015 report to the SIM Health Data Infrastructure Workgroup on the status of the ACO Data Gap Remediation Project.²⁵ The Epic system only finally announced earlier this year that it would stop charging health information exchange fees that ranged as high as 20 cents per record and an annual \$2.35-per-person fee for receiving messages from non-Epic systems.²⁶ Charging extra fees and otherwise making it difficult to convey electronic health information to outside entities is often referred to as "data-blocking." For a more detailed description of the problem of data-blocking and the business practices employed by larger HIT vendors that may engage in it, please see the Office of the National Coordinator for Health Information Technology's April 2015 report to congress, Section III.²⁷ Epic, specifically, has been accused in some areas of using its technology to support the market domination of its largest clients by limiting ease of access to information to outside parties, such as independent physicians.²⁸

The GMSC also intends to work with the Vermont Program for Quality in Health Care (VPQHC) to collect data for improvement utilizing American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP). While the IT integration and staff costs of participation will have to be carefully evaluated before making the decision to enroll, the Green Mountain Surgery Center is committed to providing high-quality, transparent surgical outcomes data

²⁴ See email exchanges regarding evaluation of ASC EHR vendors between Amy Cooper and VITL Leadership from Sep 21 – Oct 23, 2015.

²⁵ http://healthcareinnovation.vermont.gov/sites/hcinnovation/files/HIE/HDI_11.18.15.Merged.Meeting.Materials.v2.pdf

²⁶ <http://www.modernhealthcare.com/article/20150417/NEWS/304179976>

²⁷ https://www.healthit.gov/sites/default/files/reports/info_blocking_040915.pdf

²⁸ <http://www.govhealthit.com/news/connecticut-investigating-epic-hospitals-ehr-data-blocking>

alongside other outpatient surgery providers in the state. The Green Mountain Surgery Center will identify a “surgical champion” to participate in the surgical learning collaboratives that VPQHC is hosting and looks forward to working alongside Mt. Ascutney Hospital, Brattleboro Memorial Hospital, Southwestern Vermont Medical Center, Porter Hospital, and Rutland Regional Medical Center, the hospitals in the state who have committed already to working on this specific project.²⁹

16. Detail discussions you have had to date with specific area hospitals regarding transfer agreements.

Please see the letter from Stephen Leffler, MD, Chief Medical Officer of University of Vermont Medical Center, dated November 11, 2015, attached as Exhibit 6.

17. Detail discussions you have had to date with ambulance services for transport of patients requiring emergency medical services.

Please see the Memorandum of Agreement signed by Amy Akerlind for Colchester EMS on October 10, 2015, attached as Exhibit 7.

18. Page 54 of the application indicates that GMSC is committed to providing free and discounted care to needy patients at a level on par with Vermont non-profit hospitals. The ACA and IRS and Treasury Department have relevant standards, regulations and guidelines for non-profit hospitals regarding financial assistance, billing, charges and collections. State whether GMSC intends to adhere to these standards. Explain fully the rationale for implementing or not implementing any of the standards or guidelines. See, e.g., <https://federalregister.gov/a/2014-30525>

The Green Mountain Surgery Center assumes that this question refers to provisions of the Internal Revenue Code (“IRC”) added to the IRC by the Patient Protection and Affordable Care Act of 2010, codified at 26 U.S.C. § 501(r) and detailed in Department of Treasury regulations, which apply to nonprofit hospitals that are tax-exempt under IRC Section 501(c)(3). Penalties for failing to meet the requirements of Section 501(r) include the loss of tax-exempt status under Section 501(c)(3).

Tax-exempt hospitals are expected to provide charity care as a quid pro quo for relief from federal income taxes. Hospitals are also compensated for providing charity care in other ways. For example, qualifying hospitals that serve a large number of Medicaid and uninsured individuals receive Medicaid Disproportionate Share Hospital (DSH) payments. The Green Mountain Surgery Center will be neither eligible for these tax and other benefits, nor required under federal law to comply with Section 501(r). Nonetheless, as stated in the application, the

²⁹ http://healthcareinnovation.vermont.gov/sites/hcinnovation/files/Core_Team/12.09.15.CT_Meeting.Materials.pdf, pg 28.

Green Mountain Surgery Center is committed to providing free and discounted care to needy patients at a level on par with Vermont nonprofit hospitals.

The following summarizes the requirements of Section 501(r) and its implementing regulations regarding financial assistance, billing, charges, and collections, and explains whether and how the Green Mountain Surgery Center policy and practice will conform to these rules.

- Tax-exempt hospitals must establish a financial assistance policy which states eligibility criteria; whether assistance includes free or discounted care, and the amounts to which discounts will be applied; the basis for calculating amounts charged to patients, including the method used to determine amounts generally billed to individuals who have insurance covering medically necessary care; the method for applying for financial assistance; and the actions the hospital may take in the event of nonpayment. A hospital must widely publicize its financial assistance policy by making a summary of the policy and the application form available on a website; making paper copies of the policy and application form available upon request by mail and in public areas of the hospital facility; notifying members of the community the hospital serves in a manner likely to reach persons most likely to need financial assistance; notifying persons who receive care at the hospital by offering a summary of the policy to patients during the intake or discharge process, including a conspicuous written notice of the policy on billing statements, setting up conspicuous displays informing patients of the policy in public areas of the hospital facility, and translating the policy and application form into the primary languages spoken in the community the hospital serves. 26 U.S.C. § 501(r)(4)(A), 26 C.F.R. § 1.501(r)-4(b).

Green Mountain Surgery Center: A draft Green Mountain Surgery Center Free and Discounted Care Policy is Exhibit 2-a to the application. The Green Mountain Surgery Center has revised this policy since the application was filed. The Green Mountain Surgery Center's current draft policy is attached hereto. This policy states the assistance available, eligibility criteria, how to apply for assistance, and the maximum amount a patient eligible for assistance under the policy may be personally responsible to pay. The policy and application form will be available on the Green Mountain Surgery Center website, notices of the policy will be prominently posted at the Center, and copies of the policy and application form will be available to patients upon request at the Center. Notices and summaries of the policy will be available in the primary languages spoken by the population the Center serves.

The Green Mountain Surgery Center will also rely on the staff at physician offices to notify it of patients who qualify for free or discounted care. Patients are scheduled for outpatient surgeries by the staff in a surgeon's office. The staff communicates with patients about office visits and consultations, helps to manage referrals for patients from primary care providers, and is generally very familiar with each patient's ability to pay for services. The scheduling, billing and front desk staff at each physician's office will be made aware of the Green Mountain

Surgery Center Free and Discounted Care Policy and will play an active role in educating patients about this policy and helping them apply for assistance.

- Tax-exempt hospitals are required to charge persons who are eligible for financial assistance under the hospital's policy no more for medically necessary care than the amounts generally billed for the same care to persons who have insurance coverage. A person is "charged" only the amount he or she is personally responsible for paying, after all deductions, discounts (including discounts available under the financial assistance policy), and insurance reimbursements have been applied. The rules set out two methods hospitals may use to determine how much to charge. One option is to charge a person eligible for financial assistance the total amount Medicare fee-for-service or Medicaid would allow for the care (including both the amount Medicare or Medicaid would reimburse and the amount the beneficiary would be personally responsible for paying). Alternatively, a hospital may calculate the percentage of its gross charges for medically necessary care that insurers have allowed during a prior twelve-month period (the "AGB percentage"), and charge persons eligible for financial assistance not more than this percentage of gross charges. A hospital electing this latter method may apply one average AGB percentage to all medically necessary care, or it may calculate multiple AGB percentages for separate categories of care or for separate items or services. A hospital must always charge persons eligible for financial assistance less than the gross charges for any medical care covered under the hospital's financial assistance policy. 26 U.S.C. § 501(r)(5), 26 C.F.R. § 1.501(r)- 5(a), 5(b), 5(c).

Green Mountain Surgery Center: Green Mountain Surgery Center's attached draft Free and Discounted Care Policy provides that a patient who is eligible for financial assistance under this policy shall not be personally responsible for paying, after all deductions, discounts (including discounts available under this policy), and insurance reimbursements have been applied, more for medically necessary care than the amount Medicare would allow for the care (for an item or service covered by Medicare), or the average amount allowed by private health insurers (for an item or service that is not covered by Medicare).

- Tax-exempt hospitals may not engage in extraordinary collection actions before making reasonable efforts to determine whether an individual is eligible for financial assistance under the hospital's policy. Extraordinary collection actions include selling an individual's debt to a third party; making an adverse report to credit bureaus; deferring, denying, or requiring payment before providing medically necessary care due to nonpayment of bills for prior care; and actions that require legal process. A hospital has made reasonable efforts to determine an individual's eligibility for financial assistance if it notifies the individual of the financial assistance policy before initiating extraordinary collection activities; processes the individual's complete application for financial assistance to determine his or her eligibility; and gives individuals who submit incomplete applications

for financial assistance a reasonable opportunity to complete the application, and explains how to do that. 26 U.S.C. § 501(r)(6), 26 C.F.R. § 1.501(r)-6.

Green Mountain Surgery Center: A notice of the Green Mountain Surgery Center Free and Discounted Care Policy will be stated on all patient invoices, as well as conspicuously posted at the Center and on the Green Mountain Surgery Center’s website. The Green Mountain Surgery Center will not engage in “extraordinary collection actions” as this term is defined under Section 501(r) until payment is at least 180 days past-due. If an individual has submitted a complete application for assistance under the Free and Discounted Care Policy with respect to the past-due payment, the Green Mountain Surgery Center will not initiate extraordinary collection actions before it has processed the application. If an individual has submitted an incomplete application for assistance under the Free and Discounted Care Policy with respect to a past-due payment, the Green Mountain Surgery Center will not initiate extraordinary collection actions before first notifying the individual of how to complete the application, giving him or her at least 30 days to do so, and processing the application.

19. Please revise Table 1 (Project Costs) and provide the detail for what is specifically included in each line item. Note that all costs to make the proposed project fully operational must be included in the total project cost; for example, \$1,609,875 should be reflected in the “Renovation” line item and fixed equipment should be reflected in the “Fixed Equipment” line item. In addition, all costs such as the EHR, major moveable equipment, architectural/engineering fees, and debt financing costs must be reflected in the table.

Please see the revised Table 1, below. The Table 1 initially submitted showed ‘Construction Costs’ of **\$5,610,445.46**, which represents the Proposed Lease Amount (payment times term) for the building located at 535 Hercules Drive. The lease assumptions are \$38 per square foot annual payment for a 12,879 square foot building, with lease escalation of 3% per year, for 10 years. The initial Table 1 also included ‘Related Project Costs’ of **\$1,812,838**. These costs constitute the total amount of start-up capital that ACTD will need to raise to become operational. The only financing to be secured by ACTD will be a loan to cover \$680,000 of the ‘Related Project Costs’, the remaining start-up capital to be covered by a new equity raise after CON approval is granted. The terms of the loan to be secured are outlined in the original Table 2.

In order to provide more detailed information about ‘Construction Costs,’ as requested by the board, we have broken out the capitalized lease payment into its component parts of \$857,741 for Renovation/Interior Fit-up, plus \$752,134 for Fixed Equipment, which amount to the Sub-total of \$1,609,975.00 for ‘Construction Costs.’ The remaining \$4,000,570.46 in capitalized lease payments for the remaining parts of the facility are shown under ‘Related Project Costs – Purchase of Buildings,’ for a grand total capitalized lease payment once again of **\$5,610,445.46**.



Also to show more detail about 'Related Project Costs' we have added costs for Major Moveable Equipment, and Electronic Health Record (IT). The amounts shown in the Revised Table 1 are the capitalized amounts of \$4,000,000 and \$200,000 respectively, each with their own lease schedules, the details of which are spelled out in the 'Comments' box next to each line item. Capitalized lease amounts for Major Moveable Equipment and IT were not included in the original Table 1 and that is why the Total Project Costs shown in the Revised Table 1 are \$4,200,000 more than what was shown in the initial Table 1.

The remaining costs shown on the line items under 'Related Project Costs,' excluding the capitalized lease amounts for the facility, major moveable equipment, and IT, amount to **\$1,812,838**, or the start-up capital that ACTD will need to raise to become operational. On the initial Table 1, we broke this amount down into 3 component parts: Furnishing, Fixtures & Other Equipment, Working Capital, and Other. In the Revised Table 1, we have provided more detailed insight into these start-up costs by breaking them further into 7 component parts: Furnishing, Fixtures & Other Equipment, Architectural/Engineering Fees, Working Capital, Professional Services, Initial Wages and Benefits, Marketing Printing and Training Fees, and Other.

We did not include debt financing expenses in this revised Table 1. As we stated in the original Application, we intend to secure \$680,000.00 at 7% if/once we have been granted a CON. We know from conversations with conventional lenders that this is a reasonable assumption.

Table 1 Project Costs - Revised

Applicant Name

ACTD LLC

Project Name

Green Mountain Surgery Center

Construction Costs			Detail/Comments
1	New Construction	\$0	Building shell and core is a cost borne by developer/landlord, not ACTD. Capitalized Amount over 10 years. Paid for through Lease Expense. See detail in interior fit up construction budget, Application Table 2, p. 17-18., includes all line items from that table except Plumbing, Fire Protection, HVAC and Electrical, which are shown in Fixed Equipment (line 4) Cost borne by developer/landlord, not ACTD. Capitalized Amount over 10 years. Paid for through Lease Expense. Fixed Equipment Includes Plumbing, Fire Protection, HVAC and Electrical Systems. Cost borne by developer/landlord, not ACTD. Cost borne by developer/landlord, not ACTD. Cost borne by developer/landlord, not ACTD. ACTD LLC is not acquiring the land so it is incurring no other construction costs.
2	Renovation/Fit up costs	\$857,741	
3	Site Work	\$0	
4	Fixed Equipment	\$752,134	
5	Design/Bidding Contingency	\$0	
6	Construction Contingency	\$0	
7	Construction Manager Fee	\$0	
8	Other (please specify):	\$0	
Subtotal		\$1,609,875.00	
Related Project Costs			
1	Major Moveable Equipment	\$4,000,000	Major moveable equipment will be leased. Amount calculated as a 7 yr lease at 7% interest, 20% residual value; 800K per OR, \$600K per Procedure Room. Includes Initial Furniture/Fixtures (\$200,000) and Initial Inventory (\$130,000) Architect's fees for the cost of ASC design and compliance with FGI standards. Architect and engineering fees for the building's design and exterior will be borne by developer/landlord, not ACTD. Cost borne by developer/landlord, not ACTD. The ASC space will be leased, not purchased. This amount is for the capitalized lease of the facility, payments of which will be over 10 years. Cost borne by developer/landlord, not ACTD; Permits and Act 250 have to do with Construction of the building.
2	Furnishings, Fixtures & Other Equip.	\$330,000	
3	Architectural/Engineering Fees	\$10,500	
4	Land Acquisition	\$0	
5	Purchase of Buildings	\$4,000,570	
6	Administrative Expenses & Permits	\$0	
7	Total Debt Financing Expenses (see below)		
8	Debt Service Reserve Fund	\$0	
9	Working Capital	\$681,540	Assume 60 days working capital in reserve at start-up.

10	Other (please specify)	\$229,600	<p>Cost of the obtaining CON, including legal fees, and Avanza's consultant fees.</p> <p>Planning to lease the Electronic Health Record from vendor; Capitalized amount shown here. Assume 3 yr lease at 7% interest, 20% residual value.</p> <p>Cost of obtaining Accreditation, of hiring consultants to prepare for accreditation, recruitment of initial employees, setting up quality program, staffing committees, initial purchasing and procurement of supplies, etc.</p>
	Electronic Health Record (IT)	\$200,000	
	Professional Services, Consulting Corporate Formation	\$300,000	
	Initial Wages and Benefits	\$189,498	
	Marketing, Printing, training fees	\$71,700	
	Subtotal	\$10,013,408	
Total Project Costs		\$11,623,283.46	

Debt Financing Expenses		
1	Capital Interest	
	Bond Discount or Placement	
2	Fee	
	Misc. Financing Fees & Exp. (issuance costs)	
3		
4	Other (specify):	
	Subtotal	\$0
Less Interest Earnings on Funds		
	Debt Service Reserve Funds	\$0
	Capitalized Interest Account	\$0
	Construction Fund	\$0
	Other (specify):	\$0
	Subtotal	\$0
Total Debt Financing Expenses		\$0
<i>feeds to Debt Financing Expenses above</i>		

20. Explain whether GMSC will have mobile or fixed CT or MRI services.

The proposed GMSC will not have CT or MRI services.

21. Provide a narrative scope of work for the mechanical, electrical, plumbing and fire protection components included in the 12,879 square foot leased space.

Please see the attached Systems Narrative, dated September 9, 2015, attached as Exhibit 8.

Please let us know if you have any additional questions or need clarification regarding any of these responses.

Sincerely,



Eileen Elliott

cc: Judy Henkin, Health Policy Director
Michael Donofrio, Esq., GMCB
Lauren Layman, Esq., Vermont Association of Health and Hospital Systems
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Economic and Demographic Forecast

*Northwest Vermont and Chittenden County
2000 to 2035 and Beyond*

September 2000

**Prepared for:
Chittenden County Regional Planning Commission and
Metropolitan Planning Organization**

by: Economic & Policy Resources, Inc., Williston, Vermont 05495

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1.0 Summary Conclusions

Northwest Region

- G **Population:** Population in the northwest Vermont region is expected to increase by approximately 200,000, an annual average of 1.2% from 2000 to 2010 and 1.5% from 2010 to 2035, a slightly higher rate of growth than seen between 1980 and 1997 of 1.1% per year.
- G **Employment:** Full and part-time employment as measured by the total number of jobs in the northwest Vermont economy is forecast to increase 71% from 227,100 in 2000 to 388,400 in 2035, an increase of 161,300 jobs. This level of job growth takes place while labor market conditions are expected to remain tight due to an aging population and lower birth rates experienced during the 1980's and 1990's.
- G **Gross Regional Product (GRP):** Economic activity of the northwest Vermont region as measured by real GRP (measured in 1992 dollars) is expected to increase \$16 billion over the forecast period, with 44% of the increase due to gains in work force productivity. This rate of growth averages 2.9% per year over the thirty-five year study horizon. This rate is below that of the average experienced during the 1980 to 1990 period but greater than that of the 1990 to 1997.
- G **Housing Unit Demand:** Housing unit demand is expected to increase by 98,700 over the forecast period. The near-term forecast period, 2000-2010, is expected to see a slightly higher rate of growth than the balance of the forecast period, 1.7% and 1.6%, respectively. Housing demand is expected to increase at a rate which exceeds population growth due to smaller households, longer life expectancies and later marriages.

Chittenden County

- G **Population:** The population of Chittenden County is expected to increase by 102,503 persons between 2000 and 2035, an average of 1.5% per year. This represents a 69% increase. The metropolitan core cities of Chittenden County are expected to experience relatively slow population growth relative to the 1970's and 1980's – an average of 0.48% per year. The urban fringe towns of Chittenden County are expected to experience population growth averaging 1.97% per year between 2000 and 2035 with a slightly

faster rate of growth in the 2000 to 2010 period than the 2010 to 2035 period.

- G **Employment:** Full and part-time employment in Chittenden County is estimated to increase by 79% or 98,000 jobs between 2000 and 2035. There will be a continuation of the trend by which service sector employment increases. Concurrently, employment in manufacturing increases at a rate above that of the 1990's, but below historic rates of the 1970's and 1980's. Eighty-six percent of the additional jobs expected in 2035 will be in the non-manufacturing sectors.
- G **Housing Demand:** Housing demand is expected to increase by approximately 53,000 over the forecast period. Housing demand is expected to show a slightly higher rate of growth from 2000-2010 as compared to the balance of the forecast period, 2.0% and 1.6%, respectively. This is due to the lagged effects of the housing market combined with demographic changes of the population.

2.0 Executive Summary

The prospects and expectations for population growth in Chittenden County are largely governed by the economic health of the northwest Vermont region. A healthy economy means business investment which leads to employment growth and opportunity. Employment opportunity, in turn, encourages a region's population to stay in the area and others to migrate to the region. As the indigenous population grows and employment opportunity encourages in-migration, demand for housing and public services follow. The forecasts presented here have been prepared to assist the Chittenden County Regional Planning Commission and the Chittenden County Metropolitan Planning Organization to examine and prepare plans that will address the needs of the current and future residents of Chittenden County.

This study examines historic economic and demographic patterns for northwest Vermont in order to forecast population, employment, and housing demand for Chittenden County for the years 2000 through 2035. In order to build the context within which Chittenden County is influenced, the projections for Chittenden County begin with an examination of the economy of the six northwestern counties of Vermont. Economic activity throughout the northwest Vermont region greatly influences population growth and housing demand on all towns of the region and in Chittenden County where the region's population is centered.

A regional input/output model of the economic linkages within the six-county region is calibrated for recent changes in the area's economic structure. Adjustments to recognize current economic trends and the present business cycle are then made. Employment and population forecasts to 2035 for the entire region recognize the economic linkages within the economy as a whole. Historic patterns in population and employment between the entire northwest Vermont region and Chittenden County, and between Chittenden County and its sub-county regions, are then examined. This analysis provides estimates of the likely growth and pattern of population within Chittenden County itself.

Users of the information contained in this report are encouraged to recognize the inherent limitations on the population forecasts presented. The northwest region forecasts are the most likely to be proven accurate over time. The town level forecasts presented here are the most likely to be proven the least accurate with time. As is the case with all population forecasts, the more extensive the geographic surface, the lower the variability in historic patterns, and the larger the population considered, the more accurate the results are likely to be. Small swings in small populations of small areas are very difficult to accurately forecast. Relatively speaking, Chittenden County and its towns exhibit all of these characteristics.

3.0 Introduction

This study was commissioned by the Chittenden County Regional Planning Commission (CCRPC) in conjunction with the Chittenden County Metropolitan Planning Organization (CCMPO) in April 2000 to provide population, employment, and housing projections and analysis to support the Chittenden County Regional Plan and the Chittenden County Metropolitan Plan updates. This study reports the results of the projections for the northwest region of Vermont's economy as well as the projections of Chittenden County's economy, population, and housing demand. In order to establish the context in which population, employment and housing in Chittenden County is analyzed, the study begins with an analysis and projection of the economy of northwest Vermont. Subsequently, the municipalities of Chittenden County have been organized into sub-county groupings for the projection of population in those sub-county regions.¹

The northwest corner of Vermont including Chittenden County has grown in population steadily for the past forty years and is now home to 51.6% of the State's population and 56.6% of the State's employment. The region, which includes the six counties of Franklin, Grand Isle, Lamoille, Chittenden, Addison and Washington, has generally maintained a growth in population and economic activity greater than other areas of the state throughout recent history (see Figure 2). In the center of this region are the cities and towns of Chittenden County which now form the core of a highly interconnected nodal regional economy.² The characterization "nodal regional economy" refers to the spatial patterns of economic and social relationships of the people residing and working within the region. Evidence, such as the concentration of employment and increasing density of the population, indicates that the people of the region constantly interact both economically and socially such that economic and population growth of a given municipality is greatly influenced by that of the region as a whole.

¹ The sub-county region's population and employment forecasts contained in this report have been prepared to reflect future levels given historic patterns of population and employment across and within the northwest region of Vermont. As such, the forecasts reflect what is likely to be the future pattern and level of population and employment if historic trends continue— a "status quo" forecast. These historic patterns may be, and likely, will be, altered by public policy decisions and changing preferences of the region's population. These factors are particularly noticeable with forecasts at the sub-county level. Consequently, the statistical validity of the forecasts at the northwest Vermont and Chittenden County region level are higher than that at the sub-county level. For the convenience of the member towns, we have provided town level forecasts of population where analysis enabled results with reasonable statistical validity. These town-level forecasts should be viewed and used with extreme caution as the confidence intervals of these forecasts, especially in the last projection year, are quite wide and reflect the difficulty in projecting these areas so far out into the future.

² The concept of a "nodal region" refers to a geographic area where the functional linkages that exist between sub-areas exhibit social and economic ties referred to as "linkages" by regional economists and urban planners. In section 4.0 of this report we discuss the characteristics of nodal regions and some of the evidence that demonstrates these characteristics for northwest Vermont.

As the core of the northwest Vermont region becomes more densely populated and significant employment activity more concentrated, the impact of increased economic activity is spread across a broader geographic area.³ For this reason, our examination of future population, employment and housing for Chittenden County is developed from a perspective of the northwest Vermont regional economy. The analysis that follows begins with a comprehensive examination of the northwest region's future economic growth based on our knowledge of recent significant economic development events. We then examine the likely distribution of population, employment and housing to the counties of the region given historic patterns for these variables. Lastly, we examine anticipated future population and housing demand distribution across Chittenden County by aggregating individual communities into sub-county regions. In this manner, the economic momentum of the entire region's economy is incorporated into the population, employment and housing forecasts for Chittenden County. Our analysis includes population forecasts for sub-county regions of Chittenden County as opposed to individual towns because of data limitations and a desire to maintain a high degree of statistical significance in the results.⁴

3.1 Purpose of Study

The forecast will be employed in the updates to the Chittenden County Regional Plan and the Chittenden County Long-Range Transportation Plan. In turn, the plan will guide public investment, development and land use policies throughout Chittenden County for the foreseeable future. The CCRPC plan update will employ the forecasts reported here to examine and formulate public policy alternatives to achieve more desirable long-term outcomes. Accordingly, as the forecasts reported here are based on historic patterns of growth, current economic activity, and recent economic events that are expected to alter those historic patterns, the plan becomes a tool to achieve a more favorable outcome for the region's citizens. These projections will provide guidelines that will assist in the development of and, hopefully, improve the quality of the projections developed by Chittenden County member municipalities. In order for the CCRPC to update the Chittenden County Regional Plan and the CCMPO to update the Long-Range Transportation Plan, projections and analysis of future economic and demographic trends need to be developed. While the Census Bureau and other government

³ Characterizations of region must be considered in their spatial context. For example, relative to the northwest Vermont region as a whole, the towns of Chittenden County are characterized as the region's "core." Within the context of Chittenden County itself, the relatively more metropolitan areas of Burlington, South Burlington and Winooski are considered the "core" communities of the County. We will make these distinctions clear as they are employed in subsequent sections of the report.

⁴ Appendix E presents supplemental analyses of the population patterns of most of the individual towns of Chittenden County as a convenience to the member towns. The statistical validity of these forecasts are well below those of the northwest Vermont region and Chittenden County as a whole. Extreme caution should be employed in the use of these sub-county region forecasts for critical municipal planning functions.

agencies provide data in this regard, the 2000 Census data will not be available for another two or three years, nor will this data go beyond the year 2000. It is the purpose of this study to develop long-term projections and analysis of the Chittenden County population, employment, and housing demand variables needed to facilitate long-range planning. This study also develops population projections for Chittenden County sub-county regions to assist the member communities in their efforts to plan for the future as well.

3.2 Study Methods and Approach

The projections of population and employment in Chittenden County begin with a forecast of economic and demographic variables for the entire northwest region of Vermont. The northwest region has become increasingly interconnected in its economic and demographic relationships. Therefore, any examination of Chittenden County needs to look at the northwest region as a whole in order to understand the context within which Chittenden County will approach the future.

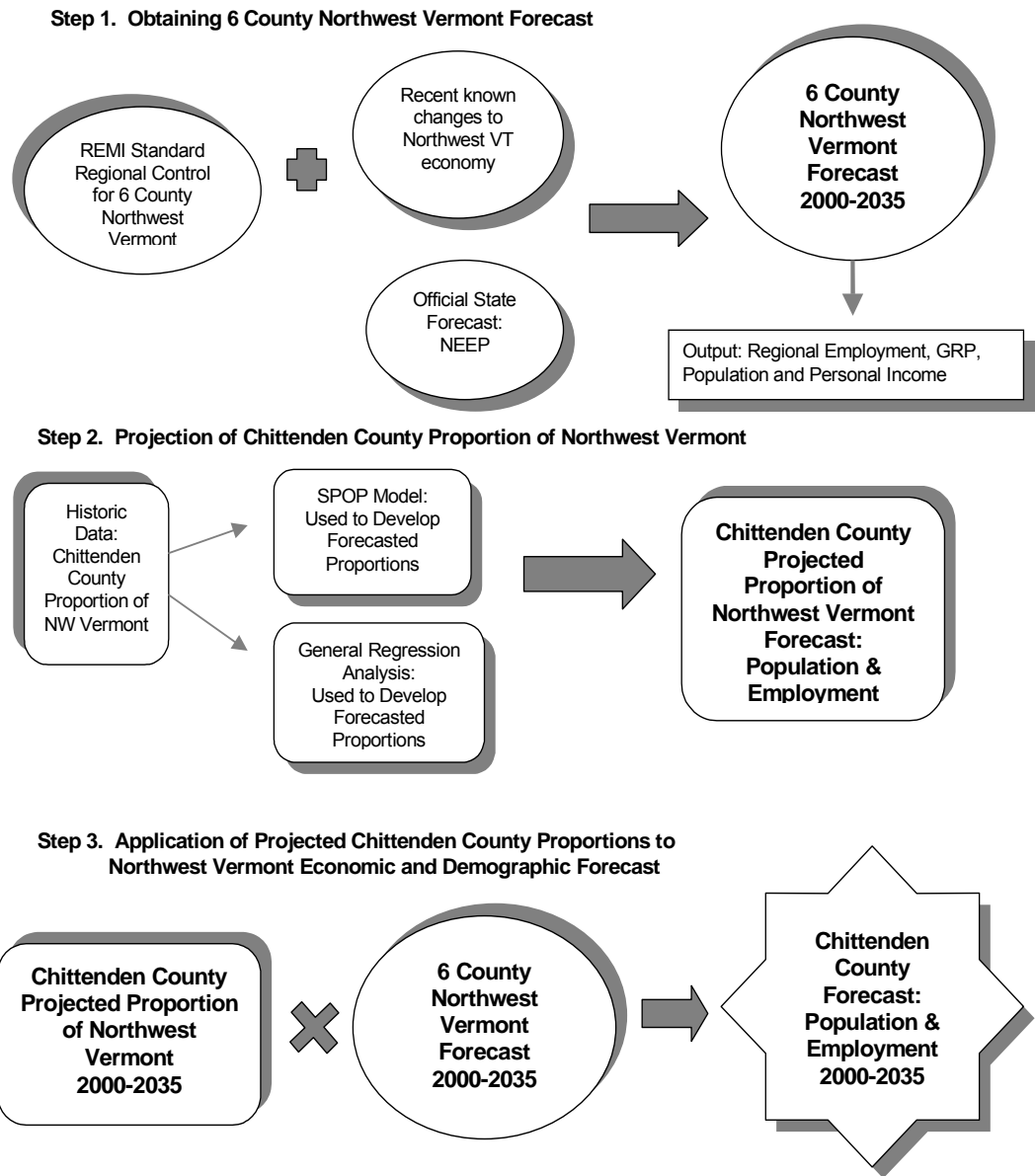
In general, economic activity governs an area's growth in population. The size and health of the economy decides population in and out-migration, relative wage levels and personal incomes. Higher incomes influence quality of life factors which, in turn, influences economic momentum and future growth. This analysis examines recent economic trends and events to forecast the northwest regional and the Chittenden County population and employment variables.

The economic and demographic forecast for the northwest region is developed using the official state forecast, known recent changes in the northwest regional economy, and a northwest regional input/output model. The official state forecast is econometrically derived using historic employment, a national economic outlook prepared by Regional Forecasting Associates (RFA) and other economic data, such as gross state product and personal income. Results of the official state forecast are then incorporated into a regional input/output model along with measures of recent economic events which are expected to influence the nature and rate of future economic growth. From this northwest regional forecast the projections at the Chittenden County level are developed using statistical forecasting models. These models relate the historic Chittenden County proportion to the total northwest Vermont region.⁵ Forecasts of population at the Chittenden County sub-county regional level are also developed using similar statistical forecasting models. In short, these models produce the Chittenden County and sub-Chittenden

⁵ All statistical forecasting estimations were made with a 95% confidence level. For a more detailed discussion of confidence levels, see Appendix D.

County region forecasts by statistically examining historic patterns and trends in population and employment change .

Figure 1. Forecasting Process



4.0 The Northwest Vermont Region

Prior to examining Chittenden County individually, it is important to look first at the whole northwest region of Vermont.⁶ This is due to the social and economic interconnectedness and interdependence of the region. Regional economists describe regions such as the northwest region of Vermont as “nodal regions.” Nodal regions are characterized by a central core, with a surrounding periphery related to the core by economic linkages. For example, as employment has grown in the central urban towns of Chittenden County, some people working in these towns move out to the surrounding rural towns in search of a particular lifestyle. Similarly, as land prices in the central urban towns increase relative to surrounding towns, more land-intense activities are encouraged to relocate or initiate economic activity on the core fringe.⁷ This shift of population and employment centers leads to increasing interdependence of the core and the periphery. Over time, densities increase, land resource pressures increase and the once periphery becomes part of the core as the pattern repeats. This section describes three critical factors that demonstrate this increasing interrelatedness and interdependence of the northwest region: the transportation networks, population and employment.

4.1 The Northwest As A Nodal Region

As a geographic region, the northwest six counties of Vermont fits the standard definition of a nodal region.⁸ A nodal region is defined as having a nucleus and a peripheral area consisting of towns functionally tied to the core.⁹ Hoover characterizes nodal regions as “...the structure is like that of a living cell or an atom: There is a nucleus and a complementary peripheral area. Functional integration, rather than homogeneity, is the basis of the correlation or community of interest within such a region.” Functional relationships used in this sense describes the numerous and

⁶ The northwest region of Vermont is defined as the six northwestern counties: Addison, Chittenden, Franklin, Grand Isle, Lamoille and Washington.

⁷ The Case for a Healthy Community: The History of Sprawl in Chittenden County. 1999. Sustainability and Growth Center Team of the Champlain Initiative, p. 42.

⁸ In reality, that portion of the northwest region which is considered part of a nodal region with Chittenden County as a core does not include all of the towns in the six-county area. A more appropriate grouping would likely include approximately 60 towns within a 60 minute commute of the core fringe. These towns incorporate approximately 80% of the region's resident population. As a practical matter the entirety of the six counties of Franklin, Grand Isle, Lamoille, Chittenden, Addison, and Washington counties are included in the definition of the northwest Vermont region because of data requirements and availability. The most complete data available for examining the economic and demographic trends and inter-relationships is county data. The input-output data which describes the flow of economic activity is county based data and county level estimates of population, employment and housing are more readily available and reliable.

⁹ Hoover, Edgar M. 1975. *An Introduction to Regional Economics*, 2nd Edition, Chapter 7.

different ways in which activities in a region interact, both economically and socially, through proximity and interdependence, thereby affecting one another's development.¹⁰ For example, when we examine and compare patterns of population and employment in an area, we gain an understanding of the commuting patterns of the communities' residents. We can see that many people work in one town and commute to their homes in another. In turn, trade patterns are influenced by where people live and their normal travel routes because retail trade is very dependent on traffic volume. In modern society, we also see that people are constantly trying to maximize the use of their time. For this reason, we find that people will combine their efforts to meet social and economic functions around their normal work-to-home travel patterns. In this way, stops along the commute between work and home to shop tend to define an individual's trade patterns. Equally, there is the tendency to meet with other family members at some central location between home and work for social activities such as dining out or watching a movie.¹¹

Although functional relationships, which include all of the linkages that exist in an economy, cannot always be identified directly they can often be recognized and understood by examining spatial relationships and patterns of demographic and socio-economic activity. For example, we can look at patterns of employment as measured by "place-of-work" data from the Vermont Department of Employment and Training and compare this with employed residents by town in the northwest Vermont region. This will show that some towns import workers while others export workers. Although we cannot tell exactly where all workers come from and go to we can see patterns of activity indicative of the functional relationship between suppliers of labor and providers of jobs.

Regions are constantly changing economically and socially. As a region grows in population and economic activity, it tends to spread out across the landscape. Towns once on the region's fringe become increasingly linked to the core towns. A strong economy offers jobs to an increasing number of people. Population increases as more people move into the area attracted by increasing economic opportunity. Some of these people move into the fringe towns as a lifestyle choice and, perhaps, in pursuit of lower-cost housing. These towns become more closely tied to the core towns as the population increases and economic and social linkages are strengthened further. Such is the case in the six counties of northwestern Vermont. Analysis of patterns of the transportation networks, population and employment demonstrate that the area has evolved over the past

¹⁰ Hoover, Edgar M. 1975. *An Introduction to Regional Economics*, 2nd Edition, page 152.

¹¹ McGuckin, Nancy and Murakami, Elaine. 1998. *Examining Trip-Chaining Behavior—A Comparison of Travel by Men and Women*. U.S. Department of Transportation, Federal Highway Administration, Washington, D.C. Note: the study indicated that 61.2% of women and 46.4% of men made one or more stops during their regular travel from work to home.

forty years and now represents a nodal region with a disperse population that shares a significant community of common interest.

4.2 Shifting Economic Patterns

Topography governs the location and concentration of population and economic development activity across the area as is typical in any nodal region. The road network, land use characteristics in general and historic settlement patterns tie the area together both economically and socially. At it's widest point, the Champlain Valley contains the central urban towns of Burlington, South Burlington and Winooski in Chittenden County. These cities are surrounded by the urban border towns of Colchester, Milton, Essex, Williston, Shelburne, and Charlotte. Surrounding these communities are the regions' peripheral towns which are more rural in character.

To the north of the core area lies the city of St. Albans in Franklin County. St. Albans is a trade and employment center for the surrounding towns of Franklin County. It has a rich history as a railroad center and a support center to surrounding agricultural activity. There is significant interaction between the St. Albans community and the northwest Vermont region's core communities. To the south of the core is the town of Middlebury and the City of Vergennes in Addison County. These two areas of population concentration within Addison County have strong ties to the core population and economic center of Chittenden County.

To the east of the core are the upland hills and valleys of the Champlain basin rivers. Here, too, the towns have had a history of declining significance as centers of employment and commerce. This is indicated when the respective town's employment is measured as a percent of total employment in the northwest Vermont region. Morrisville and Stowe in Lamoille County, and Barre and Montpelier in Washington County are upland towns located on waterways that historically provided easy access to power for the processing of agricultural, forest and natural resource products. But as employment and trade centers, relative to the northwest Vermont region, all of these towns have declined or remained stable in significance during the past forty years.

The increased concentration of economic activity in the northwest region's core and away from the periphery, has caused the surrounding rural towns to become increasingly dependent on the core for employment and services. Increasingly we see that as the Chittenden County core has grown, the county is increasingly a larger share of total economic activity drawing on the surrounding towns for labor supply and trade demand. And increasingly, the population makes its home on the rural fringe and commutes to work within the region's core and urban fringe towns. Table 1 shows the shifting significance of manufacturing and total employment in the northwest region since 1978.

Table 1. Selected Northwest Town Areas: Percentage of Northwest Employment Total and Manufacturing Employment: 1978-1998

Total Employment	1978	1980	1985	1990	1995	1998
Burlington Area Towns						
<i>Percent Total NW Emp</i>	55.5	56.6	57.9	61.2	61.8	61.8
Barre-Montpelier Area						
<i>Percent Total NW Emp</i>	22.2	21.3	20.4	20.2	19.9	19.3
Middlebury Area Towns						
<i>Percent Total NW Emp</i>	7.4	7.8	7.6	7.8	7.6	7.8
Morristown Area Towns						
<i>Percent Total NW Emp</i>	6.3	5.8	6.0	7.0	7.3	7.5
St. Albans						
<i>Percent Total NW Emp</i>	4.5	4.1	3.4	—	—	—
Swanton						
<i>Percent Total NW Emp</i>	1.0	1.0	0.9	—	—	—
Vergennes						
<i>Percent Total NW Emp</i>	1.6	1.9	1.8	1.6	1.2	1.4
Manufacturing Employment	1978	1980	1985	1990	1995	1998
Burlington Area Towns						
<i>Percent NW Manuf. Emp</i>	34.0	34.1	38.1	44.1	46.3	45.9
Barre-Montpelier Area						
<i>Percent NW Manuf. Emp</i>	31.7	32.5	29.0	30.3	27.6	27.9
Middlebury Area Towns						
<i>Percent NW Manuf. Emp</i>	10.9	10.6	10.3	10.7	11.2	11.0
Morristown Area Towns						
<i>Percent NW Manuf. Emp</i>	13.5	14.8	15.1	13.0	13.1	13.3
St. Albans						
<i>Percent NW Manuf. Emp</i>	3.2	3.9	4.2	—	—	—
Swanton						
<i>Percent NW Manuf. Emp</i>	2.6	2.8	1.9	—	—	—
Vergennes						
<i>Percent NW Manuf. Emp</i>	—	—	—	—	—	—

Notes:

Source: VT Dept. of Employment & Training, U.I. Covered Employment & Wages (ES-202) Reports 1978-1998. Burlington Area includes St. Albans and Swanton Towns starting in 1990, VT DET.

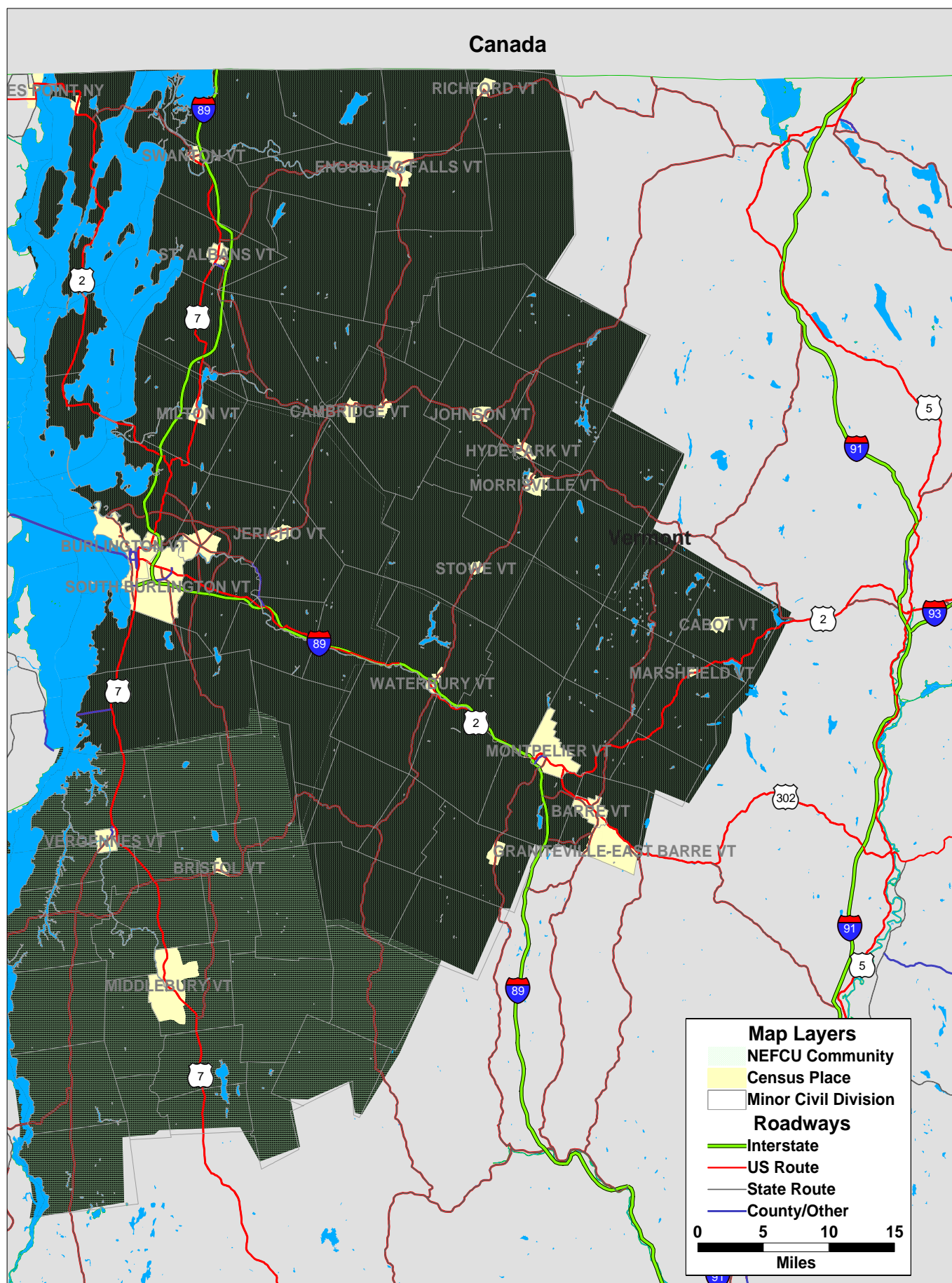
Prepared by Economic & Policy Resources, Inc. Williston, VT 05495

4.3 Transportation Network

Residents of the northwest Vermont region use the local road network for commuting to work, shopping, socializing, entertainment, and to access essential services. Through a combination of traffic flow and commuting data, it can be shown that the towns of the northwest region are linked and constitute a nodal region.

The northwest Vermont region is linked by an extensive network of primary and secondary transportation corridors (see Figure 2). As is true for many parts of the nation, these corridors consist entirely of roadways. There are no canals in Vermont and with the exception of some freight

Figure 2. Towns, Populated Places and Major Roadways - Northwest Vermont



traffic, railway usage is light. Intrastate air traffic is entirely non-commercial and sporadic.

As demonstrated by Figure 2, the principle transportation corridors of the six northwestern counties consist of: Interstate Highway 89, U.S. Route 7, and Vermont Routes 116, 115, 100, 15 and 22A. The one definitive trait of all these corridors is the increased traffic volume they all demonstrate as they approach Chittenden County.¹² This increasing volume indicates the destination for the vast majority of users of these roads is the region's core. The combination of these roadways' reach throughout the region and traffic flows, demonstrates the connection these towns have with the core and with each other.

Interstate 89 provides the major east-west connection in the northwest region. It links the Barre-Montpelier area on the eastern edge of the region to the Burlington area towns on the western edge. As can be seen in Figure 2, there are no major population or employment centers between these two points. The greatest average annual daily traffic flow (AADT) in Vermont is found along this segment of Interstate 89. Along the eastern part of this segment, between Barre-Montpelier and the intersection with Route 100, AADT is approximately 18,000 vehicles. Along the western segment, from the intersection with Route 100 and Burlington, AADT builds from approximately 22,000 vehicles near Montpelier to approximately 29,200 vehicles as Burlington is approached.

Interstate 89 also provides the single largest north-south connection in the region. It links St. Albans, a former agricultural and rail center, to the core towns of the region. As can be seen in Figure 2, there are no major population centers between these two points. AADT along this section of Interstate 89 builds from approximately 14,400 vehicles near St. Albans to approximately 28,500 as the core area is approached. Following Interstate 89, U.S. Route 7 provides the next largest transportation linkage in the northwest region. Route 7 predates the Interstate and historically was the state's predominant north-south connection. Also, unlike Interstate 89 it travels directly through the downtown or center of most towns along its path. Route 7 provides two north-south linkages for the region, Middlebury-Vergennes to the Greater Burlington area and St. Albans to the Greater Burlington area.

Route 7 also provides the region with a second major north-south linkage between St. Albans and Greater Burlington. For the most part, its path is parallel to Interstate 89. As with the north-south segment of Interstate 89, the traffic flow is decidedly into the region's core. AADT in Georgia, just south of St. Albans, is approximately 4,100 vehicles and this increases rapidly to approximately 9,400 vehicles as Greater Burlington is

¹² Vermont Agency of Transportation. 1998 Route Log Annual Daily Traffic Flow (AADT) Data.

approached.

In addition to the north-south linkage provided by Route 7, the northwest region is also linked north-south by secondary routes such as the Monkton Ridge Road and Route 116. Route 116 is a two lane road that originates in Middlebury-Vergennes and terminates in the core towns. It is supplemented by the Monkton Ridge Road, a narrow and lower grade roadway than Route 116, but one that provides a more direct route to the core for people traveling from Middlebury-Vergennes and beyond. Traffic along Route 116 increases from Middlebury-Vergennes to Bristol but then drops off until picking up again in Starksboro where it increases from less than 4,200 vehicles to approximately 9,200 vehicles in Hinesburg. North of Hinesburg traffic becomes divided between Route 116 and Route 2A, both of which direct vehicle traffic from the hinterland and urban fringe to the region's core.

The northwest Vermont region is also served by several roadways that are not directly connected to the core but rather serve as branches that funnel commuters into the main corridors. These "feeder" roadways include Routes 100, 115 and 22A. Route 100 is one of several two lane feeder roadways that provides the region with a north-south linkage both north and south of Interstate 89. It connects towns in the southwest and northwest portions of the region, such as Moretown, Waitsfield, Warren, and Granville in the southwest, and Eden, Hyde Park, Morristown, Stowe and Waterbury in the northwest, via Interstate 89, with the core.

The pattern of traffic flowing from the periphery towns into the core and amongst each other, can be reaffirmed with Journey to Work data from the 1990 Census. Part of the 1990 Census included questions regarding place of residence and place of work. For New England states, this data is available by town.

According to the Journey to Work data, the average time spent traveling to work, by persons residing in the northwest Vermont region, was approximately 20 minutes in 1990. Given the relatively minor traffic congestion of the region this travel time translates into significant distance. Figure 3, in conjunction with Figure 6, demonstrates the large portion of the regional population that is within a 15 minute to 30 minute driving span of the region's metropolitan core.

Table 2. Ranking of Towns According to Average Travel Time to Work (minutes)

<u>Town/City</u>	<u>Ave. Time</u>	<u>Town/City</u>	<u>Ave. Time</u>
Montpelier	19	Waterville	28
South Burlington	19	Bristol	29
Burlington	19	New Haven	29
Williston	20	Whiting	30
Middlebury	20	Wolcott	30
Berlin	20	Georgia	30
Winooski	20	Monkton	30
Barre City	21	Ripton	31
St. George	21	Enosburg	31
Weybridge	21	South Hero	31
St. Albans City	21	Hyde Park	31
Morristown	21	Ferrisburg	31
Essex	22	Cambridge	32
Colchester	22	Plainfield	32
Salisbury	23	Granville	32
Barre Town	23	Duxbury	32
Vergennes	23	Sheldon	33
Richford	23	Franklin	33
Waterbury	23	Bridport	33
Shelburne	24	Goshen	33
Stowe	24	Middlesex	34
Northfield	24	Calais	34
Warren	24	Westford	34
Richmond	25	Grand Isle	34
Leicester	25	Alburg	34
St. Albans Town	25	Belvidere	34
Johnson	25	Fairfax	35
Hancock	25	Worcester	35
East Montpelier	26	Addison	35
Panton	26	Underhill	35
Waltham	26	Marshfield	36
Jericho	27	Huntington	36
Fayston	27	North Hero	36
Roxbury	27	Elmore	36
Hinesburg	27	Orwell	37
Swanton	28	Lincoln	38
Charlotte	28	Eden	38
Moretown	28	Starksboro	38
Montgomery	28	Berkshire	38
Highgate	28	Woodbury	38
Cornwall	28	Fletcher	39
Waitsfield	28	Cabot	39
Milton	28	Bakersfield	40
Shoreham	28	Isle La Motte	42
Bolton	28	Fairfield	43

Source:

1990 Census, Journey to Work Data.

Prepared by Economic & Policy Resources, Inc. - Williston, VT 05494.

Examining the rankings of towns in the northwest Vermont region according to the average travel time to work reported for each town demonstrates a general pattern by which residents of towns in the core have the lowest travel times whereas those on the periphery have the highest travel times (see Table 2). This pattern indicates that residents' principle economic interaction—their employment—is not limited to the specific town in which they live. Rather, these peoples' interests interact with those of many other communities and especially with those of the region's core.

Using the average commuting time as a basis for comparison, the percent of each town's employed residents that travel 20 minutes or more to work was calculated. By limiting the analysis to persons commuting 20 minutes or more, those who do not travel outside their town of residence for work are excluded. Figure 4 shows the distribution of towns with employed residents who travel 20 minutes or more to work. The circle size represents the total amount of employed residents that commute 20 minutes or more to work. The largest circles are found outside the core, showing that considerable portions of these towns' employed residents commute 20 minutes or more to work. Of those residents that commute 20 minutes or more, the green portion of the circle denotes the portion that commutes to the core. Outside the core, more than half of these towns have 40% or more of their commuters who travel to the core for work.

Transportation data for the region provides clear evidence that common economic interests pervade residents of the six-county northwest Vermont region. Figure 3 provides a physical description of how region members' common economic and social interests bring them together on a daily basis. 1990 Census Journey to Work data, as summarized in Figure 3, shows the geographic extent and magnitude to which these common economic interests bind residents of the region.

In sum, residents of the northwest Vermont region share common interests that bring them together on a daily basis. These interests include powerful financial interests that bind residents of the region together. The region's roadways and subsequent traffic flows provide physical evidence that the region functions as a nodal region.

4.4 Population and Employment

In order to fully understand the socio-economic relationships among the towns of the northwest Vermont region, examination of the changes in population and employment patterns over time is necessary. As the northwest region becomes more integrated, population growth is fueled by economic growth in the central core area and expands outward from the core towards the secondary towns, as well as from the secondary towns

Figure 4. Commuting Patterns of Residents - Northwest Vermont

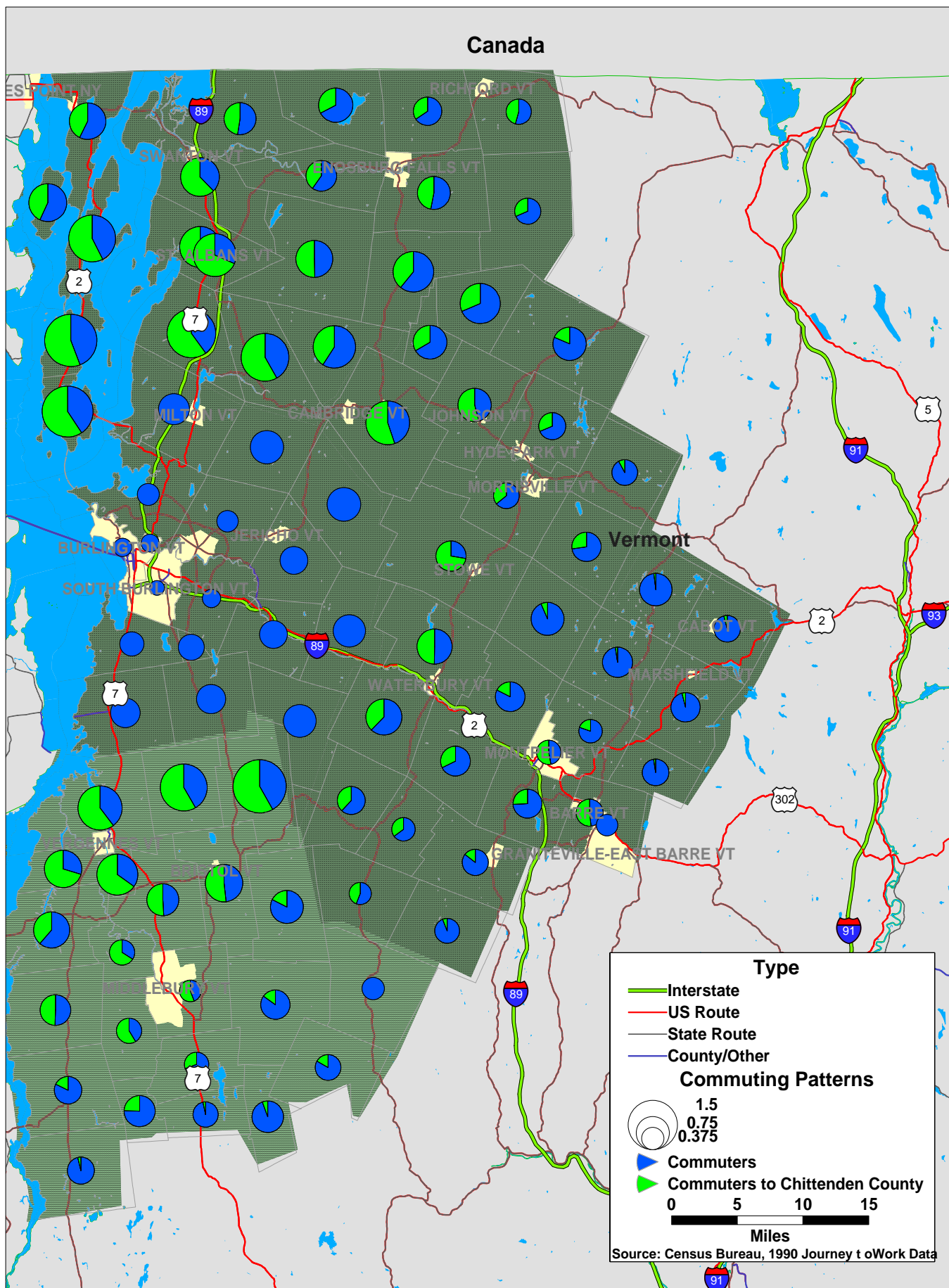
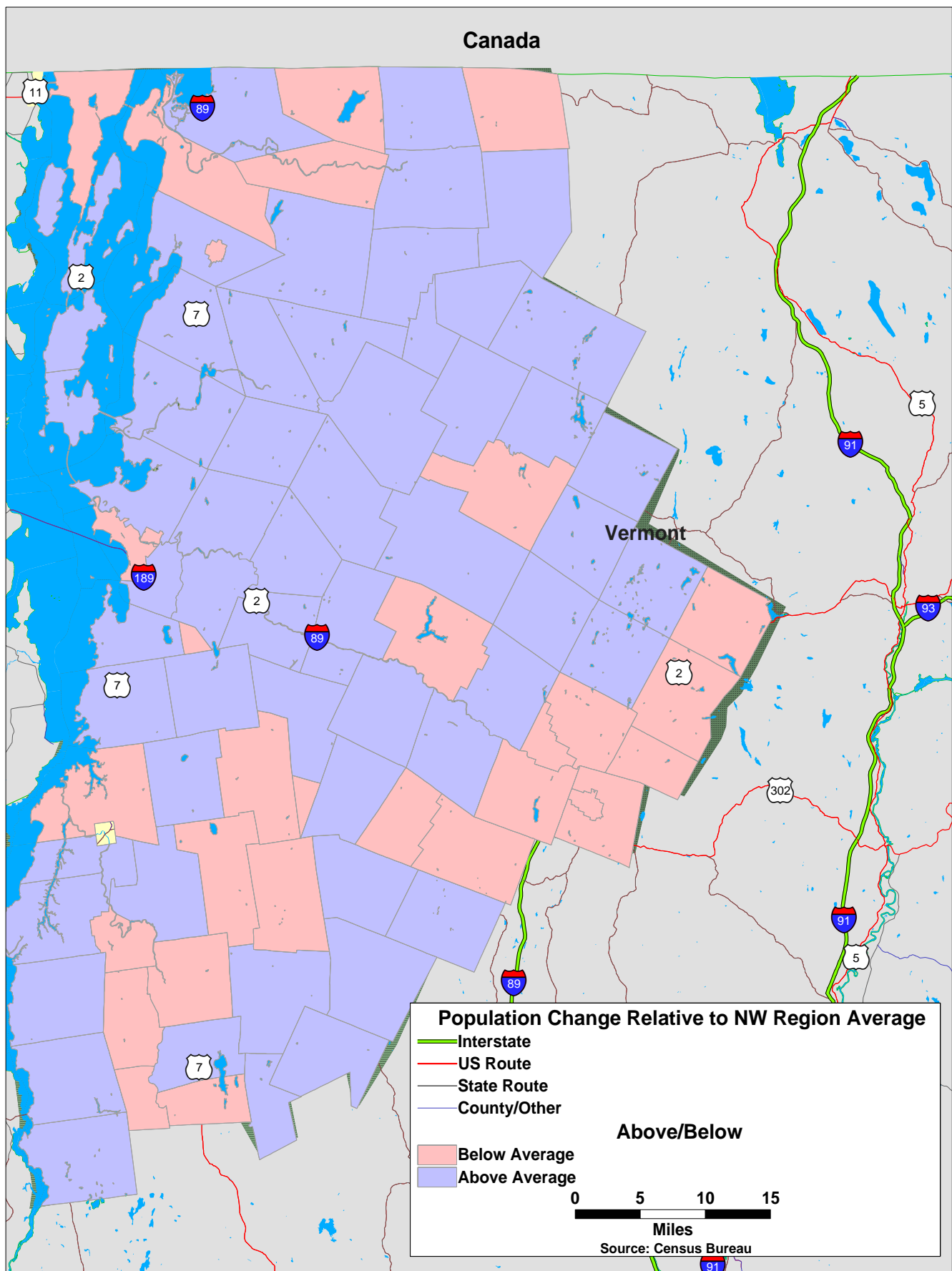


Figure 5. Population Change 1980 to 1998 - Northwest Vermont



back towards the central core area. As the population expands outward, these areas become more residential in nature and employment begins to concentrate around the central core and secondary towns. This phenomenon of centralizing employment leads to a shift in employment/residence patterns, where the central core and the secondary towns become net importers of jobs and the periphery becomes a net exporter of workers to those jobs. This pattern of concentrating employment in the central core while the population growth expands outward from the central core is evidence of the functional integration of a nodal region described by Hoover.¹³ This section describes the relationships and shifting patterns of population and employment witnessed in the northwest region from 1980 to 1998, emphasizing the linkages within the northwest Vermont region that define it to be a nodal region.

Examination of the changes in population and in the population growth rates from 1980 to 1998 is evidence of the growing integration among the towns within the northwest Vermont region. Analysis of population data from the Bureau of the Census reveals that the total population has grown an average 1.07% annually from 1980 to 1998. Upon examination of the growth in population of the individual towns in the six-county region, the differences among their growth rates is apparent. Figure 5 shows the towns that have grown faster than the annual average growth rate of 1.07% . As can be seen from Figure 5, these towns comprise the periphery radiating out from the central core area towards the secondary towns. This growth of population on the periphery of the central core area and the secondary towns is due to the rise in the residential population seeking traditional housing opportunities. This causes, in effect, the rise in 'bedroom' towns where there is very little employment actually within the town itself, as a greater and greater percentage of the population is employed outside their town of residence, yet within the northwest region.

Further evidence of this characteristic pattern of a nodal region can be seen in Figure 6. This population density map demonstrates the changes in density within the six-county area from 1980 to 1998. Whereas the areas with the highest population density were localized around the specific towns in 1980, in 1998 the densest population towns can be seen to form a continuous band that radiates out from the core towards the periphery and from the secondary towns towards the region's core.

These patterns of change in the population in the northwest region are also enabled by the major roadways in the region. The towns with the fastest population growth and the greatest population density follow along and radiate out from four major routes, which all converge in the core. These routes are: Interstate 89 running southeast and north of the core,

¹³ Hoover, Edgar M. 1975. *An Introduction to Regional Economics*, 2nd Edition, page 152.

Route 7 running north and south of the core, Route 15 running northeast of the core and Route 100 running north and south of Interstate 89. These roadway networks allow for the expansion of the residential population outward from the core into the periphery and towards the secondary towns and create the integration of the northwest region. This movement of population and the increasing density of population outward from the core towards the periphery demonstrates the linkages between the individual towns of the six-county region, one element that defines the region as a nodal region.

Conversely, as the population grows out from the region's core towards the periphery and secondary towns, employment becomes concentrated within the core. As with the patterns of population growth, this concentration of jobs is also found along the four major roadways radiating out from the central core towards the secondary towns and away from the secondary towns towards the central core. This trend of concentration of employment towards the core then becomes the complementary element to the movement of population patterns. These complementary elements, the shifting of population and employment, further define the northwest region as a nodal region.

To highlight the concentration of employment, differences among two series of employment data are examined. ES-202 employment data, which measures employment in establishments covered by unemployment insurance and the Local Area Unemployment Statistics (LAUS), which are data collected by the Current Population Survey. The major difference between these two series is that the ES-202 data is collected on a 'place of work' basis, while the LAUS series is collected on a 'place of residence' basis. Examining the differences between these two series highlights the relationship between where people work and where they live within the northwestern Vermont.

These two data series were compared for 1998 for all the towns located in the six northwestern counties. The difference between the two series was calculated and diagramed, as shown in Figure 7. As can be seen from the map, there are fifteen towns that can be considered 'job-importing' towns, as the employment by place of work is much greater than the employment by place of residence. The remaining seventy-six towns are then 'job-exporting' towns, as the employment by place of residence is much greater than the employment by place of work. The job-importing towns contain the bulk of the employment, while the job-exporting towns contain the bulk of the people who fill these positions. This pattern demonstrates the important place-of-work/place-of-residence linkage

Figure 6. Population Density 1980 and 1998 - Northwest Vermont

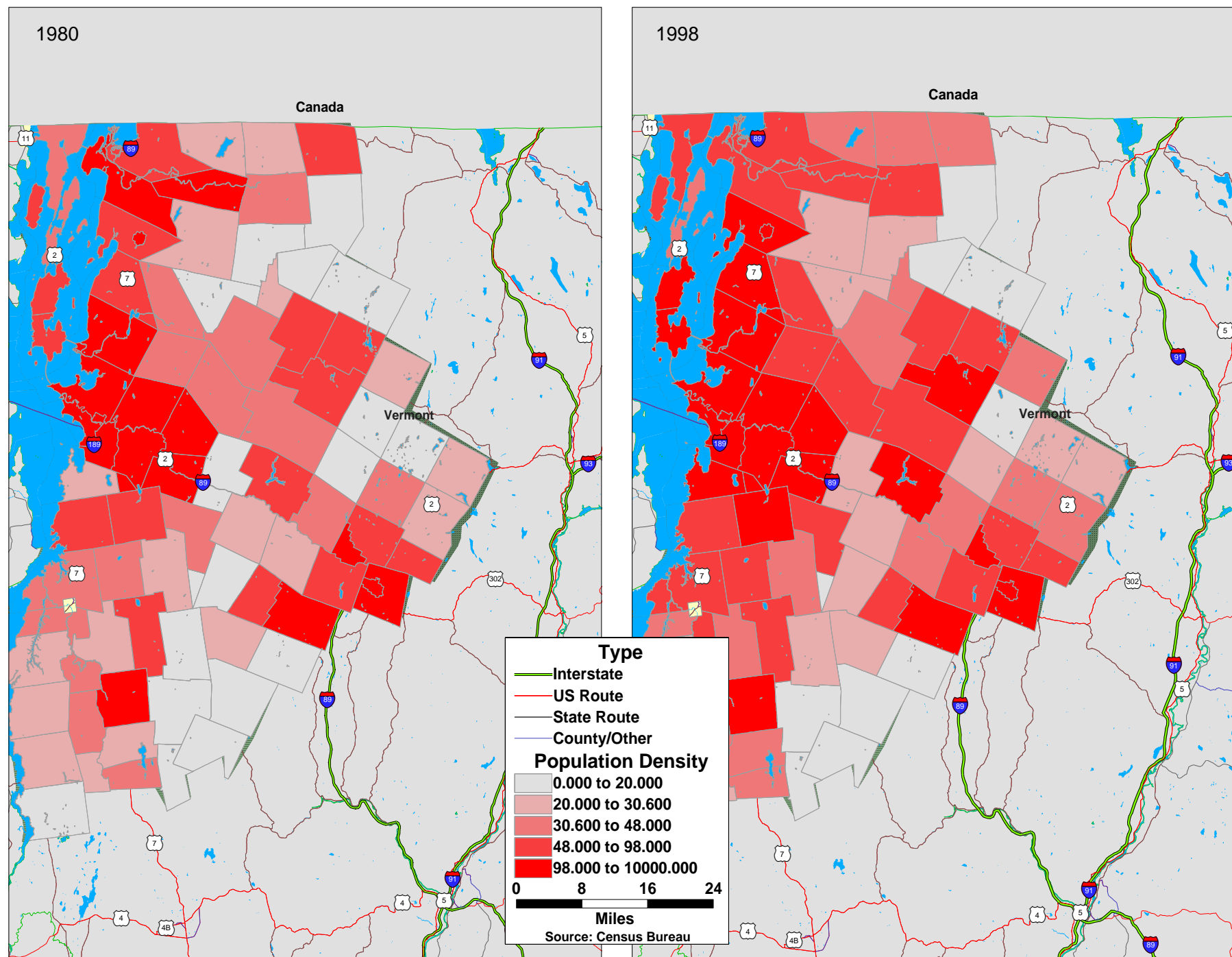
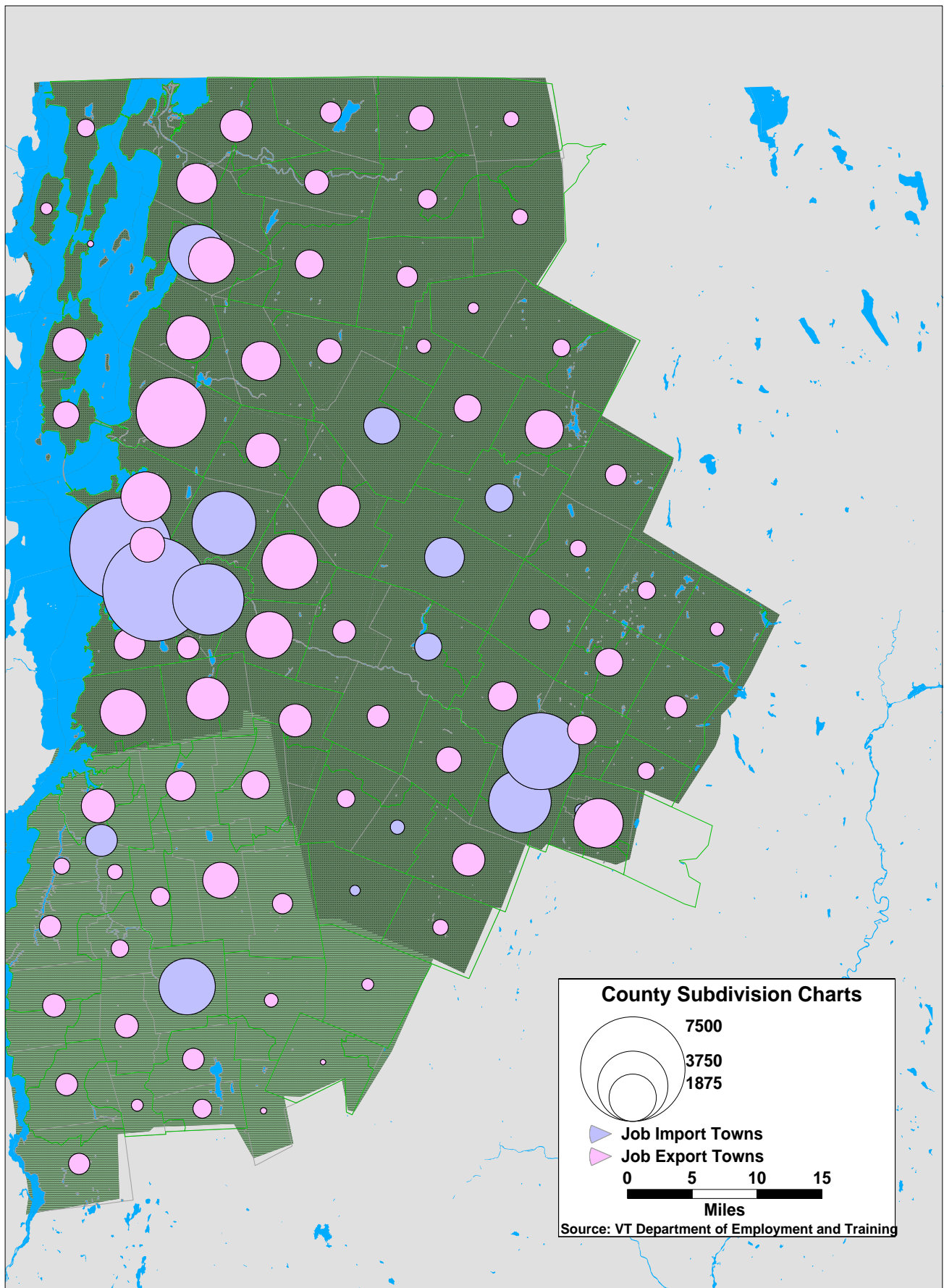


Figure 7. Job Import and Export Towns - Northwest Vermont



common to the population of the northwest Vermont towns.

The largest job-importing area is the central core area of the northwest Vermont region and, specifically, the more urban area of Chittenden County, which imports approximately 21,600 jobs. On the periphery of the northwest region are smaller job-importing areas. The eleven other job-importing towns collectively import approximately 16,300 workers.

This configuration of job-importing towns and job-exporting towns follows the same path as does the population density and employment concentration patterns. The largest job-importing area is the central urban area, where the majority of the region's employment is located. Pushing outwards are the towns that show the highest population growth and densities, which are also the areas that contain the job-exporting towns. Underlying these relationships is the access to residential towns from the central urban area and access to jobs in the central urban area from the residential towns along four major roadways of the northwest region, namely Interstate 89, Route 7, Route 15 and Route 100. The analysis of population and employment patterns described in this section corroborate Hoover's description of a nodal region which states:

A city and its surrounding commuting and trading area make a nodal region. The parts with the main concentration of business and employment are in sharp contrast to the residential areas, especially to the "bedroom suburbs," but they are tightly linked to them by flows of labor, goods, and services. Thus, the region is usefully considered as a unit in its reaction to changed conditions affecting economic growth and well-being. Neither core nor periphery can flourish without the other.¹⁴

Examination and analysis of the changing patterns of population and employment within the six northwestern counties demonstrates just such linkages. Employment has become concentrated within the central urban area, while the areas surrounding the central urban area has shown the largest growth in population since 1980. Evidence of the interdependence of the northwest region is further detected when observing the differences between job-importing areas and job-exporting areas. The central urban core imports employees from the periphery and the periphery supplies the necessary labor, thus, neither area can function fully without the other. Without the employees supplied by the periphery towns, the central urban area's capacity to operate is constrained, and conversely, without the central urban area's capacity to offer employment, the periphery is constrained economically. This interdependence is what defines northwestern Vermont as a nodal region.

The preponderance of evidence indicates that the six-county region of northwest Vermont is a nodal region. In geographic terms, what unites

¹⁴ Hoover, Edgar M. 1975. *An Introduction to Regional Economics*. 2nd Edition, page 154.

residents of the six counties is the region's core in Chittenden County. In economic terms, these people work in the same places and depend on the same factors for their livelihood. For the majority of people, these are found in the region's core. Residents of the six counties also use the same roads to shop at the same stores and travel to their employment, which are in the region's core.

5.0 Forecast Methods

The economic and demographic forecast for the six-county northwest region of Vermont was accomplished using a dynamic input-output model known as the REMI Policy Insight Model.¹⁵ The REMI model is constructed to estimate future levels of economic and demographic variables based on the historic mathematical relationships among these variables. This estimation is the baseline forecast for the northwest region, also known as the standard regional control. As the standard regional control of the REMI model is constructed using historical data from 1969-1997, further calibration was necessary to move from a near-term perspective to a long-term perspective in the forecast horizon. The calibration procedure consisted of incorporating recent known changes in the regional economy as well as incorporating the short-term official statewide economic forecast. Once the model was calibrated, the forecasted macroeconomic variables for the northwest region are obtained. Further details regarding the REMI model calibration can be found in Section 5.2.

To move from the northwest prospective to the Chittenden County perspective, two different forecasting methods were employed: a multiple-regression model called SPOP: Small Area Population Projection and general regression analysis.¹⁶ Further explanation of the methods used in projecting the Chittenden County variables can be found in Section 5.4.

The future demand for housing units in the northwest region was accomplished in a three-step process. First, the REMI model uses statistical information about the population's birth and death rates by age, and econometrically combines this information with the relationship between economic activity and migration patterns to produce age-specific population forecasts for the northwest Vermont region. Second, future levels of households were projected by applying household to population ratios developed from the 1990 Census to the REMI demographic forecast for the northwest region. Of principal interest is the rate of

¹⁵ Regional Economic Modeling, Inc., Amherst, Mass.

¹⁶ Gabbour, Iskandar. 1993. "SPOP: Small-Area Population Projection." In R.E. Klosterman, R.K. Brail and E.G. Bossard (eds) *Spreadsheet Models for Urban and Regional Analysis*. Center for Urban Policy Research, New Brunswick, New Jersey, pp. 69-84.

household formation of persons by age category. The population forecast is converted to households by applying the household formation rates by age category to the population forecast. Third, once the projected household levels are obtained, the number of households is translated into housing units using the relationship of households to housing units from the 1990 Census, and vacancy and destruction rates.

5.1 Forecast Horizon

This forecast perspective is from the year 2000 to the year 2035. In the near-term perspective (2000-2005) there is an assumption of the continuation of the current cyclical behavior observed in the economy when historical data are examined. However, when moving from the near-term to the long-term perspective, it becomes impossible to know the exact magnitude and timing of upcoming economic cycles. Therefore, long-term forecasts necessitate smoothing of the generally cyclical behavior of the economy out into the future. This smoothing is done by examining the general trends of the various macroeconomic variables in the past and results in a forecast which produces a long-term outlook that reflects the direction and magnitude of change, but will likely differ from actual annual results when viewed after the fact. This move from the near-term to the long-term forecast horizon is one reason for the calibration of the forecasting model discussed in the next section.

5.2 REMI Calibration for Northwest Forecast: 1997-2000

A standard regional control was obtained from REMI for the northwest region of Vermont. This standard regional control uses historical data from 1969-1997, from a variety of data sources, such as the Bureau of the Census, the Bureau of Labor Statistics and the Bureau of Economic Analysis. As 1997 is the last history year in the standard regional control, it was constructed prior to the period when IBM expanded its facility in 1999, the development of the first phase of the Husky Injection Molding Systems, Inc., U.S. manufacturing campus, and prior to the initiation of the IDX expansion project in late 1999. The actual and expected incremental employment and investment activity from these past and/or already permitted development projects was added to the REMI standard regional control to capture changes to the appropriate economic performance baseline for the six-county regional economy. Probability weights based on subjective judgement were assigned to the employment and payroll expansions for the Husky and IDX expansions to account for some risk that the actual implementation of these planned projects are delayed or downsized through the planning horizon.¹⁷

Along with the known changes occurring in the regional economy, the

¹⁷ The following probability weights were assigned. For IDX: 2001- 90%, 2002 - 90%, 2003 - 80%, 2004 - 70%, 2005 - 2010 - 70%. For Husky: 2002 - 90%, 2003 - 90%, 2004 - 2010 - 80%.

REMI standard regional control was adjusted to capture the most recent official Vermont state forecast, which is a five-year forecast reflecting the best available outlook for cyclical activity.¹⁸ That forecast can be characterized as a continuation of the most recent economic expansion but at a rate which is slower than that experienced during the most recent 24 to 36 month period.

5.3 Northwest Vermont Forecast

Table 3 shows the forecast for the macroeconomic variables for the six northwest counties in Vermont. Total employment is expected to grow by approximately 161,000 full and part-time jobs across the 2000 to 2035 forecast period, with the first ten years showing slightly higher average annual growth than the latter part of the forecast period, 1.8% and 1.4% respectively. While this level of growth might seem high, it is actually below the average annual rates of growth exhibited in the past. For example, between 1980 and 1990, employment grew on average 3.3% per year. However, the near-term forecasted employment is expected to grow slightly faster than from 1990 and 1997 where employment grew an average 1.6% per year.

Eighty-six percent of the growth in employment will be found in the non-manufacturing sector. The average annual growth of the non-manufacturing sector is expected to be higher than the manufacturing sector, both in the near-term and the long-term forecast horizon, 2.1% and 1.4%, and 1.6% and 1.2%, respectively. Non-manufacturing employment is expected to grow more slowly than in the past, 3.74% from 1980-1997, while manufacturing employment is expected to grow more quickly than in the recent past, 0.54% for the same time period. These rates of growth demonstrate that there will continue to be a shift in the region's economy away from the traditional manufacturing sectors into the non-manufacturing sectors as the non-manufacturing sectors are relatively larger than manufacturing.

The labor force is expected to add approximately 110,700 people over the forecast period. There is expected to be slightly higher growth in the near-term as compared to the balance of the forecast period, 1.6% and 1.3% respectively. As the population ages and people have less children, the growth in the labor force slows.

The difference in the growth rates for employment and the labor force figures indicate that tight labor market conditions are expected to continue

¹⁸ At the beginning of this forecasting procedure, the most current state forecast was the November 1999 New England Economic Project (NEEP) Outlook.

Table 3. Economic and Demographic Forecast - Northwest Vermont

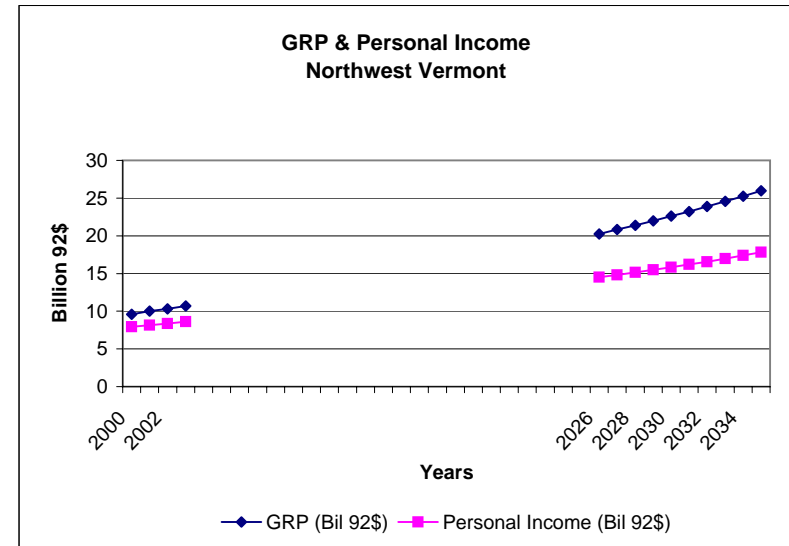
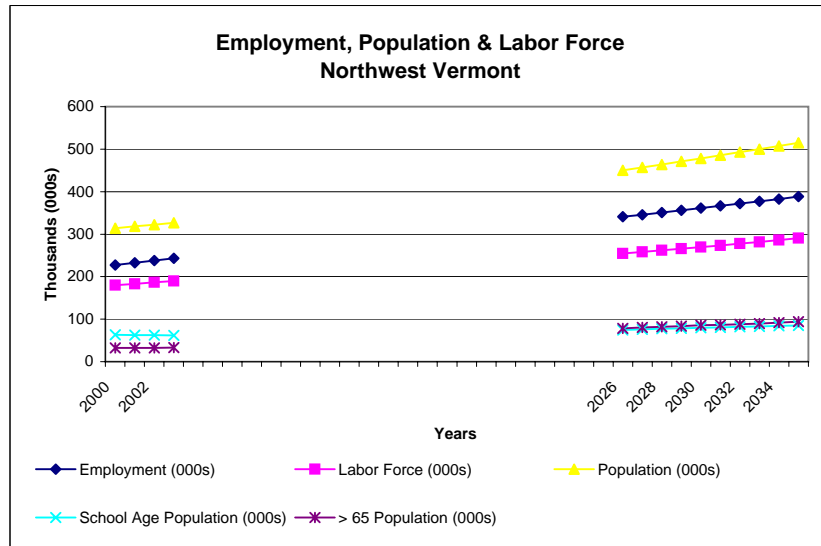
	History			Forecast								Absolute Change 00 - 35	CAA Change 00 - 10	CAA Change 10 - 35
	1980	1990	1997	2000	2005	2010	2015	2020	2025	2030	2035			
Employment (000s)	134.185	185.855	208.032	227.104	252.046	271.345	291.44	312.977	335.71	361.07	388.396	161.292	1.8%	1.4%
Manufacturing (000s)	25.081	26.428	27.485	30.72	33.44	35.35	37.66	40.04	42.26	44.79	47.531	16.811	1.4%	1.2%
Non-Manufacturing (000s)	79.63	127.441	148.61	163.3	184.77	201.74	218.74	237.08	256.8	278.73	302.324	139.024	2.1%	1.6%
Labor Force (000s)	123.003	155.89	169.545	179.583	196.522	209.704	221.42	235.208	250.93	269.64	290.245	110.662	1.6%	1.3%
GRP (Bil 92\$)	4.662	7.348	8.322	9.584	11.439	13.122	15.02	17.215	19.7	22.61	25.96	16.376	3.2%	2.8%
Personal Income (Bil 92\$)	4.092	5.973	6.990	7.92	9.04	10.3	11.31	12.68	14.19	15.84	17.84	9.92	2.7%	2.2%
Population (000s)	254.189	285.762	303.784	314.287	334.937	355.697	379.88	409.673	442.87	478.39	514.897	200.61	1.2%	1.5%
School Age Population (000s)	61.993	56.858	62.754	63.072	61.374	60.673	62.75	67.755	73.67	79.55	85.094	22.022	-0.4%	1.4%
> 65 Population (000s)	24.482	27.979	31.548	32.041	34.256	40.306	50.379	62.799	76.201	85.495	93.919	61.878	2.3%	3.4%
Housing Unit Demand (000s)	101.0	122.7	133.9	127.6	138.9	151.2	164.3	178.7	193.9	212.5	226.3	98.7	1.7%	1.6%

Notes:

[1] The Northwestern Vermont region includes the six counties of Addison, Chittenden, Franklin, Grand Isle, Lamoille and Washington.

[2] Long-term forecast results are obtained through simulations of economic activity in the region using the dynamic input-output model of Regional Economic Modeling, Inc. (REMI).

[3] CAA = Compound Annual Average Rate of Growth.



into the future. The change in employment and labor force levels also indicate the continued presence of multiple job-holders. The continued tight labor market conditions highlight that there will continue to be a shifting relationship between employees and employers: job training and retention factors will become even more important.

Economic activity as measured by real GRP is expected to increase by \$16 billion from \$9.6 billion in 2000 to \$26 billion in 2035. This increase breaks out into slightly higher average annual growth rates for the near-term than for the balance of the forecast period, 3.2% and 2.8%, respectively. These rates of growth are slightly lower than historic rates of growth in real GRP. Forty-four percent of the increase in real GRP is due to increased labor productivity, with per-worker productivity forecast to increase by 67% over the period.

Real personal income increases \$9.9 billion from \$7.9 billion in 2000 to \$17.8 billion in 2035. As with real GRP, growth is expected to be higher in the near-term as compared to the balance of the forecast period, 2.7% and 2.2%, respectively. The growth in real personal income is influenced by the increases in productivity and the shift in employment from manufacturing to non-manufacturing. Personal income is influenced by these changes through their effect on employment needs; the need for more highly trained employees in turn leads to higher incomes for those jobs. Personal income also includes proprietor's income, therefore, an increase in total personal income denotes an increase in the return on investment for proprietors.

The total population of the northwest region is expected to grow to almost 515,000 people over the forecast period. This represents an increase of approximately 200,000 people over the forecast period. Conversely from the previous variables, there is a slightly lower rate of growth in the near-term as compared to the balance of the forecast period, 1.2% and 1.5%, respectively. These rates of growth are slightly higher than seen historically. Between 1980 and 1990, population exhibited an average annual growth rate of 1.2% per year and between 1990 and 1997, that rate dropped to less than 1% per year. The growth of the population over the forecast period does not keep up with employment growth. This is due to the shift in demographics; the baby boomers age, families have less children and have children later in life. This difference in growth rate between population and employment is the cause for the lag in the growth of the labor force as compared to the growth in employment.

School-age population is expected to remain relatively flat through the forecast period. In the near-term, there is an actual decline in this segment of the population. The school age population then begins to show an increase in 2015, with the total increase for the period being approximately 22,000. The growth rates for school age population are

essentially mimicking the pattern seen in history - declines through the 1980's and then increasing again in the 1990's.

The greater-than-65 population is expected to grow by approximately 61,000 over the forecast period. The growth of this population segment is expected to be slightly lower in the near-term, 2.3%, over the long-term, 3.4%. As the bulk of the baby boomer population reaches 65 years old after 2010, this accounts for the higher growth in the latter part of the forecast period.

Housing unit demand is expected to increase approximately 98,700 units over the forecast period. This variable shows the same trend as employment and GRP, slightly higher rates of growth in the near-term, 1.7%, with the balance of the forecast period showing a slightly lower rate of growth, 1.6%. Smaller households, longer life expectancies and later marriages all combine to create a discontinuity in population and housing growth such that housing demand increases at rate which exceeds population growth.

5.4 The Chittenden County Perspective

While the REMI model is an effective tool for forecasting the northwest region of Vermont, it is not well-suited for forecasting at the level of a single county such as Chittenden County. This is due to the leakages that occur when attempting to use an economic region's input-output model to forecast for one segment of the economic region. The leakages cause the underlying economic and mathematical relationships to be invalidated. Therefore, alternative methods must be found to focus the northwest regional projections down to the Chittenden County level. When choosing the forecasting methods for Chittenden County and the sub-county regions used in this study, examination of the problems associated with different methodologies was examined, especially as to how these problems relate to forecasting for small areas.¹⁹ This research resulted in choosing two methodologies for the projection of the variables in the Chittenden county level: 1) a multiple-regression model: SPOP: Small Area Population Projection and, 2) general regression analysis.²⁰

The essential task for projecting at the Chittenden County and sub-county regional level is to allocate the appropriate shares from the northwest region forecast to Chittenden County, and then to allocate the appropriate shares of Chittenden County to the sub-county regions. The SPOP model is ideally suited for this type of analysis, as the model does not project absolute levels for smaller areas, but percentage shares of the small

¹⁹ For a list of the studies consulted, see Appendix B.

²⁰ For a discussion of the SPOP model, see Appendix C.

areas to a larger area. This is accomplished by projecting the total for a larger area and projecting the percentage share of that total for each of the smaller areas. This characteristic of projecting shares of sub-areas also allows for the model to be used for the projection of other variables, such as employment and housing demand.

The SPOP model is a multiple-regression spreadsheet model that uses 6 different regression functions to forecast the input variables. The set of 6 regression equations are used to find the equation that produces the best fitting line for each of the smaller area's data, which is historical. The best-fitting equation is chosen based upon the R^2 's for each equation in each area. The R^2 , or coefficient of determination, is a standard statistic used in examining the fit of an estimated line to the data points. Essentially, it is a ratio of the residuals, or errors due to the regression line to the total error within a data set. The closer the ratio is to 1, the better the estimated line fits the data set.²¹

While the SPOP model is a versatile and useful tool, it also has some constraints. For the model to function properly, it is necessary to have six data points, in evenly-spaced time periods. Due to the nature of three of the six functions contained within SPOP, it is possible to have data that do not allow the model to operate fully, for example, only three of the six equations will be fitted. While several years of data are available from the Bureau of Economic Analysis for use in the SPOP, there were data constraints involved with the operation of the SPOP model for some of the forecasted variables. Therefore, since the historical data was complete enough, general regression analysis was used for this series of projections. This methodology is actually what the SPOP model is based upon. Use of one equation at a time, however, allows for greater flexibility in the years of data used.

General regression analysis is a long-standing tool in econometrics and statistics. General regression analysis examines the relationship between a dependent variable and one or more independent variables. Once a relationship is established with a high degree of statistical significance, the estimated parameters can be used to forecast the levels of the dependent variable. For the purpose of this study, general regression analysis was done using the same principle as the SPOP model, namely the percentage shares of subsets of a larger set. As with the SPOP model, the best-fitting line is chosen based upon the R^2 's.²²

²¹ For a list of the R^2 's of all the forecasted variables, see Appendix D.

²² For a discussion of General Regression Analysis, see Appendix C.

6.0 Chittenden County Projections

As mentioned earlier, it is important to recognize that the projections presented here are prepared based on the historic relationships between economic and demographic variables specific to the study region. Accordingly, these forecasts represent likely future levels of population and housing demand given a continuation of historic and current relationships and patterns. For example, the forecasts capture very effectively demographic trends associated with a population getting older—fewer persons of school age, more persons over age 65, smaller households. However, the forecasts are not able to anticipate changes that may result through public policy decisions such as those related to the planning process for which these forecasts have been prepared. For example, a policy decision that impacts development densities across the fringe towns may alter the pattern of future population change and, therefore, change the parameters of the forecast producing future results which significantly differ from the forecast presented here. Additionally, no forecast method exists that is able to predict discontinuous events. A significant economic development event in northwest Vermont, such as the sudden loss or gain of a major employer, will alter the forecast parameters and lead to results differing from those presented here.

6.1 Chittenden County Population

The Chittenden County population forecast was obtained using the SPOP model to project the percentage share of the northwest region's population attributable to Chittenden County. The historical data used in this estimation was Chittenden County population as a percentage share of the northwest region's population for the Census years 1940-1990. The projected shares were then applied to the northwest forecasted population to produce the results for Chittenden County shown in Table 4.

The Chittenden County population is expected to increase approximately 103,000 over the forecast period. This represents approximately 51% of the total population growth for the northwest region. The percentage of growth seen in Chittenden County population in the forecast time period is slightly smaller than the percentage of the growth experienced by Chittenden County between 1960-1990, which was approximately 55%. This follows the pattern of development seen in the northwest region as a whole. As the core of the region, Chittenden County, begins to become denser in population, the population spreads out into the surrounding counties. So even though Chittenden County will continue to see the major portion of the population growth in the northwest region, the surrounding counties begin to gain percentage points of the population growth. As Chittenden County continues to see the majority of the population growth, the share of Chittenden County population as a percentage of the total northwest population continues the trend seen

between 1960 and 1990, albeit at a much slower rate. In 1960, Chittenden County represented 41.2% of the total northwest population and by 1990 that percentage had climbed to 46.3%. By the end of the forecast period, Chittenden County population is expected to represent approximately 48.7% of the total northwest population.

There is slightly higher growth in the long-term period (2010-2035), an average annual growth rate of 1.6% per year, than in the near-term period (2000-2010), an average annual growth rate of 1.4% per year. These growth rates are slightly above the average annual growth seen between 1980-1990 and 1990-1997 of 1.3% per year and 1.04% per year, respectively. However, these growth rates are below the average annual rate of growth experienced by Chittenden County between 1960-1990, 1.9% per year.

6.2 Chittenden County's Sub-County Regional Population

In order to see the pattern of distribution of the Chittenden County population projections around the county, the county was broken out into three sub-county regions.²³ Those sub-county regions are as follows.

Region 1: Burlington, South Burlington and Winooski

Region 2: Colchester, Essex and Williston

Region 3: Bolton, Buel's Gore, Charlotte, Hinesburg, Huntington, Jericho
Richmond, Shelburne, St. George, Underhill and Westford.

The sub-county regional population forecasts were obtained using general regression analysis. Shares of each sub-county region's population as a percent of the total Chittenden County population were projected using equations estimated with general regression analysis, then the projected shares were applied to the projected Chittenden County population obtained in Section 6.1. An additional component to this estimation involved the use of the projected shares for each sub-county region's population in 2000. This component was achieved by using the Census estimates from 1990 to 1998 for each sub-county region and projecting the sub-county region's 2000 population based on the growth rates from the Census 1990-1998 estimates. This procedure is akin to the calibrations made to the REMI model to account for the known changes in recent past for each sub-county region that are not captured in the 1990 Census. For example, it is known that the population of some individual towns in Chittenden County have experienced significant growth since the 1990 Census. Incorporating these known factors allows for a truer picture on which the projections can be based. The projected population for each sub-county region is shown in Table 4.

²³ For member communities' informational purposes, town forecasts were developed and are presented in Appendix E.

Table 4. Chittenden County and Chittenden County Sub-Regional Population Forecast

	History			Forecast								Absolute Change 00-35	CAA Change 00-10	CAA Change 10-35
	1980	1990	1997	2000	2005	2010	2015	2020	2025	2030	2035			
Population (000s)	115.534	131.761	141.618	148.295	158.998	169.76	182.176	197.324	214.171	232.212	250.798	102.503	1.4%	1.6%
Chittenden County Sub-Regions Population (000s)														
Region 1	54.709	58.585	59.124	61.453	62.82	63.762	65.037	66.893	68.899	70.861	72.556	11.103	0.4%	0.5%
Region 2	30.864	36.116	40.628	42.783	47.334	51.896	57.021	63.144	69.927	77.205	84.795	42.012	1.9%	2.0%
Region 3	29.961	37.06	41.806	44.058	48.844	54.103	60.118	67.287	75.345	84.146	93.447	49.389	2.1%	2.2%

Notes:

[1] Chittenden County Sub-Regions:

Region 1: Burlington, South Burlington, Winooski

Region 2: Colchester, Essex, Williston

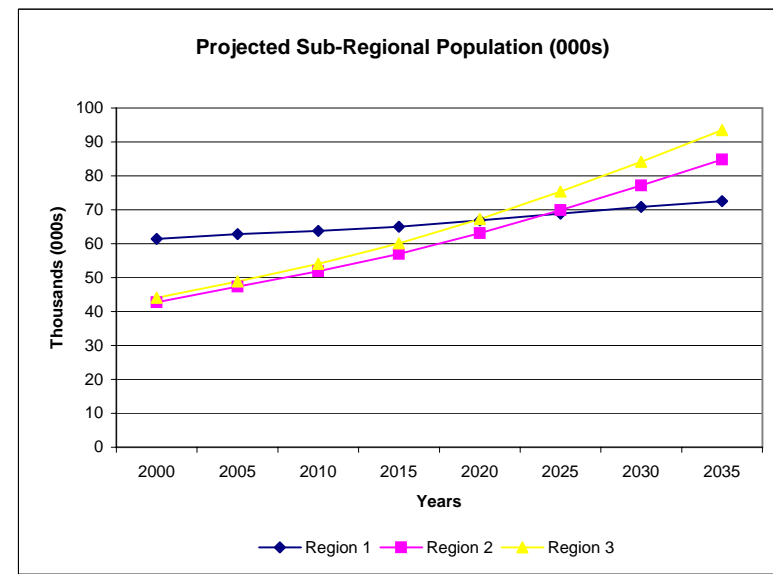
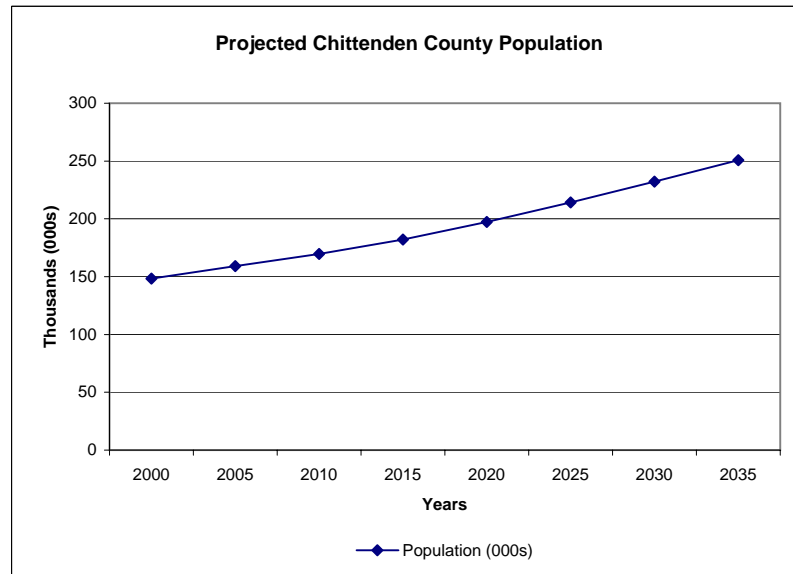
Region 3: Bolton/Huntington/Buel's Gore/Underhill, Charlotte, Hinesburg/St. George, Jericho, Milton, Richmond, Shelburne, Westford

[2] Chittenden County and Sub-Regional 1997 population data obtained from the Bureau of the Census Estimates Series.

[3] Differences in the totals of the sub-regions and Chittenden County due to rounding.

[4] Long-term forecast results obtained from SPOP population forecasting model and General Regression Analysis.

[5] CAA = Compound Annual Average Rate of Growth



Region 1 is expected to have the smallest increase in population, in absolute terms, approximately 11,000 over the forecast period. This number represents the addition of approximately 317 people per year to the sub-county region as a whole. As with the total Chittenden County population forecast, Region 1 is expected to show a lower average annual growth rate in the near-term versus the long-term forecast period, 0.4 and 0.5%, respectively. This is slightly below the average annual growth rate seen between 1980 and 1990 of 0.69%, although it is above the average annual growth rate seen between 1990 and 1997 of 0.13% per year. These rates of growth are approximately the same as the rates of growth seen between 1960 and 1990, 0.54% per year. These rates of growth demonstrate that as a whole, this region is expected to grow more slowly than the surrounding towns. This pattern mimics the pattern seen when looking at Chittenden County in relation to the northwest region. As the urban core builds in population density, the population moves out to the surrounding towns.

Region 2 is expected to add approximately 42,000 people over the forecast period. This represents an increase of approximately 1,200 people per year for the sub-county region as a whole. For this region as well, average annual growth is expected to be slightly lower in the near-term forecast period as compared to the long-term forecast period, 1.9% per year and 2.0% per year, respectively. These rates of growth are above the rates of growth seen between 1980 and 1990, 1.6% per year, and between 1990 and 1997, 1.7% per year. These rates of growth are significantly lower than the rate of growth seen between 1960 and 1990, 3.9% per year. As the population base becomes larger, the annual population growth becomes a smaller and smaller percent of the total. Between 1960 and 1990, this region experienced an almost tripling of their population.

Region 3's population is expected to grow by over 49,000 over the forecast period, the largest of the three sub-county regions. This represents yearly additions of approximately 1,400 people. It is important to note here that this sub-county region represents twelve individual towns, whereas the other two sub-county regions represent six towns combined. This region is also expected to show slightly slower growth in the near-term, 2.1% per year, than over the long-term, 2.2% per year. These rates are comparable to the rates of growth seen between 1980 and 1990, 1.98% per year and between 1990 and 1997, 2.15% per year. While these rates might seem high, they are actually below the average annual rate of growth experienced by this region between 1960 and 1990, 4.0% per year. This region saw a more than three-fold increase in the population between 1960 and 1990.

6.3 Chittenden County Employment

To project the employment levels for Chittenden County, a combination of

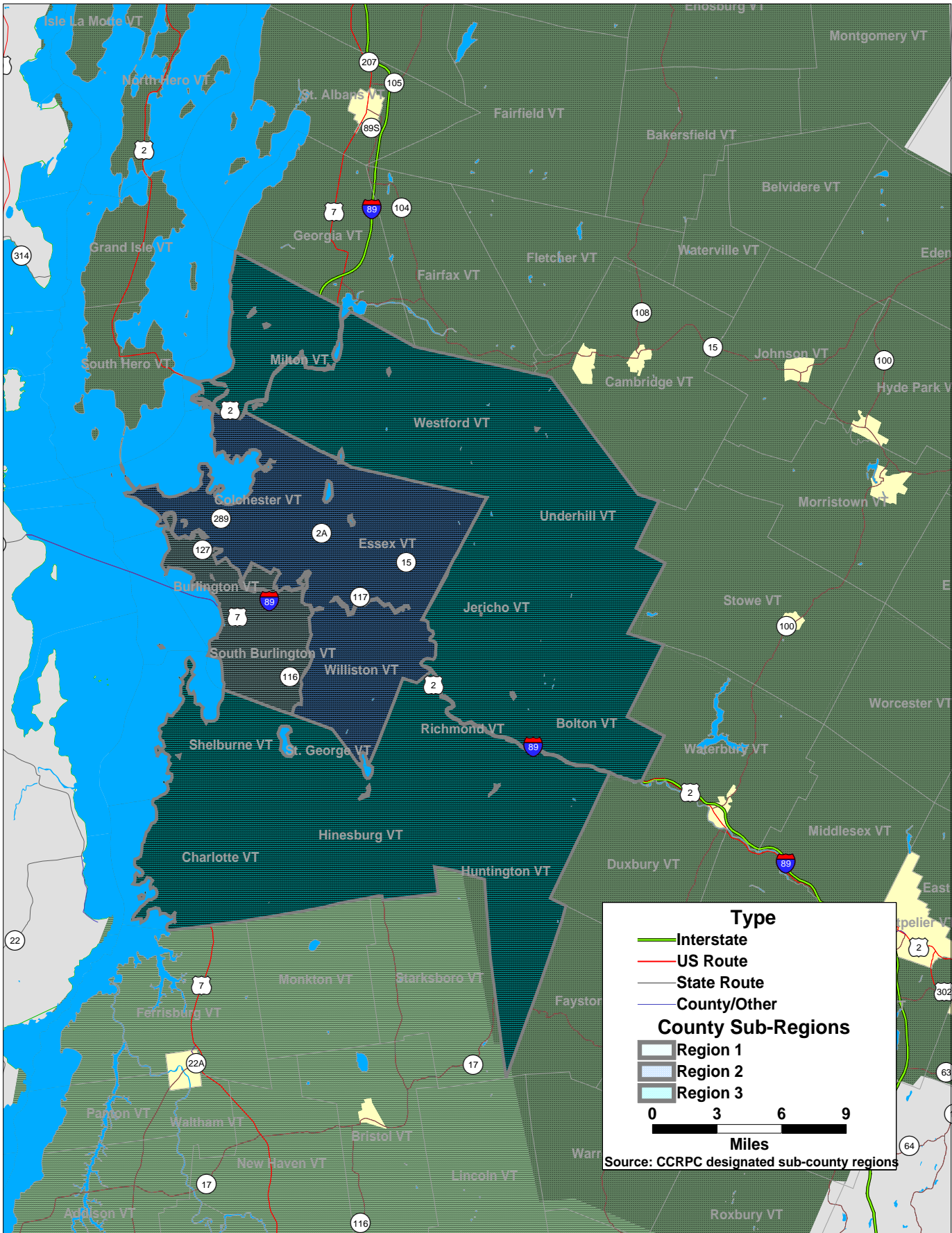
the SPOP model and general regression analysis was employed. First, the Chittenden County shares of the major sectors: Non-Manufacturing, Government and Farm, were projected using the SPOP model. The historical data series used in this estimation was the Bureau of Economic Analysis' (BEA) full-and part-time employment data for 1982-1997. This series was used as it corresponds to the concept of employment found in the REMI model. The employment variable here is defined as a total establishment job count, in other words, all the jobs, both full-and part-time, by place of work are counted. It is important to use the same concept of employment in the estimation process, so that distortions between different definitions of employment do not arise. The years 1982 through 1997 were chosen specifically to capture two business cycles in the economy, rather than attempting to project from either a trough or a peak in a business cycle. For the projection of the Government sector, BEA employment from 1970 to 1997 was used as the 1982-1997 data did not yield statistically reliable results.

For each of the employment sectors, the proportion of Chittenden County employment as a percent of the northwest Vermont region's employment were projected, then the projected shares were applied to the projected employment for the northwest region. Manufacturing employment, however, has shown such variability and volatility in the past, that neither SPOP nor general regression analysis yielded statistically reliable results. Therefore, Manufacturing employment has been calculated as a residual from total employment by subtracting the other forecasted employment sectors, Non-Manufacturing, Government and Farm, from total employment.

The next step was to estimate the 1-digit employment sectors within Non-Manufacturing. Again, BEA's employment data for the years 1982-1997 was used. Transportation and Public Utilities was estimated using the SPOP model, Agricultural Services, Forestry and Fishing, Services, Finance, Insurance and Real Estate, Retail and Wholesale Trade were estimated using general regression analysis. The Mining and Construction sector data were too variable and volatile to yield any statistically reliable results with either estimation method, so this sector is calculated as a residual from the total Non-Manufacturing sector. The employment projections for Chittenden County are shown in Table 5.

Total employment is expected to increase by approximately 98,000 over the forecast period. Employment is expected to grow an average of 2.0% per year in the near-term forecast period and then slow to an average of 1.6% per year in the long-term forecast period. This is slightly below the rate of growth seen between 1980 and 1990, 4.0% per year, but the near-term rate of growth is slightly above the rate of growth seen between 1990 and 1997, 1.7% per year, and the long-term growth is slightly below this rate. Chittenden County total employment has seen the majority of the

Figure 8. Chittenden County Sub-Regions



employment for the northwest region since 1982, when Chittenden County employment was 51.2% of the total northwest employment. By 1997, that share had risen to 53.8%. This trend is expected to continue over the forecast period, with Chittenden County employment becoming 57.3% of the total northwest employment by the end of the forecast period. This trend is also demonstrated in Table 1, which shows the increasing concentration of employment within Chittenden County and away from the surrounding counties of the northwest region.

Approximately 86% of the growth in employment is expected to be in the Non-Manufacturing sector, with the addition of approximately 85,000 full- and part-time jobs over the forecast period. Not surprisingly, the average annual rate of growth is expected to be higher in the near-term forecast period over the long-term forecast period, 2.3% and 1.7% per year, respectively. This trend of an increasing shift towards the Non-Manufacturing sector is the same for Chittenden County as it is for the northwest region.

While the Manufacturing sector has seen some drastic changes over the historic period, 1982-1997, employment in this sector is expected to continue to grow over the forecast period, adding approximately 10,000 jobs. The average annual rate of growth is expected to be slightly higher near-term forecast period as compared to the long-term forecast period, 1.4% and 1.2% per year. These rates of growth are higher than the rates of growth seen between 1980-1990 and 1990-1997, 0.9% and 0.1% per year, respectively. Manufacturing employment was severely affected by the recession of the late 1980's and early 1990's and has only in the last five years begun to rebound from it.

The Government sector is expected to increase by almost 3,600 over the forecast period. The rates of growth for the near-term forecast period and the long-term forecast period are extremely close to the same, 0.6% and 0.7% per year, respectively. These rates of growth are higher than the rate of growth between 1990-1997, 0.2% per year, yet significantly lower than the rate of growth seen between 1980-1990, 2.2% per year.

Farm employment in Chittenden County is expected to continue its historic trend of decreasing employment. Over the forecast period, Farm employment is expected to decrease by approximately 300 jobs. The rate of decline is expected to be slightly lower in the near-term forecast period as compared to the long-term forecast period, -2.1% and -2.4% per year, respectively. These rates of decline are lower, however, than the rates of decline seen between 1980-1990, -4.2% per year, and between 1990-1997, -2.8% per year. Joint pressures affect this sector. First, as the average wage earned by farmers continues to be below that of other sectors, people move out of farming and into other sector employment. Second, the economic and population development of the county affects

the ability for farmland to stay open. The best farming land is also the best building land.

Within the Non-Manufacturing sector, Services employment is where the majority of the increase is expected to fall. Services employment is expected to grow by almost 52,000 jobs, or almost 61% of the increase in Non-Manufacturing employment. As with Non-Manufacturing employment, the average annual growth rate in Services employment is expected to be higher in the near-term forecast period as compared to the long-term forecast period, 2.8% and 2.0% per year, respectively. While the absolute increase in Services employment might seem high, the growth rates are actually significantly below the rates of growth seen between 1980-1990 and 1990-1997, 6.4% and 3.7% per year, respectively.

The Retail Trade sector is expected to have the second largest gain in employment, approximately 12,000 jobs added over the forecast period. Here as well, the near-term forecast period is expected to grow at a faster rate than the long-term period, 1.6% and 1.3% per year, respectively. These rates of growth are much lower than the rate of growth seen between 1980-1990, 4.7% per year, but higher than the rate of growth seen between 1990-1997, 1.1% per year.

Wholesale Trade, on the other hand, is only expected to see a modest increase in employment over the forecast period, approximately 1,100 jobs. Most of this growth is expected to be in the near-term forecast period with average annual growth of 1.7% per year. This is significantly lower than the 1980-1990 rate of growth, 4.6% per year, but the same as the rate of growth seen between 1990-1997. The long-term forecast period is expected to only see an average annual rate of growth of 0.1% per year.

The Agricultural Services, Forestry and Fishing sector is expected to show the highest rates of growth over the forecast period, however, this can be misleading. The actual projected employment gain is only 1,600 jobs over the forecast period. As this sector is so small, even modest gains show up as a sizable growth rate. The sector grew more than three times from 1980-1997, with growth rates of 10.22% per year between 1980-1990 and 4.3% per year between 1990-1997. The near-term forecast period is expected to grow by 3.3% per year and the long-term forecast period by 2.3% per year. Most of the growth will likely be in the landscaping and horticultural services sectors, due to the growth in development that have accompanying landscaping needs.

Transportation and Public Utilities is expected to add approximately 3,600 jobs over the forecast period. In this sector, however, the near-term forecast period is expected to grow at a slightly slower rate than the long-

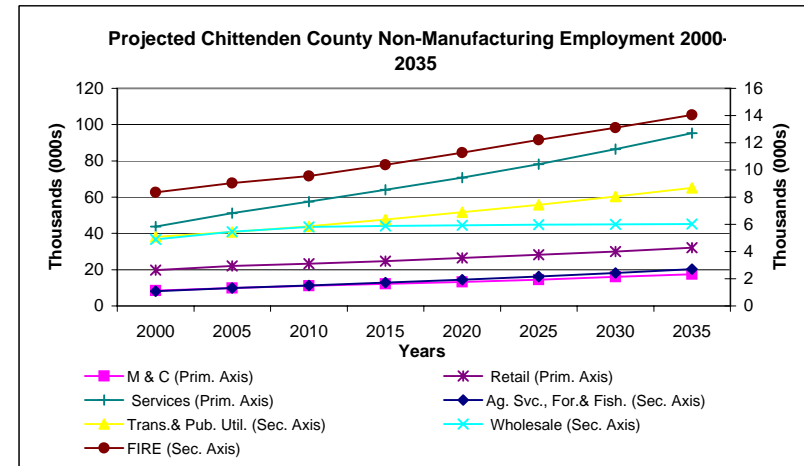
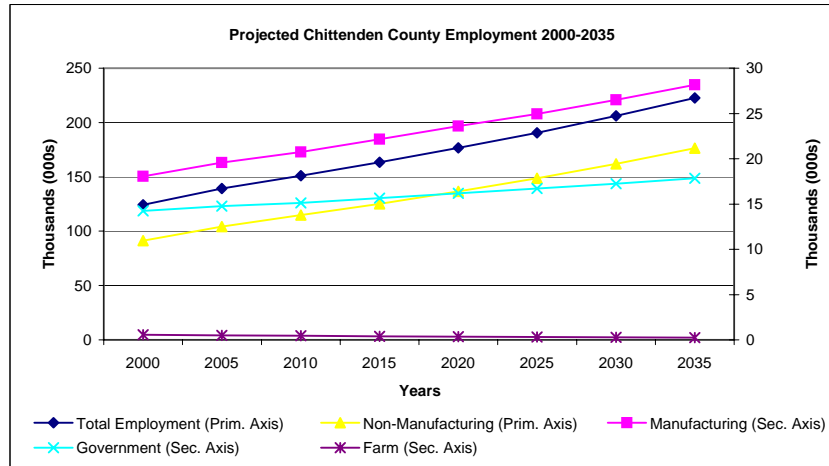
Table 5. Chittenden County Employment Forecast

	History			Forecast								Absolute	CAA	CAA
	1980	1990	1997	2000	2005	2010	2015	2020	2025	2030	2035	Change	Change	Change
												00-35	00-10	10-35
Total Employment	67.239	99.676	111.920	124.203	139.205	151.112	163.466	176.676	190.583	206.027	222.629	98.425	2.0%	1.6%
Manufacturing	15.041	16.396	16.520	18.048	19.585	20.755	22.145	23.597	24.957	26.497	28.168	10.120	1.4%	1.2%
Non-Manufacturing	40.415	69.258	81.378	91.364	104.339	114.791	125.272	136.534	148.611	161.997	176.376	85.012	2.3%	1.7%
Agricultural Services, Forestry & Fishing	0.268	0.709	0.952	1.090	1.314	1.512	1.719	1.938	2.169	2.423	2.696	1.606	3.3%	2.3%
Mining & Construction	4.079	6.367	6.797	8.426	9.877	11.113	12.109	13.255	14.503	15.971	17.511	9.086	2.8%	1.8%
Transportation & Public Utilities	2.621	4.020	4.840	5.081	5.429	5.864	6.352	6.884	7.441	8.045	8.690	3.609	1.4%	1.6%
Wholesale Trade	2.801	4.389	4.942	4.905	5.460	5.822	5.880	5.933	5.965	6.002	6.034	1.129	1.7%	0.1%
Retail Trade	10.751	17.019	18.416	19.836	22.004	23.329	24.775	26.429	28.161	30.057	32.072	12.235	1.6%	1.3%
Finance, Insurance & Real Estate	4.079	7.335	7.540	8.348	9.024	9.565	10.379	11.266	12.205	13.096	14.038	5.689	1.4%	1.5%
Services	15.816	29.419	37.891	43.677	51.232	57.586	64.058	70.831	78.166	86.402	95.336	51.658	2.8%	2.0%
Government	10.635	13.272	13.409	14.223	14.773	15.108	15.644	16.185	16.697	17.251	17.836	3.613	0.6%	0.7%
Farm	1.148	0.750	0.613	0.568	0.507	0.458	0.406	0.359	0.318	0.281	0.248	-0.320	-2.1%	-2.4%

Notes:

[1] Chittenden County employment forecast obtained using the SPOP model, except for the Non-Manufacturing sectors which were obtained using general regression analysis.

[2] CAA = Compound Annual Average Rate of Growth.



term forecast period, 1.4% and 1.6% per year, respectively. These rates of growth are significantly lower than the rates of growth seen between 1980-1990, 4.4% per year and 1990-1997, 2.7% per year.

Finance, Insurance and Real Estate is expected to show fairly steady growth over the forecast period, adding approximately 5,700 jobs. The near-term and long-term forecast periods show very similar rates of growth, 1.4% and 1.5% per year, respectively. These rates of growth are significantly below the growth rate seen between 1980-1990, 6.0% per year, yet significantly higher than the growth rate seen between 1990-1997, 0.4% per year.

Mining and Construction is expected to add approximately 9,000 jobs over the forecast period. The near-term forecast period is expected to grow more quickly than the long-term forecast period, 2.8% and 1.8% per year, respectively. These growth rates are significantly lower than the growth rate seen between 1980-1990, 4.6% per year, yet significantly higher than between 1990-1997, .9% per year. The Mining and Construction sector is notably variable, as it follows the general health of the economy. During the boom period of the 1980's, Mining and Construction grew significantly, then suffered sharp setbacks with the recession that followed. As the economic cycle has again begun to climb, Mining and Construction has followed by showing gains in employment.

6.4 Chittenden County Housing Demand

The housing demand figures projected in this section of the study differ from the housing unit demand projected for the northwest region. The figures reported in this section of the study are essentially the number of projected households, which gives a much broader sense of the housing demand than housing unit demand. Housing unit demand differs from housing demand in that factors such as multiple households living in single units, vacancy rates, and annual unit destruction rates are not considered. Reliable data to convert overall housing demand to a more specific housing unit demand concept for the county was not available.

The housing demand for Chittenden County was estimated using the general regression analysis to forecast the shares of Chittenden County as a percent of the northwest region's housing demand. The data used for this estimation is Census data, 1950-1990, Chittenden County households and the northwest region households. Once the projected shares of Chittenden County are obtained, then they are applied to the projected housing demand for the northwest region. The projected Chittenden County housing demand is shown in Table 6.

Housing demand is expected to increase by approximately 53,000 over the forecast period. As the total population of Chittenden County shows a slightly lower rate of growth in the near-term forecast period, 1.4% per

year, the housing demand for Chittenden County shows a slightly higher rate of growth in this time period, 2.0% per year. The situation is then reversed for the long-term forecast period, with population showing a slightly higher rate of growth, 1.6% per year, and the housing demand showing a slightly lower rate of growth, 1.8% per year. This phenomenon is consistent with the demographic changes in the population, i.e. the aging of the population, children of the baby boomers becoming adults and starting households, people stay in their housing longer, and with the lagged effects of the housing market to economic and demographic changes. As the economy turned around in the latter part of the 1990's, the increases in employment generate an increase in the demand for housing. However, this demand cannot be filled instantaneously, so the growth in housing demand continues to be higher in the near-term forecast period. Housing demand continues to grow as the population ages and people stay in their housing longer. However, as the near-term forecast period moves into the long-term forecast period, a large part of the population (the baby boomers) will no longer need their housing and the population growth rate decreases, thus resulting in a lower rate of growth in housing demand.

Table 6. Projected Chittenden County Housing Demand

History	Projected Housing Demand (000s)
1980	38.528
1990	48.439
Forecast	
2000	58.955
2005	65.015
2010	71.609
2015	78.613
2020	86.386
2025	94.629
2030	103.325
2035	112.287
Abs. Change	53.332
CAA Chge 00-10	2.0%
CAA Chge 10-35	1.8%

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6.5 Chittenden County Projections: 2100

While a long-term view is always advantageous to the planning procedure, projection of Chittenden County population, employment and housing demand to 2100 can not be considered without a great deal of caution. Projections to a time horizon that exceed the amount of data with which to forecast can be problematic, as the margin of error increases as the time horizon lengthens. Therefore, to estimate Chittenden County population, employment and housing, examination of the long-term trends in population and relationship between population, employment and housing demand was necessary.

In order to create the most complete picture possible, an examination of the trend in population in Chittenden County from 1970 to 2035 was undertaken. By using general regression analysis, a line was fit to the data and the resulting equation of that line is used to project Chittenden County population for 2050, 2075 and 2100, shown in Table 7. Again, this projection should be viewed with extreme caution, as there are many factors that influence population over such a distant time horizon. Changes in fertility, natality and mortality rates, and other discontinuous and unforeseen occurrences are not factored into the projection. In other words, given the past and no changes in any factors that affect population growth, these are the estimates of what direction Chittenden County population might be headed in.

To estimate employment and housing demand, examination of the relationship between population and employment and population and housing demand is examined. The ratio of population to employment is steady through the 2000-2035 period. Given the population level from 2035 to 2100, employment is then calculated from there by applying the ratio to population. Housing demand is calculated in the same manner.

Table 7. Chittenden County Population and Employment:2050, 2075 and 2100

	2035	2050	2075	2100	CAA Change 2035-2100
Population (000s)	250.798	306.946	424.797	568.288	1.26%
Employment (000s)	222.629	276.252	382.318	511.459	1.29%
Housing Demand (000s)	112.287	131.679	182.238	243.796	1.20%

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7.0 Conclusion

As the Chittenden County Regional Planning Commission moves forward in the development of an updated Regional Plan, an understanding of population, employment and housing demand in Chittenden County is vital. Developing appropriate policies to influence future outcomes is dependent upon this understanding, not only for CCRPC, but its member communities.

In order to estimate what the future holds for Chittenden County, it is necessary to examine the economic and demographic patterns at a broader, regional level. The six northwestern counties of Vermont have become increasingly interrelated and interdependent as economic activity creates ever-stronger linkages within the region. As the core of the region, Chittenden County is expected to experience growth in population density connected to the concentration of employment. This increased population begins to disperse into the surrounding areas in search of traditional housing opportunities. Therefore, a forecast of the northwest region is developed in order to lend the context for the Chittenden County forecast.

Employment in the region is expected to grow by approximately 161,000 full-and part-time jobs over the forecast period. The labor force is expected to grow, but not as fast as employment, indicating a continuation of tight labor market conditions. Real GRP is expected to increase by \$16 billion, with 44% of the increase due to increases in productivity. Total population is expected to grow to almost 515,000, which represents slightly higher growth than over the 1980-1997 period.

Chittenden County will continue to see the majority of the population and employment growth, with employment increasing by approximately 98,000 and population increasing by approximately 103,000 over the forecast period. The majority of the increase in employment will be in the Non-Manufacturing sector, which demonstrates the continuation of the historic shift in employment patterns. Services will continue to gain the largest share of Non-Manufacturing employment. As employment and population increase, so does the demand for housing, which is expected to increase by approximately 53,000 over the forecast period.

As the population continues to grow, growth is expected to be larger in Chittenden County sub-county regions 2 and 3 than in sub-county region 1. As this urban core area of Chittenden County experiences higher population densities, the surrounding municipalities experience population growth in response to people's preferences in housing opportunities.

As with any long-range forecast, it is important to recognize that the basis of the forecast which distributes population and employment across the

northwest Vermont region is historical patterns. Therefore, the projections in this study have an underlying assumption of the continuation of the underlying elements which are expressed in historic patterns. These projections cannot foresee discontinuous changes in technology or the economic operating environment that could cause changes in structure or direction of the relevant variables. That being said, the projections in this study demonstrate that the conflicting needs of economic development and population growth are not likely to be reduced in the future.

Appendices

Appendix A: The REMI Model

Appendix B: Forecast Methodology Bibliography

Appendix C: General Regression Analysis and The SPOP Model

Appendix D: Statistical Notes

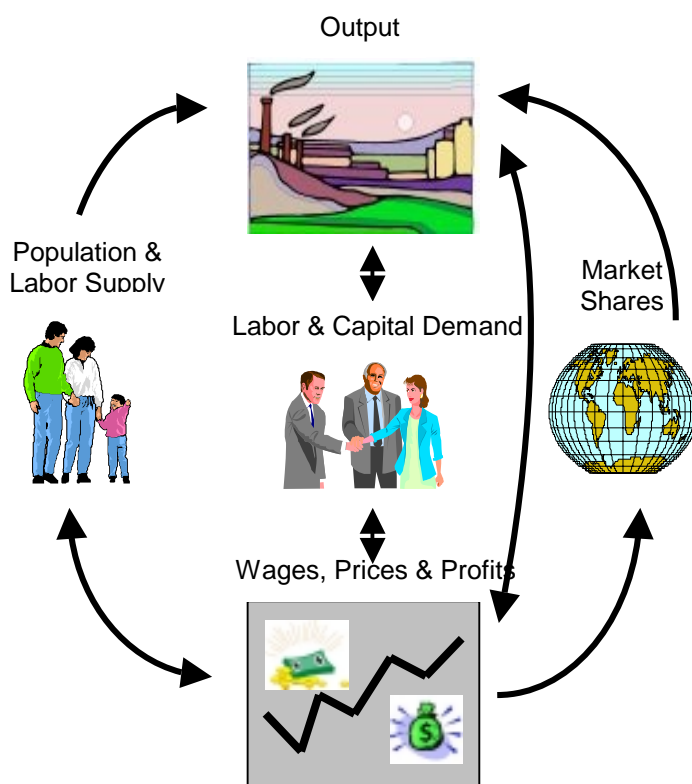
Appendix E: Town Estimates

Appendix A: The REMI Model

The REMI model is a structural model, meaning that it clearly includes cause-and-effect relationships. The model shares two key underlying assumptions with mainstream economic theory: *households maximize utility and producers maximize profits.*

In the model, businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside the region. The output is produced using labor, capital, fuel and intermediate inputs. The demand for labor, capital and fuel per unit output depends on their relative costs, since an increase in the price of any one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects the population size. People will move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Figure 9. Model Overview



Supply and demand for labor in the model determines the wage rates. These wage rates, along with other prices and productivity, determine the cost of doing business for every industry in the model. An increase in the cost of doing business causes either an increase in price or a cut in profits, depending on the market supplied by local firms. This market share combined with the demand described above determines the amount of local input. Of course, the model has many

other feedbacks. For example, changes in wages and employment impact income and consumption, while economic expansion changes investment and population growth impacts government spending.

Figure 9 is a pictorial representation of the model. The Output block shows a factory that sells to all the sectors of final demand as well as to other industries. The Labor and Capital Demand block shows how labor and capital requirements depend on both output and their relative costs. Population and Labor Supply are shown as contributing to demand and wage determination in the product and labor market. The feedback from this market shows that economic migrants respond to labor market conditions. Demand and supply interact in the Wage, Price and Profit block. Once prices and profits are established, they determine market shares, which along with components of demand, determine output.

The REMI model brings together all of the above elements to determine the value of each of the variables in the model for each year in the baseline forecasts. The model includes all the inter-industry relationships that are in an input-output model in the Output block, but goes well beyond the input-output model by including the relationships in all of the other blocks shown in Figure 9.

In order to broaden the model in this way, it was necessary to estimate key relationships. This was accomplished by using extensive data sets covering all areas of the country. These large data sets and two decades of research effort have enabled REMI to simultaneously maintain a theoretically sound model structure and build a model based on all the relevant data available.

The model has strong dynamic properties, which means that it forecasts not only what will happen, but when it will happen. This results in long-term predictions that have general equilibrium properties. This means that the long-term properties of general equilibrium models are preserved without sacrificing the accuracy of event timing predictions and without simply taking elasticity estimates from secondary sources.

Understanding the Model

In order to understand how the model works, it is critical to know how the key variables in the model interact with one another and how policy changes are introduced into the model. To introduce a policy change, begin by formulating a policy question. Next, select a baseline forecast that uses the baseline assumptions about the external policy variables and then generate an alternative forecast using an external variable set that

includes changes in the external values, which are effected by the policy issue.

Figure 10 shows how this process would work for a policy change called Policy X.

In order to understand the major elements in the model and their interactions. Subsequent sections examine the various blocks and their important variable types, along with their relationships to each other and to other variables in the other blocks. The only variables discussed are those that interact with each other in the model.

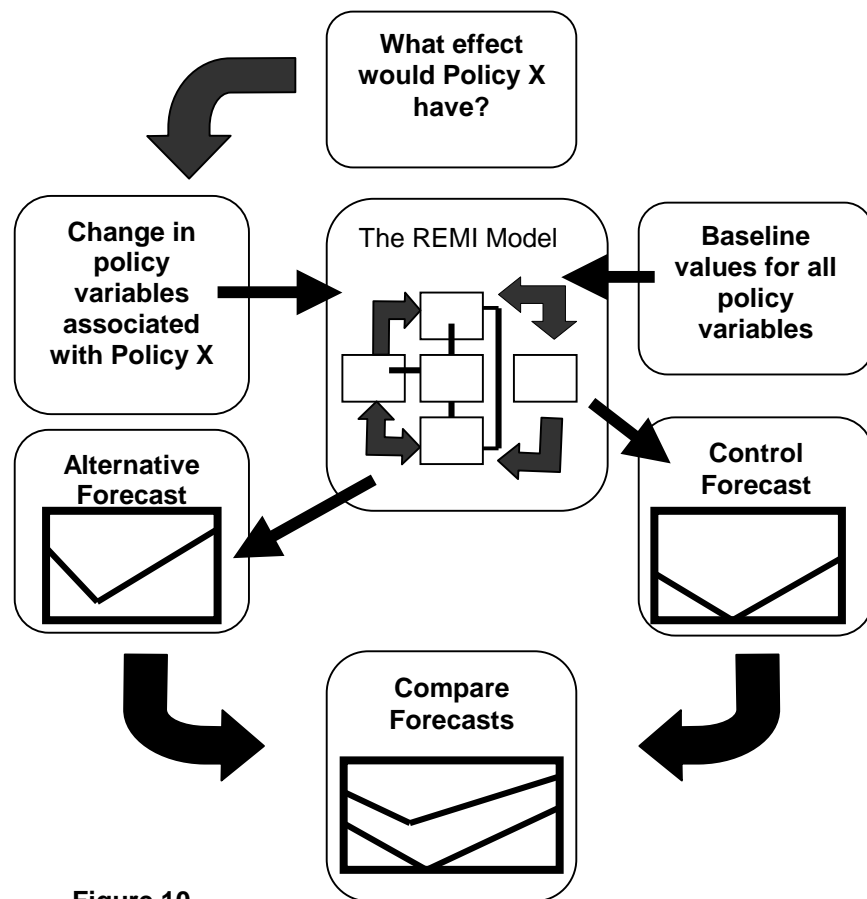


Figure 10

Variables determined outside of the model include:

- Variables determined in the U.S. and world economy (e.g., demand for computers).
- Variables that may change and affect the local area, but over which the local area has no control (e.g., an increase in international migration).
- Variables that are under control of local policy (e.g., local tax rates).

For simplicity, the last two categories are called policy variables. Changes in these variables are automatically entered directly into the appropriate place in the model structure. Therefore, the diagram showing the model structure also serves as a guide to the organization of the policy variables (see Figure 11).

Output Block

The Output Block variables are:

- State and Local Government Spending
- Investment
- Exports
- Consumption
- Real Disposable Income

These variables interact with each other to determine output and also depend on variable values determined in other blocks as follows:

Variable in Output Block	Variables Outside of the Output Block that are Included in its Determinants
State and Local Government Spending	Population
Investment	Optimal Capital Stock (also the actual capital stock)
Output	Share of Local Market (The proportion of local demand supplied locally, called the Regional Purchase Coefficient)
Exports	The Regional Share of Interregional and International Trade
Real Disposable Income	Employment, Wage Rates and the Consumer Expenditure Index

Labor and Capital Demand Block

The Labor and Capital Demand block has only three types of key variables:

- Employment – determined by the labor/output ratio and the output in each industry, determined in the Output block.
- Optimal Capital Stock – depends on relative labor, capital and fuel costs and the amount of employment.
- Labor/Output Ratio – depends on relative labor, capital and fuel costs.

Simply put, if the cost of labor increases to the cost of capital, the labor per unit of output falls and the capital per unit of labor increases.

Population and Labor Supply Block

The model predicts population for 600 cohorts segmented by age, ethnicity and gender. This block also calculates the demographic processes – births, deaths and aging. The models deals with different population sectors as follows:

- Retired Migrants are based on past patterns for each age cohort 65 and over.
- International migrants follow past regional distributions by country of origin.
- Military and college populations are treated as special populations that do not follow normal demographic processes.
- Economic migrants are those who are sensitive to changes in quality of life and relative economic conditions in the regional economies. The economic variables that change economic migration are employment opportunity and real after-tax wage rates.

This block allows a determination of the size of the labor force by predicting the labor force participation rates for age, ethnicity and gender cohorts, which are then applied to their respective cohorts and summed. The key variables that change participation rates within the model are the ratio of employment to the relevant population (labor market tightness) and the real after-tax wage rates.

Wage, Price and Profit Block

Variables contained within the Wage, Price and Profit block are:

- Employment Opportunity
- Wage Rate
- Production Costs
- Housing Price
- Consumer Price Deflator
- Real Wage Rate
- Industry Sales Price
- Profitability

The wage rate is determined by employment opportunity and changes in employment demand by occupation for occupations that require lengthy training. The housing price increases when population density increases. The Consumer Expenditure Price Index is based on relative commodity

prices, weighted by their share of US nominal person consumption expenditures. The model uses the price index to calculate the real after-tax wage rate for potential migrants that includes housing price directly, while the price index used to deflate local income uses the local sales price of construction.

Wage rates affect production costs, as well as other costs, and they in turn determine profitability or sales prices, depending on whether the type of industry involved serves mainly local or external markets. For example, a cost increase for all local grocery stores results in an increase in their prices, while an increase in costs for a motor vehicle factory reduces its profitability of production at that facility by may not increase their prices worldwide.

Market Shares Block

The Market Shares Block consists of:

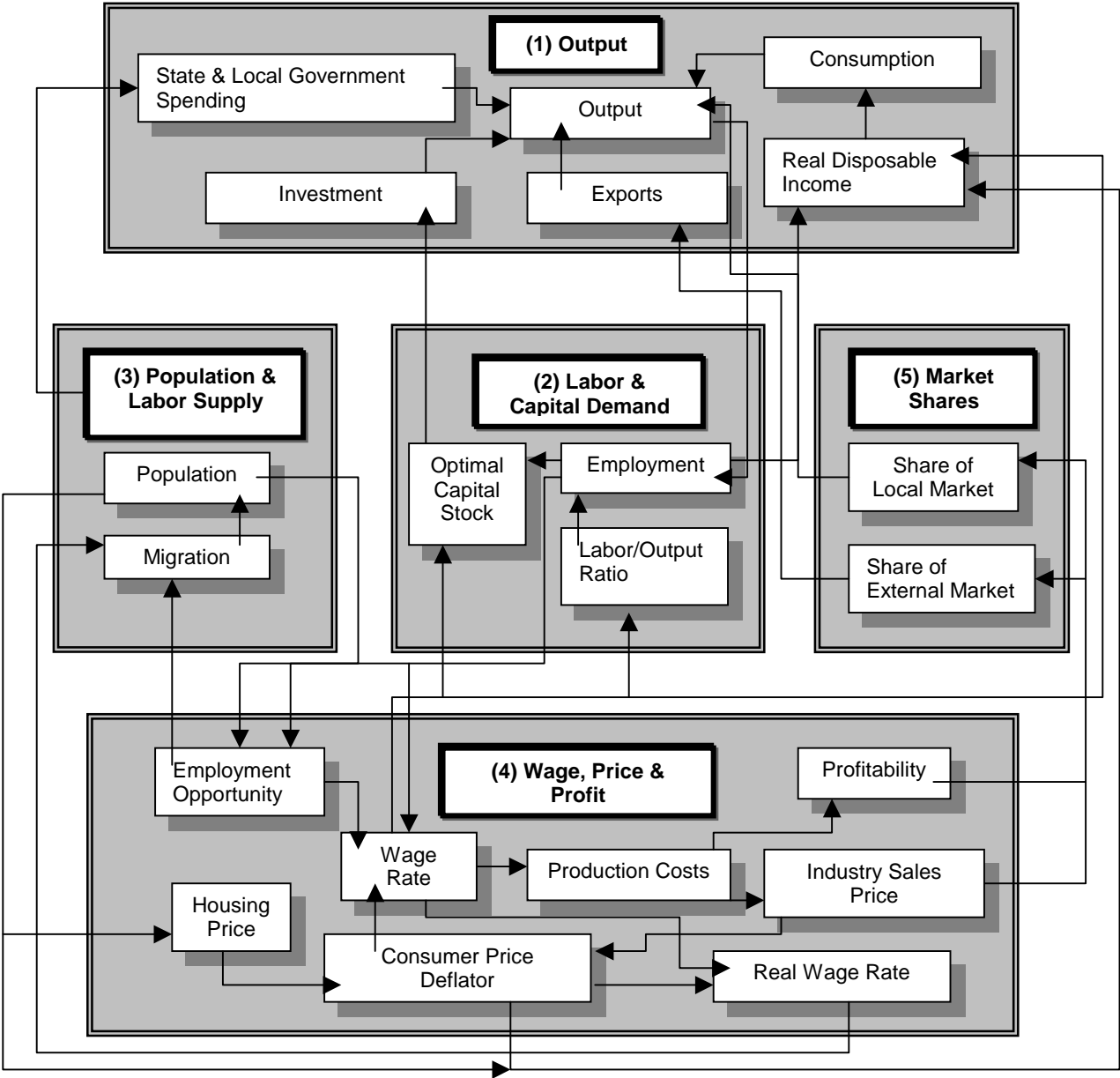
- Share of Local Market
- Share of External Market

An increase in prices leads to some substitution away from local suppliers towards external suppliers. Also, a reduction in profitability for local factories leads to less expansion of these factories relative to those located in areas where profits have not decreased. These responses occur because the US is an open economy where firms can move to the area that is most advantageous for their business.

The Total Model

Figure 11 illustrates the total model and its components and linkages. This diagram is helpful in order to understand the complex relationships shared by variables within the various blocks discussed above, as well as their relationship to variables in other blocks.

Figure 11. The Total REMI Model



Appendix B: Forecast Methodology Bibliography

These studies were consulted as part of the research into the issues in forecasting methodology. The central issue in forecasting concerns accuracy, accuracy in the actual forecast and accuracy differences among methods. The general conclusion from this research is that:

- There is no empirical evidence that supports the theory that complex forecasting models are more accurate than simpler models
- Forecast accuracy is impacted by the length of the forecast horizon and the length of the base period used to forecast from
- Size and growth rates of areas also impact forecast accuracy. Large, slow-growing areas tend to show less error than small, fast-growing areas.

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Appendix C: General Regression Analysis and The SPOP Model: Small Area Population Projection

The following appendix is intended to give the reader a more comprehensive explanation of the general regression analysis and SPOP model used in estimating Chittenden County population and employment projections from 2000-2035.

General Regression Analysis

General regression analysis is a common tool used by economists and statisticians and is the basis for the SPOP model. This tool examines the relationship between a dependent variable and one or more independent, or explanatory variables. More specifically, general regression analysis examines the *mathematical* relationship between the dependent and independent variables. The mathematical relationship is represented by the equation for the line that best fits the data. The equation is determined by a mathematical procedure known as *ordinary least squares method*.²⁴

The basic principle of the ordinary least squares method is to estimate a line that minimizes the sum of the squared errors of the line. The error is defined as the numerical distance from the expected or predicted value given by the equation and the actual, observed value of the data. The standard equation for a simple, two variable regression function is:

$$Y = \beta_0 + \beta_1 x$$

where β_0 is a constant or the intercept of the line and β_1 is the slope of the line. If a line could be computed that would exactly hit every data point, then the equation for the line could be computed exactly. This, however, is not the case in reality. A line must be found then, that fits the data as best as possible. This is how error is introduced into the equation. Since there will always be some deviation of the predicted values of Y and the observed values of Y , an accounting of this error must be made in the estimation of the equation. The equation for the line then becomes:

$$Y = \beta_0 + \beta_1 x + e_i$$

The method of ordinary least squares then determines the equation for the line that minimizes the sum of the squared errors. The errors are squared and summed, rather than just summed, because the values of

²⁴ Gujarati, Damodar. 1999. *Essentials of Econometrics*. 2nd Edition. Irwin/McGraw-Hill, pp. 123-144.

the unsquared errors sums to zero. This is due to some of the error terms being larger than the observed values and some error terms being smaller than the observed values.

The arithmetic procedure for determining the values of β_0 and β_1 that yield the best-fitting line are:

$$\beta_0 = \bar{Y} - \beta_1 \bar{X}$$

and

$$\beta_1 = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sum (X_i - \bar{X})^2}$$

Once a line equation has been estimated, it is necessary to see how well that line fits. Does there appear to be a strong relationship between Y and X or is there very little relationship? This test is done by means of the R^2 . The R^2 is the coefficient of determination and is calculated thus:

$$R^2 = \frac{TV - UV}{TV}$$

where TV is equal to the total variation for the observed variables, or the total sum of squares; UV is the unexplained variation or the error sum of squares. The other component of the total sum of squares is the explained variation, or the sum of squares due to regression. As the total error is made of error that can be explained by the regression function and error that is purely random, the ratio of the explained variation to the total variation gives a measurement of how well the regression equation is at explaining the relationship between the two (or more) variables.

As the R^2 is a ratio of the explained variation to the total variation, its value lies between 0 and 1, with 0 meaning that there is absolutely no relationship and 1 meaning that there is a perfect relationship between them. Most regression analysis falls somewhere in between. There is no set figure needed for the R^2 , however, to be certain that the R^2 is significant, there is a statistical test of significance that can be done.

Using as the null hypothesis that the R^2 is not significantly different from 0, then a test statistic following the F distribution, d.f = $k-1$, $n-k$ can be done. The F statistic is computed as:

$$F = \frac{R^2 / (k-1)}{(1-R^2) / (n-k)}$$

If the computed F statistic is greater than the critical value of F at the chosen significance level, then the null hypothesis can be rejected, the R^2 is significantly different from 0.

While the general regression equation for a line shown in this section is linear both in the parameters and in the variables, it can also be used for equations that are not linear by transformation of the variables. The basics of these procedures are explained in the following section detailing the SPOP model.

The SPOP Model

The SPOP Model is a small-area population projection forecasting model.²⁵ The SPOP model projects population for smaller areas using the percentage shares of the small areas to a larger area. This is accomplished by projecting the total population for the larger area and projecting the percentage share of that total population for each of the smaller areas. The SPOP model uses a set of six regression equations to find the equation that produces the best-fitting line for each of the smaller area's data. The best-fitting equation is chosen based upon the R^2 s for each equation in each area. The model consists of seven basic steps, which are outlined below.

Step 1: This step involves computing the percentage shares for each of the small areas within the larger area. The model can accommodate up to six separate regions, the sum of which are considered to be the larger region. The sum of the total region is divided into the separate totals for each smaller area to obtain a percentage share of each small region in relation to the larger region for each time period. There are six time periods, equally spaced, used for each small area.

Step 2: The small areas' percentage shares and the total region's data are then analyzed using six regression functions to identify the best-fitting equation and the parameters of those equations. The six equations are: 1) linear function, 2) power function, 3) exponential function, 4) modified exponential function, 5) Gompertz function and, 6) logistic function. A detailed mathematical description of the six functions follows below. The modified exponential, Gompertz and logistic functions are asymptotic.

1) Linear Function: $y = a + bx$; x = year, y = small area share, n = number of observations

²⁵ Gabbour, Iskandar. 1993. "SPOP: Small-Area Population Projection." In R. E. Klosterman, R. K. Brail and E. G. Bossard (eds) *Spreadsheet Models for Urban and Regional Analysis*. Center for Urban Policy Research, New Brunswick, New Jersey, pp 69-84.

$$a = \frac{\sum x \sum xy - \sum y \sum x^2}{(\sum x)^2 - n \sum x^2}$$

$$b = \frac{\sum xy - (\sum x \sum y / n)}{\sum x^2 - [(\sum x)^2 / n]}$$

2) Power Function: $y = ax^b$. The function is first converted to a linear form by taking the logarithm of both sides, which results in:

$$\log y = \log a + b(\log x)$$

This can then be rewritten using capital letters to equal the log of the values:

$$Y = A + bX$$

This function is then identical to the first linear function, so that the parameters for this function are:

$$A = \frac{\sum X \sum Y - \sum Y \sum X^2}{(\sum X)^2 - n \sum X^2}$$

$$b = \frac{\sum XY - (\sum X \sum Y / n)}{\sum X^2 - [(\sum X)^2 / n]}$$

where: X = logarithm of year
 Y = logarithm of small area share
 n = number of observations

The parameter a is then calculated by raising the base 10 to the power A ,
 $a = 10^A$.

3) Exponential Function: $y = ab^x$. This function can also be converted to linear form with the application of logarithms, so that:

$$\log y = \log a + (\log b)x$$

Again, using capital letters to represent the logarithm of the parameters gives the linear function:

$$Y = A + Bx$$

The parameters are then computed with the following formulas:

$$A = \frac{\sum x \sum xY - \sum Y \sum x^2}{(\sum x)^2 - n \sum x^2}$$

$$B = \frac{\sum x \sum Y - (\sum x \sum Y / n)}{\sum x^2 - [(\sum x)^2 / n]}$$

with parameter definitions of: x = year
 Y = logarithm of small area share
 n = number of observations

As with the power function, the a and b parameters are then computed by raising the base 10 to the A and B powers, $a = 10^A$ and $b = 10^B$.

4) Modified Exponential Function: $y = k + ab^x$ For this function, the observations are divided into three subgroups containing the same number of observations. The parameters are found by computing:

$$b = n \sqrt{\frac{\sum_3 y - \sum_2 y}{\sum_2 y - \sum_1 y}}$$

$$a = (\sum_2 y - \sum_1 y) \frac{b-1}{b(b^n - 1)^2}$$

$$k = \frac{1}{n} \left[\frac{\sum_1 y \sum_3 y - (\sum_2 y)^2}{\sum_1 y \sum_3 y - 2 \sum_2 y} \right]$$

where: $\sum_i y$ = sum of values in i th subgroup
 n = number of values in each subgroup

5) Gompertz Function: $y = ka^{(b^x)}$. This function also uses logarithms to solve for a and k , substituting A for $\log a$ and K for $\log k$. The parameters are computed according to the following formulas:

$$b = n \sqrt{\frac{\sum_3 Y - \sum_2 Y}{\sum_2 Y - \sum_1 Y}}$$

$$A = (\sum_2 Y - \sum_1 Y) \frac{b-1}{b(b^n - 1)^2}$$

$$K = \frac{1}{n} \left[\frac{\sum_1 Y \sum_3 Y - (\sum_2 Y)^2}{\sum_1 Y + \sum_3 Y - 2 \sum_2 Y} \right]$$

where: $\sum_i Y$ = sum of logarithms of values in i th subgroup
 n = number of values in each subgroup

The a and k parameters are then found by raising the base 10 to the A and K powers, $a = 10^A$ and $k = 10^K$.

6) Logisitic Function: $y^{-1} = k^{-1} + ab^x$. The parameters for this function are found with the following computations:

$$b = n \sqrt{\frac{\sum_3 y^{-1} - \sum_2 y^{-1}}{\sum_2 y^{-1} - \sum_1 y^{-1}}}$$

$$a = (\sum_2 y^{-1} - \sum_1 y^{-1}) \frac{b-1}{b(b^n - 1)^2}$$

$$\frac{1}{k} = \frac{1}{n} \left[\frac{\sum_1 y^{-1} \sum_3 y^{-1} - (\sum_2 y^{-1})^2}{\sum_1 y^{-1} + \sum_3 y^{-1} - 2\sum_2 y^{-1}} \right]$$

where: $\sum_i y^{-1}$ = sum of the inverses of values in i th subgroup
 n = number of values in each subgroup

Step 3: Once the values for all the parameters for each of the six functions are obtained, then six sets of estimates for each small area and the total region are computed. As the time periods for the observations are equally spaced, an index number can be substituted for x (the years). This functions correctly as long as an index number is used for the projection year as well.

Step 4: To identify which function yields the best-fitting line for each small area and the total region, the R^2 is computed and the equation yielding the highest is chosen for that area.

Step 5: The best-fitting equation chosen in Step 4 is used to project each small area's share and the total region's population for projection year. The projection year, coded into an index, is placed back into each small area's chosen equation. The coefficients are determined from the equations in Step 2, so the result is the projected share of the total population for each small area and the total population for the region.

Step 6: As the results for the percentage share projections are estimates, it is possible that the total of all the small area's percentage shares do not equal one hundred percent. This makes it necessary to adjust each small area's percentage share. The adjustment factor applied is calculated by dividing one hundred by the total of the projected shares. For example, if

the total of all the small area's percentage shares equals 99.27, then the adjustment factor is equal to 100 divided by 99.27, or 1.0074. Each small area percentage share is then multiplied by this adjustment factor. The adjusted percentage shares of all the small areas now total one hundred.

Step 7: The actual projected population for each small area is then calculated by applying each projected percentage share for each small area to the total region's projected population.

Appendix D: Statistical Notes

This section is intended to provide the reader with further details on the R^2 's and confidence levels of the forecasted Chittenden County variables. Confidence intervals are provided for Chittenden County total employment and total population as an example.

The confidence level employed for all statistical projections was 95%. This is a standard setting for confidence levels and confidence intervals in statistics and econometrics. The confidence level has to do with the precision and accuracy of the estimated statistic based on standard sampling procedures and has as its basis the properties of probability distributions. What essentially a confidence level says, is that *the probability that the interval calculated contains the true mean of an estimated statistic is 0.95.*²⁶ Precision and accuracy in statistics are inversely related. In other words, a confidence interval may be calculated at the 95% level, but it may seem rather wide. It is possible to calculate a narrower confidence interval, but then the confidence level would go down. So that the probability of the true mean of the statistic being found in the interval would drop from 0.95 to 0.90 or lower, depending on the calculations. So in essence, to be more sure, the interval has to be wider and conversely, if the level of certainty goes down, then the interval can become narrower.

Confidence intervals are constructed using the following formula:

$$Y_i - (\text{standard error of } Y_i)(\text{critical } t) \leq Y_i | X_i \leq Y_i + (\text{standard error of } Y_i)(\text{critical } t)$$

where: Y_i is the estimated value and X_i is the chosen level of the independent variable (in these forecasts, the years)
the standard error of Y_i is calculated
the critical t is a factor obtained from statistical tables of the t distribution and chosen based on the confidence level

The formula for the standard error of Y_i is:

the square root of: $\sigma^2(1/n + (X_i - \text{Average of } X) / \text{sum of squared deviations of all } X \text{ from average } X)$

where σ^2 is the variance of the estimated regression function.

So the confidence interval is not only a function of the confidence level,

²⁶ Gujarati, Damodar. 1999. *Essentials of Econometrics, 2nd Edition*. Irwin-McGraw Hill. Chapter 4.

but a function of the standard error of the estimated statistic. The standard error contains within it not only the variance of the total data set, but the effect of the size of the data set and the variation found within the independent variable, X.

As detailed in Appendix C, the R^2 is a measure of fit of an estimated line to the data set. In general regression analysis, the line is assumed to have error, as it is in reality highly unlikely that there will exist a perfectly correlated relationship between the dependent and independent variables. Therefore, the “error” or deviation of the line from the data set, is measured in by the total sum of squares, which is the magnitude of the deviation of the dependent variable from its mean. The total sum of squares, or total error, is broken into two parts, the error, or deviation explained by the regression line and the error, or deviation not explained by the regression line, or residual error. The error due to the regression line, or sum of squares error due to regression, is measure of the deviation of the estimated dependent variable from the actual dependent variable mean.

Table 8. R^2 for Forecasted Chittenden County Employment Variables

Variable	Forecast Method	R^2
Non-Manufacturing	SPOP	0.9441
Government	SPOP	0.9569
Farm	SPOP	0.8727
Manufacturing	NA	NA
Agricultural Services, Forestry & Fishing	GRA	0.8911
Services	GRA	0.8489
Mining & Construction	NA	NA
Transportation & Public Utilities	SPOP	0.8455
Finance, Insurance & Real Estate	GRA	0.9310
Wholesale	GRA	0.8269
Retail	GRA	0.9056

Notes:

NA = Not applicable

GRA = General Regression Analysis

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The error due to the residual or sum of squares error, is the error of the estimated dependent variable from the actual observed dependent

variable. The R^2 is a ratio of the sum of squares regression to the total sum of squares. As the R^2 is a ratio, the closer the number is to 1, the more of the error is explained by the regression line, and therefore, the better the regression line fits the data set.

Table 8 shows the R^2 's for all the estimated variables at the Chittenden County level (statistics for the sub-county region population projections are found in Appendix E with the town level estimates).

As an example, the following confidence intervals were constructed for the projected Chittenden County total employment and total population. The confidence intervals are constructed at the 2035 point, as it is the estimation point furthest from the mean of the X's, which in this case is time, so the confidence intervals are at their widest.

Table 9. Confidence Intervals for Chittenden County Total Employment and Population

Variable	Forecast Method	R^2	Confidence Interval	CI as Percent
Total Employment	SPOP	0.9247	(201.559, 243.699)	+/- 9.5%
Total Population	SPOP	0.9714	(226.157, 275.439)	+/- 9.8%

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The interpretation of these confidence intervals is then, there is a 95% probability that the actual value of the forecasted total employment or total population forecast is found between the two numbers listed in the parentheses.

Appendix E: Town Estimates

This appendix is intended to provide some disaggregated population projections for the member communities. First, a note of caution concerning the estimates is necessary. When projecting for such small areas, while the level of confidence is the same used as for the other Chittenden County projections, the confidence intervals are on the whole, quite wide and therefore the projections should be used with extreme caution. As the forecast period is thirty-five years into the future, many events can affect a town's population growth. General economic conditions affect the county as a whole, and therefore each community. Policy changes at the state, county and neighboring community level also have an impact on an individual community. Therefore, these population forecasts are made based on historic patterns and represent a 'status quo' projection. Other factors, such as birth and natality rates, also affect population growth and cannot be accounted for when looking at historic patterns. With this caveat in mind, the town level population projections are shown in Table 10. Confidence intervals for the estimates are shown in Table 11.

While most of the town projections were made using general regression analysis, satisfactory results could not be obtained for Burlington, Winooski, and Williston with this method. For the towns that were estimated using general regression analysis, an projection for 2000 was made in the same fashion as for the sub-county regional projections, namely the average growth rate from the 1990-1998 Census estimates was used to grow the estimate from 1998 to 2000. Then, this estimate was used in the general regression analysis to incorporate a more accurate picture of the recent past into the regression function.

For Burlington and Winooski, the historic patterns in the shares of these two towns were compared in a different fashion. The average change in share was calculated for the period 1940-2000, using the average change in share of these towns as a percent of the sub-county region from each Census period to the next. Then, the change in share from each Census period was averaged to obtain an average for the whole historic time period. This average change in share was used to grow the 2000 share to each of the forecast time points. Therefore, a confidence interval cannot be calculated for these communities.

Williston is calculated simply as a residual from the Region 2. After projecting Colchester and Essex, the remainder is attributed to Williston.

As can be seen from the table, Bolton, Huntington, Buel's Gore and Underhill have been aggregated for forecast purposes. This has been done so as to allow for the use of general regression analysis to project population.

Table 10. Town Population Projections

	2000	2005	2010	2015	2020	2025	2030	2035
Burlington	40.295	40.663	40.738	41.006	41.614	42.283	42.892	43.301
South Burlington	14.362	15.240	16.036	16.936	18.014	19.168	20.344	21.484
Winooski	6.797	6.916	6.988	7.096	7.265	7.448	7.625	7.771
Colchester	16.798	18.269	20.015	22.007	24.389	27.050	29.955	32.980
Essex	18.736	21.163	23.053	25.177	27.744	30.584	33.648	36.842
Williston	7.249	7.902	8.828	9.837	11.011	12.293	13.602	14.973
Bolton/ Huntington/ Buel's								
Gore	6.112	6.724	7.461	8.217	9.325	10.471	11.738	13.643
Charlotte	3.735	3.905	4.213	4.503	4.955	5.396	5.854	6.592
Hinesburg/ St. George	5.175	5.807	6.477	7.188	8.192	9.260	10.420	12.181
Jericho	5.171	5.939	6.635	7.356	8.399	9.484	10.689	12.485
Milton	10.339	11.893	13.411	14.992	17.250	19.619	22.257	26.155
Richmond	4.271	4.689	5.069	6.082	5.988	6.523	7.075	7.948
Shelburne	7.091	7.672	8.425	9.172	10.271	11.390	12.593	14.442
Westford	2.164	2.216	2.411	2.607	2.906	3.202	3.520	3.654

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Table 11. Confidence Intervals for Selected Chittenden County Projections - 2035

Variable	Projection Method	Projection	R ²	Confidence Interval	C.I. As Percent
Total Employment	SPOP	222.629	0.9247	(201.559, 243.699)	± 9.5%
Total Population	SPOP	250.798	0.9714	(226.157, 275.439)	± 9.8%
County Sub-Region 1	GRA	72.556	0.9261	(65.884, 79.228)	± 9.2%
Burlington	Other	43.301	NA	NA	NA
South Burlington	GRA	21.484	0.9498	(22.202, 25.453)	± 7.6%
Winooski	Other	7.771	NA	NA	NA
County Sub-Region 2	GRA	84.795	0.9166	(66.524, 103.271)	± 21.5%
Colchester	GRA	32.980	0.8326	(23.261, 42.699)	± 29.5%
Essex	GRA	36.842	0.9127	(28.515, 45.169)	± 22.6%
Williston	Other	14.973	NA	NA	NA
County Sub-Region 3	GRA	93.447	0.8088	(68.418, 118.476)	± 26.8%
Bolton/Huntington/ Buel's					
Gore/Underhill	GRA	13.643	0.5085	(8.461, 18.825)	± 37.9%
Charlotte	GRA	6.592	0.8119	(5.013, 8.171)	± 24.0%
Hinesburg/St. George	GRA	12.181	0.7998	(9.058, 15.304)	± 25.6%
Jericho	GRA	12.485	0.8582	(9.927, 15.043)	± 20.5%
Milton	GRA	26.155	0.8531	(19.634, 32.676)	± 24.9%
Richmond	GRA	7.948	0.9923	(7.574, 8.322)	± 4.7%
Shelburne	GRA	14.442	0.8651	(11.846, 17.038)	± 17.9%
Westford	GRA	3.654	0.9151	(2.972, 4.336)	± 18.7%

Notes:

[1] Confidence intervals are given for 2035 as at the last projection point, confidence intervals are at their widest.

[2] All confidence intervals are calculated at the 95% level.

[3] SPOP = Small Area Population Projection Model; GRA = General Regression Analysis.

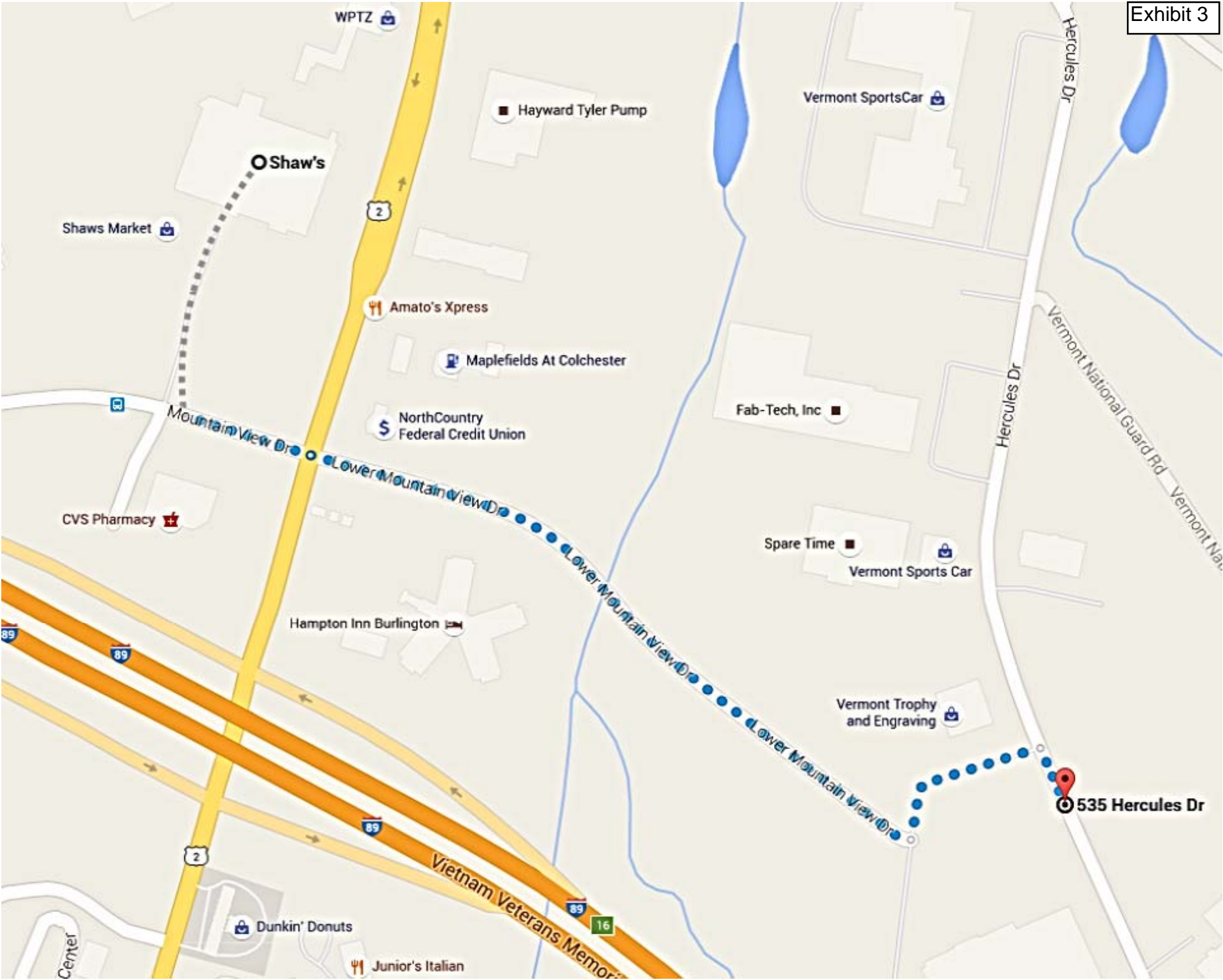
MILTON COMMUTER (#56)

AM to Burlington		
Stop	City/Town	Notes
River Street @ Villemaire Lane	Milton	Shelter
River Street @ Barnum Street	Milton	
River Street @ Cherry Street	Milton	
Main Street @ United Church of Milton	Milton	
Husky	Milton	On-board request only
Railroad Street @ Villemaire Street	Milton	
Middle Road @ Domino's Pizza	Milton	
Milton Town Office Park & Ride	Milton	Shelter
Rt.7 @ Boysenberry Drive	Milton	
Rt.7 @ Nancy Drive	Milton	
Catamount Industrial Park	Milton	On-board request only
Chimney Corners Park & Ride	Colchester	Shelter
Creek Farm Plaza	Colchester	
Severance Corners	Colchester	Johanna's Lane @ Sophie's Way
Rathe Road @ opp. Residence Inn	Colchester	
Mountain View Dr. @ Albany College	Colchester	
Mountain View Dr. @ opp. Shaws	Colchester	
Main Street @ Pecor Auto	Winooski	Opposite Bellevue Street. On-board request only
Main Street @ opp. Platt Street	Winooski	On-board request only
Champlain Mill	Winooski	On-board request only
FAHC	Burlington	Shelter @ Main Entrance
Pearl Street @ North Prospect Street	Burlington	Shelter
Pearl Street @ North Union Street	Burlington	
Cherry Street @ St.Paul Street	Burlington	Transit Station
College Street @ Pine Street	Burlington	In front of 101 College Street.
Pine Street @ Maple Street	Burlington	
Pine Street @ Opposite Howard Street	Burlington	Across from Dealer.Com
Pine Street @ Burlington Electric Dept.	Burlington	
Pine Street @ Cumberland Farms	Burlington	Lakeside Avenue

PM to Milton		
Stop	City/Town	Notes
Pine Street @ Locust Street	Burlington	Shelter across from DPW. No mid-day or 9:40 PM trip service
Pine Street @ Howard Street	Burlington	Dealer.Com. No mid-day or 9:40 PM trip service
Cherry Street @ St.Paul Street	Burlington	Transit Station
Pearl Street @ Hungerford Terrace	Burlington	
UHC	Burlington	Shelter on Pearl Street
FAHC	Burlington	Shelter @ Main Entrance
Champlain Mill	Winooski	
Main Street @ Platt Street	Winooski	
Main Street @ Normand Street	Winooski	Winooski School
Mountain View Dr. @ Shaws	Colchester	
Mountain View Dr. @ Fox 44	Colchester	
Rathe Road @ Residence Inn	Colchester	
Severance Corners	Colchester	Johanna's Lane @ Sophie's Way. On-board request only
Creek Farm Plaza	Colchester	On-board request only
Chimney Corners Park & Ride	Colchester	Shelter
Catamount Industrial Park	Milton	On-board request only
Rt.7 @ CITGO Station	Milton	
Rt.7 @ Ice Barn	Milton	
Milton Town Office Park & Ride	Milton	Shelter. 9:40 and 12:15 PM trips serves after traveling to Main & Railroad Streets
Rt.7 @ Centre Drive	Milton	Mobil Station
River Street @ Villemaire Lane	Milton	Shelter
River Street @ Barnum Street	Milton	
River Street @ Cherry Street	Milton	
Main Street @ United Church of Milton	Milton	
North Rd. @ Hunting Ridge Ln.	Milton	4:20 PM Departure Only
Husky	Milton	4:20 PM Departure Only
Railroad Street @ Villemaire Lane	Milton	
Middle Road @ Domino's Pizza	Milton	

AM to Milton		
Stop	City/Town	Notes
Pine Street @ Locust Street	Burlington	Shelter across from DPW
Pine Street @ Howard Street	Burlington	Dealer.Com
Cherry Street @ St.Paul Street	Burlington	Transit Station
Pearl Street @ Hungerford Terrace	Burlington	
UHC	Burlington	Shelter on Pearl Street
FAHC	Burlington	Shelter @ Main Entrance
Champlain Mill	Winooski	
Main Street @ Platt Street	Winooski	
Main Street @ Normand Street	Winooski	Winooski School
Mountain View Dr. @ Shaws	Colchester	On-board request only
Mountain View Dr. @ Fox 44	Colchester	On-board request only
Rathe Road @ Residence Inn	Colchester	On-board request only
Chimney Corners Park & Ride	Colchester	On-board request only
Premier Coach	Milton	On-board request only
Catamount Industrial Park	Milton	On-board request only
Rt.7 @ CITGO Station	Milton	
Rt.7 @ Ice Barn	Milton	
Rt.7 @ Centre Drive	Milton	Mobil Station
River Street @ Villemaire Lane	Milton	Shelter
River Street @ Barnum Street	Milton	
River Street @ Cherry Street	Milton	
Main Street @ United Church of Milton	Milton	
North Rd. @ Hunting Ridge Ln.	Milton	On-board request only
Husky	Milton	On-board request only
Railroad Street @ Villemaire Street	Milton	
Middle Road @ Domino's Pizza	Milton	
Milton Town Office Park & Ride	Milton	Shelter

PM to Burlington		
Stop	City/Town	Notes
Milton Town Office Park & Ride	Milton	Shelter
River Street @ Villemaire Lane	Milton	Shelter
River Street @ Barnum Street	Milton	
River Street @ Cherry Street	Milton	
Main Street @ United Church of Milton	Milton	
Husky	Milton	5:26 PM hard stop only
Railroad Street @ Villemaire Street	Milton	
Middle Road @ Domino's Pizza	Milton	
Rt.7 @ Boysenberry Drive	Milton	
Rt.7 @ Nancy Drive	Milton	
Catamount Industrial Park	Milton	12:15 & 9:40 PM trips by on-board request. 5:38 PM hard stop
Chimney Corners Park & Ride	Colchester	Shelter
Creek Farm Plaza	Colchester	
Severance Corners	Colchester	Johanna's Lane @ Sophie's Way
Rathe Road @ opp. Residence Inn	Colchester	
Mountain View Dr. @ Albany College	Colchester	
Mountain View Dr. @ opp. Shaws	Colchester	
Main Street @ Pecor Auto	Winooski	Opposite Bellevue Street. On-board request only
Main Street @ opp. Platt Street	Winooski	On-board request only
Champlain Mill	Winooski	On-board request only
FAHC	Burlington	On-board request only. Shelter @ Main Entrance
Pearl Street @ North Prospect Street	Burlington	Shelter
Pearl Street @ North Union Street	Burlington	
Cherry Street @ St.Paul Street	Burlington	Transit Station
College Street @ Pine Street	Burlington	In front of 101 College Street. No mid-day service
Pine Street @ Maple Street	Burlington	No mid-day service
Pine Street @ Opposite Howard Street	Burlington	Across from Dealer.Com. No mid-day service
Pine Street @ Burlington Electric Dept.	Burlington	No mid-day service
Pine Street @ Cumberland Farms	Burlington	Lakeside Avenue. No mid-day service



Chapter Name: Quality Management	Policy #: 3.65
Title: DRAFT Peer Review	

Policy Statement

To provide an ongoing, comprehensive self-assessment of the quality of care provided, including types of surgical procedures performed, the medical necessity of procedures performed, and the appropriateness of the care that was given. Green Mountain Surgery Center ("GMSC") will use the peer review findings when appropriate, in the revision of its policies and the consideration of privileges.

Procedures

- I. Peer review shall be ongoing and comprehensive. Criteria by which peer review will be conducted should be determined by the Medical Executive Committee ("MEC") and approved by the Governing Board.
- II. Green Mountain Surgery Center will peer review the following:
 - a) 100% of all patient transfers from GMSC to other facilities; all patients seen in an ER within 72 hours of discharge; all returns to the OR within 30 days, either at GMSC or off site; all major complications to include but not limited to, wrong site surgery, patient injury, patient death, patient disfigurement, etc., and all indications through routine incident monitoring and risk management that show a trend for a specific physician or a specific procedure.
 - b) Any aggregate or individual information derived from generic screens, medical staff monitors, complaints from patients, third party agencies or other sources of information within GMSC or the medical community that suggest possible deviation(s) from accepted standards of patient care, state and federal regulatory requirements or other policies that have been approved by the medical staff.
 - c) Performance of clinical procedures that fall outside the boundaries of documented competencies identified in GMSC credentialing process.
 - d) A potential clinical quality issue raised by another medical staff member.
 - e) Disruptive/inappropriate conduct displayed by a physician. Examples of such conduct would include, but not be limited to, verbal or physical assaults of staff, patients, visitors, or other medical staff members, impertinent or inappropriate comments written in patient medical records or hospital records, or refusal to accept appropriate medical staff or committee assignments.
 - f) Quarterly, a random number of patient medical charts that do not fall within the above review categories, up to 5% or 20, whichever is less, will be subject to a peer review to ensure that the GMSC's procedures are medically necessary and appropriate for the patient's diagnosis.

Additional studies or peer reviews can be performed at the discretion of the Medical Director or Administrator.

For adverse incidents, the chart will be pulled and given to a physician reviewer who will review

the complication and give his/her opinion as to the acceptable/unacceptable level of care provided. This opinion will be forwarded to Medical Executive Committee and then to the Governing Board.

- III. Each physician shall receive a peer-based review from at least one physician within the same specialty, which may be an external physician consultant.
- IV. A Physician Peer Review Evaluation Form will be utilized as a reporting mechanism.
- V. Physician peer reviews will be presented to the MEC on an on-going basis. In addition, the reports of such information will also continue to be presented to the Governing Board for review and approval.
- VI. The Medical Director, MEC, and/or the Governing Board have the authority to contract with an external, qualified peer review consultant.

Physician Peer Review Evaluation

Chart #: _____ Physician #: _____

Review Date: _____ Reviewer: _____

Criteria Utilized to Initiate a Review (circle all that apply):

Transfer	ER visit w/in 72 hours	Death w/in 72 hours	CODE		
Infection	Wrong site surgery	Wrong procedure performed			
Major change from proposed surgery	Complication	Return to OR	OTHER:		
			Yes	No	N/A
1. Is the consent consistent with the operative report, H&P and the diagnosis?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are Pre & Post-Operative orders appropriate to the patient's condition and surgical findings?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is the final diagnosis consistent with the surgical findings and the pre-operative diagnosis?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was the surgical procedure consistent with the diagnosis?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Does the operative report adequately describe the details of the procedure?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are follow-up care and/or discharge instructions adequate and appropriate?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. When significant or sustained deviations from normal values or expectations were observed, were interventions timely and appropriate?			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

In consideration of the stated reason for review, this record is determined to be:

- _____ Acceptable: No Quality of Care or Documentation Problem
- _____ Documentation incomplete, but patient outcome not affected; refer to Medical Director
- _____ Not acceptable for reasons related to medical management; refer to Medical Executive Committee for Peer Review Recommendation

Disposition:

- ☐ Return file to chart. No quality of care and/or documentation problems
- ☐ Medical Director discussed with physician
- ☐ Letter to physician
- ☐ Refer to Governing Board
- ☐ Peer Review Recommendation

Reviewed by Medical Director: _____ Date: _____

Chart #: _____ Anesthesiologist/CRNA#: _____
Review Date: _____ Reviewer: _____

Transfer Infection	ER visit w/in 72 hours	Death w/in 72 hours	CODE
Wrong site surgery	Wrong procedure performed		
Major change from proposed surgery	Complication	Return to OR	OTHER:
			Yes No N/A
1.	Anesthesia record present and includes pre- and post-op assessments.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2.	Anesthesia record complete and reflects appropriate monitoring.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3.	Evidence of re-evaluation post-induction		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
4.	Required signatures present and dates.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5.	Procedure completed without intra- or post-op complication.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
6.	Complications managed appropriately.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
7.	Discharge orders made present and accurate.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
8.	Abnormal lab values addressed in anesthesia notes.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Comments: _____

_____	Acceptable: No Quality of Care or Documentation Problem
_____	Documentation incomplete, but patient outcome not affected; refer to Medical Director/Administrator
_____	Not acceptable for reasons related to medical management; refer to Medical Executive Committee for Peer Review Recommendation

- ☐ Return file to chart. No quality of care and/or documentation problems
- ☐ Medical Director discussed with physician
- ☐ Letter to anesthesiologist/CRNA
- ☐ Refer to Governing Board
- ☐ Peer Review Recommendation

Reviewed by Medical Director: _____ Date: _____

Chart #: _____ AHP #: _____
Review Date: _____ Reviewer: _____

Infection	Exposure/Injury	Break in Aseptic Technique	Incorrect Count
Delayed Case Start	Equipment Malfunction	OTHER:	

	Yes	No	N/A
1. Coordinates OR preparation with team so cases start on time?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Maintains aseptic technique preparing for and during surgical cases?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Assures all equipment & supplies are available and functioning prior to the start of the case?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Performs accurate counts at appropriate times with team member?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Consistently anticipates physician's needs during procedure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Handles surgical equipment/instruments in a proper, safe manner?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Uses the appropriate personal protection equipment at all times?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Properly disposes of biohazardous waste?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Properly disposes/transportes sharps to minimize hazardous exposure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

_____	Acceptable: No Quality of Care Problem
_____	Quality of care problem, but patient outcome not affected; refer to Medical Director/Administrator
_____	Not acceptable for reasons related to medical management; refer to Medical Executive Committee for Peer Review Recommendation

- ☐ Return file to chart. No quality of care and/or documentation problems
- ☐ Medical Director discussed with AHP
- ☐ Letter to AHP
- ☐ Refer to Governing Board
- ☐ Peer Review Recommendation

Reviewed by Medical Director/Administration: _____ Date: _____

A Comparative Study of Quality Outcomes in Freestanding Ambulatory Surgery Centers and Hospital-Based Outpatient Departments: 1997–2004

Askar S. Chukmaitov, Nir Menachemi, L. Steven Brown, Charles Saunders, and Robert G. Brooks

Research Objective. To compare quality outcomes from surgical procedures performed at freestanding ambulatory surgery centers (ASCs) and hospital-based outpatient departments (HOPDs).

Data Sources. Patient-level ambulatory surgery (1997–2004), hospital discharge (1997–2004), and vital statistics data (1997–2004) for the state of Florida were assembled and analyzed.

Study Design. We used a pooled, cross-sectional design. Logistic regressions with time fixed-effects were estimated separately for the 12 most common ambulatory surgical procedures. Our quality outcomes were risk-adjusted 7-day and 30-day mortality and 7-day and 30-day unexpected hospitalizations. Risk-adjustment for patient demographic characteristics and severity of illness were calculated using the DCG/HCC methodology adjusting for primary diagnosis only and separately for all available diagnoses.

Principal Findings. Although neither ASCs nor HOPDs performed better overall, we found some difference by procedure that varied based on the risk-adjustment approach used.

Conclusions. There appear to be important variations in quality outcomes for certain procedures, which may be related to differences in organizational structure, processes, and strategies between ASCs and HOPDs. The study also confirms the importance of risk-adjustment for comorbidities when using administrative data, particularly for procedures that are sensitive to differences in severity.

Key Words. Quality, mortality, hospitalization, outpatient surgery, risk adjustment

Over the past few decades, several factors including improvements in medical technology, anesthesia, and pain management have facilitated the push of surgical services to outpatient facilities (Medicare Payment Advisory

Commission [MedPAC] 2004; Shugarman et al. 2004; Wynn 2004). Today, up to 70 percent of all surgeries performed in the United States take place in the ambulatory setting (MedPAC 2004). Medicare spending on outpatient services has dramatically increased for hospital-based outpatient departments (HOPDs) and freestanding ambulatory surgery centers (ASCs) between 1993 and 2003 (MedPAC 2004). Despite these recent trends and the Institute of Medicine's (2000) suggestion to focus research on adverse events in the outpatient setting, little comparative research on quality outcomes exists. The current study compares quality outcomes for ASCs and HOPDs.

To date, a limited number of studies have examined quality outcomes by location of outpatient care and yielded mixed findings. Vila et al. (2003) compared office-based and ASC-based mortality and found a 10-fold increased death rate in office settings in Florida. These results have been questioned in a reanalysis of the same data by Hancox et al. (2004) and by Venkat et al. (2004). We identified only two studies by Fleisher et al. (2004) and Fleisher, Pasternak, and Lyles (2007) that examined patient outcomes in settings that included both ASCs and HOPDs. Fleisher et al. (2004) used Medicare data to study quality outcomes following 16 combined outpatient procedures. After adjusting for patient demographics and the Charlson comorbidity index, patients treated at HOPDs were at an increased risk of 7-day mortality, emergency department visits, and hospitalization.

The current study builds on previous work, but is different in several important ways. First, using large patient-level, all payer claims data allowed us to study quality outcomes for each of the 12 most common outpatient procedures performed at ASCs and HOPDs in Florida during the 1997–2004 period. Second, we compared outcomes individually for these procedures in order to explicitly examine whether ASCs or HOPDs perform better for certain types of procedures. Third, we used the literature on specialty facilities (especially studies relevant to ASCs) and general hospitals to conceptualize on whether ASCs or HOPDs may provide superior quality care. Fourth, we utilized the Diagnostic Cost Groups/Hierarchical Condition Categories

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(DCG/HCC) for risk-adjustment. Finally, using the DCG/HCC, we applied multiple approaches to risk-adjustment to address the issue of nonreporting of secondary diagnoses in ambulatory surgical data.

BACKGROUND

There are several theoretical reasons why ASCs would have better quality of care when compared with HOPDs. On the other hand, HOPDs have certain characteristics that may give them an advantage over ASCs with respect to quality. In this section, we begin by describing reasons why ASCs may perform better. These reasons include favorable selection of patients, specialization and increased volume for select procedures, newer facilities equipped with the latest technologies, and better staffing. Next, we describe the characteristics of HOPDs and why by virtue of their hospital affiliation, they may potentially have higher quality of care.

Physicians, who are commonly owners of ASCs, may engage in favorable selection of patients because they are more likely to refer relatively healthy patients to their facilities for treatment (Devers, Brewster, and Ginsburg 2003). Sicker and more complex patients may be referred to hospitals because additional resources are present there that may be needed to care for these patients. If favorable selection of patients occurs in ASCs and not fully accounted for by risk-adjustment, ASCs may be portrayed as having better outcomes.

ASCs are also more likely to specialize on certain types of outpatient procedures (MedPAC 2004). This specialization may increase the procedural volume for these procedures and may result in improved patient outcomes (Devers, Brewster, and Ginsburg 2003; Casalino, Devers, and Brewster 2003; Shactman 2005). A well-established body of inpatient literature has found a strong relationship between hospital procedural volume and improved patient outcomes (Chowdhury, Dagash, and Pierro 2007). If a similar relationship exists in the outpatient setting, ASCs would have an advantage for quality.

ASCs tend to have newer and more technologically advanced facilities. Equipped with clinical information systems, these facilities may stimulate the development of effective processes, better coordination and communication among staff, and development of patient-centered organizational cultures (Casalino, Devers, and Brewster 2003; Devers, Brewster, and Ginsburg 2003). All of these factors may have a positive effect on quality of care at ASCs.

Despite ASCs characteristics, HOPDs may have better quality outcomes due to an affiliation with a hospital or larger system. Having access to a hospital's financial and organizational resources may provide HOPDs with the necessary components to improve their quality of care. Additionally, HOPDs associated with health systems are more likely to benefit from system-led patient safety programs, including those that focus on increasing procedural volume for selected ambulatory procedures.

Specifically, previous research found that hospital financial performance was associated with investment in the physical plant, updated equipment, and robust information technology in hospitals, which may be related to improvements in quality performance (Burke et al. 2002; Chaudhry et al. 2006; Menachemi et al. 2006; Bazzoli et al. 2007). Additionally, by virtue of their location, HOPDs have access to other organizational resources such as emergency and intensive care services, advanced anesthesia care, subspecialty care when needed, and/or the ability to immediately transfer patients to other clinical departments or providers. HOPDs may also be affiliated with teaching hospitals that are known to readily engage in quality improvement activities (Hartz et al. 1989; Silber et al. 1995; Mitchel and Shortell 1997; Frezza et al. 2000; Ayanian and Weissman 2002). Together, these characteristics may help HOPDs outperform ASCs with respect to quality of care.

Also, HOPDs that are a part of health systems may use system-wide strategies to improve their overall financial and quality performance (Jiang, Friedman, and Begun 2006; Bazzoli et al. 2000). These strategies may include integration of certain clinical areas, services, and departments (Gillies et al. 1993; Devers et al. 1994; Shortell et al. 2000). Improved coordination of clinical services and integrated processes of care delivery between outpatient and other departments may improve HOPDs quality performance (Shortell et al. 2000). Additionally, large health systems are more likely to pursue specific patient-centered programs, such as Continuous Quality Improvement (CQI), which can positively affect outcomes at HOPDs (Shortell, Bennett, and Byck 1998).

For select ambulatory procedures, HOPDs may actually secure high volumes through several mechanisms. Hospitals may be solo providers of some procedures in certain local markets, especially in rural areas. Given hospitals' market position and commitment to quality improvement programs, private payers may exclusively contract with hospitals for select outpatient services. Hospitals may also redesign their outpatient departments by "specializing" their operating suites (i.e., providing a "limited service" focus) for certain outpatient procedures. Hence, higher procedural volumes for some procedures in HOPDs may lead to improved patient outcomes (Begg et al. 2002).

METHODS

Data and Variables

Three patient-level databases representing the 1997–2004 period were used in this study. The ambulatory patient discharge and the inpatient hospital discharge datasets were obtained from the Florida Agency for Health Care Administration (AHCA), and vital statistics data were obtained from the Florida Department of Health.

The ambulatory discharge data contain unique patient identification numbers, demographic characteristics, primary and up to four secondary diagnoses as classified by International Classification of Diseases (ICD-9), procedure codes based on Current Procedural Terminology (CPT), payer type, and location of care (freestanding ASCs or HOPDs) for all outpatient encounters. Using unique patient identifiers, the ambulatory discharge data were merged with the inpatient and vital statistics datasets. The inpatient hospital discharge data include information on all admissions to acute-care hospitals in Florida. The vital statistics dataset is the state's death registry. Additionally, organizational-level descriptors of ASCs and HOPDs were obtained from the AHCA and the American Hospital Association Annual Survey for 2004, respectively.¹

We chose to study the 12 most common procedures that were performed in Florida's ASCs and HOPDs during the period 1997–2004. These procedures include arthroscopy, biopsy of the liver, biopsy of the prostate, cataract removal, central venous catheterization, colonoscopy, debridement of skin and other tissues, upper gastrointestinal endoscopy, laparoscopic cholecystectomy, laparoscopic occlusion and fulguration of oviducts, spinal injection for myelography and/or computed tomography, and repair of inguinal hernia. The related CPT codes were grouped together to represent each aggregated procedure (Appendix A).

Approximately 18.9 million outpatient encounters were registered in Florida during the study period, 7,638,680 (about 40 percent) of which were for the 12 study procedures in adult patients (18 years of age and older). We excluded 41,172 observations (0.5 percent) that did not meet our criteria described below, so our sample totaled 7,597,508 observations.

Dependent Variables

We used 7- and 30-day binary variables for mortality and unexpected hospitalization calculated from the date of ambulatory surgery as our quality indicators. Mortality is a quality indicator commonly used in the inpatient setting

(Chowdhury, Dagash, and Pierro 2007). Even though mortality related to the ambulatory surgical setting is rare (Shnaider and Chung 2006), this indicator was used to flag potential quality problems associated with ambulatory surgery (Fleisher et al. 2004, 2007). Shnaider and Chung (2006) proposed unexpected hospital admission as an easily identifiable quality indicator and important outcome measure in the ambulatory surgical setting because it reflects peri-operative complications, adds to health care cost, and is disruptive for patients. We used 7-day indicators since as a shorter measure it can reduce the effects of extraneous factors unrelated to outpatient procedures (Fleisher et al. 2004). However, in some instances, it may take longer time for a complication to develop: thus, 30-day indicators were used as well (Warner, Shields, and Chute 1993; Gold et al. 1998; Mezei and Chung 1999; Fleisher et al. 2004, 2007).

In order to distinguish between mortality and hospitalization outcomes, and between different primary procedures, we created an individual data set for each quality outcome and for each procedure. We treated each procedure as a separate event performed on that encounter for each patient, and we also counted adverse outcomes only once in cases when the same patients had multiple encounters for the same procedure. For example, if a patient had two arthroscopies and later died within a 30-day period, his/her mortality could only be counted once (this most commonly occurred for cataract extractions, arthroscopies, and debridements). However, if a patient had a colonoscopy and later a central venous catheterization, this would be represented in two separate data sets.

Given that not all postambulatory discharge mortality and hospitalizations are associated with a given ambulatory procedure, the research team of physicians and researchers discussed each mortality or admission diagnosis category, and, with a high degree of agreement, determined unrelated categories for exclusion. For example, suicides and homicides were excluded as mortality outcomes, and ambulatory patients who later were hospitalized for drug use, HIV/AIDS, or psychiatric disorders were excluded as hospitalization outcomes, because they were likely unrelated to the studied procedures.

Independent Variables and Risk Adjustment

A key independent binary variable was constructed to compare ASCs and HOPDs with respect to quality outcomes. In our analyses, HOPD served as the reference category.

We utilized a continuous measure of severity (i.e., risk scores) that was generated by *RiskSmart Stand Alone V.2.1* software, using the DCG/HCC

methodology (DxCG 2005). The DCG/HCC uses all available diagnosis codes (ICD-9-CM) and classifies them in clinically homogeneous and meaningful groups named condition categories (CCs) (Ash et al. 2003; Pope et al. 2004; Petersen et al. 2005; DxCG 2005). The CCs are then hierarchically grouped by severity (HCC) and ranked according to their historical and empirically determined diagnostic costs (i.e., DCG/HCC) (Ash et al. 2003; Pope et al. 2004; Petersen et al. 2005; DxCG 2005). Patients with multiple diagnoses are assigned into a single group with the highest hierarchy, where higher group number indicates increasing severity (Ash et al. 2003; Pope et al. 2004; Petersen et al. 2005; DxCG 2005). These groups are then translated into risk scores by the *RiskSmart* software.

The DCG/HCC method was previously validated in outcomes research that suggested it had better predictive power than other related administrative methodologies (i.e., the Charlson index, the Adjusted Clinical Groups) and self-reported risk-adjustment methods (Ash et al. 2003; Pope et al. 2004; Petersen et al. 2005; Maciejewski et al. 2005). Moreover, the Centers for Medicare and Medicaid Services (CMS) used the DCG/HCC for risk-adjustment in Medicare+Choice capitation payments because the method was deemed transparent, easy to modify, and had good clinical coherence (Pope et al. 2004).

In our ambulatory data, we found that fewer secondary diagnoses were reported among ASCs compared with HOPDs. Furthermore, some ASCs, at least in some years, did not report secondary diagnoses at all during the study period. Thus, we addressed the problem of potential nonreporting of comorbidities by comparing results from models that were risk adjusted using primary diagnosis only with models using all available secondary diagnoses for risk adjustment.

We generated risk scores in two ways. The first set adjusted for primary diagnosis only, while the second set of risk scores adjusted for all available primary and secondary diagnoses. The state-wide average risk scores equaled 1.35 when adjusting for primary diagnosis only and 1.66 when adjusting for all available diagnoses. These state-wide average risk scores were scaled down to 1.00 and the procedure-specific risk scores were modified accordingly to make easy comparisons of descriptive findings.

Given that we used all outpatient encounters in Florida to compute risk scores, the risk scores predicted the severity of illness for each patient relative to that of the average ambulatory patient in Florida for every study year (1997–2004). Hence, relative risk scores above the average represented increased severity, and scores below the average represented decreased severity (Winter

2003; DxCG 2005). To estimate the effects of nonreporting of secondary diagnoses on comparative quality outcomes, we separately estimated regression models for these different types of risk-adjusters, and therefore, two sets of findings are compared.

All regressions included the same independent variables. Patient age was categorized into five groups (18–49 [the reference group], 50–64, 65–74, 75–84, 85, or greater). Race/ethnicity was coded as white (the reference group), African American, Hispanic, or other (including unknowns). We also included a binary variable for sex (female as reference). Patient insurance types included Commercial/PPO (the reference group), Medicare, Medicare HMO, Medicaid, Medicaid HMO, HMO, self-pay, or other. We also controlled for changes over time common to both ASCs and HOPDs by including a set of dummy variables for each year between 1997 and 2004 in our analyses.

Statistical Analysis

We used a pooled, cross-sectional design and compared the estimated differences between ASC and HOPDs with adjusted odds ratios generated from logistic regressions. In all, 96 models were estimated separately for each of the four quality outcomes (7- and 30-day mortality and unexpected hospitalization), 12 procedures, and two types of risk scores (adjusting for primary diagnosis only or all available diagnoses). All models also adjusted for the clustering of outcomes within the same facility. Lastly, analyses of the data were approved by our university Institutional Review Board.

RESULTS

We present the descriptive results showing the distribution of procedures and patient characteristics by location of care in Table 1. We then present the overall severity scores for patients in the current study. We also contrast the risk scores calculated using two different risk-adjustment approaches (i.e., adjusting for primary diagnosis only or for all available diagnoses) (Table 2). Lastly, we synthesize the findings from the regression models and compare results for the two risk-adjustment approaches (Tables 3 and 4).

Descriptive Findings

Information in Table 1 shows that arthroscopy, colonoscopy, and upper gastrointestinal endoscopy were commonly provided in approximately equal numbers in both ASCs and HOPDs. However, biopsies of the prostate and

Table 1: Cumulative Number of Procedures and Patient Demographic Characteristics by Facility Type (1997–2004)

	<i>Ambulatory Surgery Centers (ASC)</i>	<i>Hospital-Based Outpatient Departments (HOPD)</i>
Procedures		
Colonoscopy	1,481,157 (52.1%)	1,361,963 (47.9%)
Cataract	1,741,784 (84.1%)	328,408 (15.9%)
Upper gastrointestinal endoscopy	632,515 (46.2%)	736,899 (53.8%)
Debridement of skin and other tissues	3,759 (0.9%)	435,929 (99.1%)
Arthroscopy	183,000 (50.0%)	183,309 (50.0%)
Repair of inguinal hernia	34,284 (22.9%)	115,283 (77.1%)
Central venous catheterization	9,183 (8.9%)	93,730 (91.1%)
Laparoscopic cholecystectomy	2,988 (3.0%)	97,092 (97.0%)
Biopsy of liver	1,897 (2.4%)	76,853 (97.6%)
Laparoscopic occlusion and fulguration of oviducts	21,494 (29.2%)	52,212 (70.8%)
Biopsy of prostate	43,258 (64.2%)	24,082 (35.8%)
Spinal injection for myelography and/or computed tomography	2,077 (3.7%)	54,274 (96.3%)
Patient age		
18–49	392,098 (38.3%)	631,438 (61.7 %)
50–64	552,942 (46.3%)	640,845 (53.7%)
65–74	569,165 (56.7%)	435,314 (43.3%)
75–84	439,329 (60.9%)	281,617 (39.1%)
85 or greater	91,156 (58.7%)	64,189 (41.3%)
Patient race/ethnicity		
White	1,452,216 (48.0%)	1,576,596 (52.0%)
Black	88,522 (34.0%)	171,987 (66.0%)
Hispanic	147,589 (41.2%)	210,913 (58.8%)
Other	356,500 (79.1%)	93,964 (20.9%)
Patient gender		
Male	898,010 (48.9%)	938,491 (51.1%)
Female	1,146,817 (50.7%)	1,114,969 (49.3%)
Payer		
Medicare	897,832 (59.5%)	612,007 (40.5%)
Medicare HMO	55,834 (31.3%)	122,429 (68.7%)
Medicaid	30,759 (36.3%)	54,083 (63.8%)
Medicaid HMO	4,374 (15.4%)	24,042 (84.6%)
Commercial/PPO	664,156 (51.4%)	627,337 (48.6%)
HMO	251,665 (35.4%)	459,549 (64.6%)
Self pay	30,532 (43.6%)	39,484 (56.4%)
Other payer	109,675 (48.9%)	114,529 (51.1%)

Note: All patient demographic differences between ASCs and HOPDs were statistically significant at a 0.01 significance level.

Table 2: Relative Risk Scores for Patients Undergoing Outpatient Procedures by Facility Type (1997–2004)

Procedure	Risk Scores Adjusted for Primary Diagnoses Only			Risk Scores Adjusted for Primary and All Secondary Diagnoses			Percent Patients with Reported Secondary Diagnoses	
	ASC	HOPD	p-Value*	ASC	HOPD	p-Value*	ASC	HOPD
1. Colonoscopy	0.83	0.82	<.0001	0.66	0.84	<.0001	44.78	88.15
2. Cataract	1.20	1.18	<.0001	1.00	1.39	<.0001	8.68	59.87
3. Upper gastrointestinal endoscopy	0.92	0.90	<.0001	0.82	1.05	<.0001	47.13	89.05
4. Debridement of skin and other tissues	1.51	2.89	<.0001	1.74	4.45	<.0001	30.20	65.81
5. Arthroscopy	0.62	0.61	<.0001	0.52	0.69	<.0001	61.07	85.54
6. Repair of inguinal hernia	0.71	0.70	.0409	0.47	0.68	<.0001	15.28	52.27
7. Central venous catheterization	4.39	5.08	<.0001	5.50	7.02	<.0001	35.82	65.63
8. Laparoscopic cholecystectomy	0.48	0.55	<.0001	0.31	0.57	<.0001	30.22	59.85
9. Biopsy of liver	0.85	2.28	<.0001	0.77	2.91	<.0001	31.70	51.60
10. Laparoscopic occlusion & fulguration of oviducts	0.19	0.19	.8270	0.01	0.10	<.0001	32.36	47.54
11. Biopsy of prostate	1.13	1.24	<.0001	0.98	1.21	<.0001	28.70	62.67
12. Spinal injection for myelography and/or computed tomography	1.29	1.26	.0725	1.22	1.19	.0928	55.33	65.54
13. Overall average for 12 procedures	1.18	1.47		1.17	1.84		35.11	66.13

Note: *ttests compare means of relative risk scores for ASC and HOPD.

Table 3: Summary Findings of Quality Performance by Facility Type, Reporting Odds Ratios and Confidence Intervals with Risk Adjustment for Primary Diagnosis Only

	Mortality (1997–2004)		Hospital Admission (1997–2004)	
	7-Day	30-Day	7-Day	30-Day
1. Colonoscopy			HOPD 1.28 (1.18–1.39) [‡]	
2. Cataract		ASC 0.84 (0.73–0.98) [*]		ASC 0.87 (0.82–0.93) [‡]
3. Upper gastrointestinal endoscopy	ASC 0.66 (0.52–0.84) [‡]	ASC 0.73 (0.64–0.84) [‡]		ASC 0.88 (0.83–0.93) [‡]
4. Debridement of skin and other tissues			HOPD 2.11 (1.67–2.67) [‡]	HOPD 2.04 (1.68–2.46) [‡]
5. Arthroscopy			HOPD 1.24 (1.08–1.41) [†]	
6. Repair of inguinal hernia			HOPD 1.50 (1.26–1.79) [‡]	
7. Central venous catheterization			HOPD 1.40 (1.18–1.67) [‡]	
8. Laparoscopic cholecystectomy			HOPD 1.76 (1.18–2.64) [†]	
9. Biopsy of liver				
10. Laparoscopic occlusion and fulguration of oviducts				HOPD 1.36 (1.10–1.68) [†]
11. Biopsy of prostate				
12. Spinal injection for myelography and/or computed tomography			ASC 0.18 (0.09–0.35) [‡]	ASC 0.18 (0.11–0.27) [‡]

Notes: Blank cells denote no statistically significant differences at the 0.05 significance level; ASC denotes that Ambulatory Surgical Centers were statistically significantly “better” quality performers in this category; HOPD denotes that hospital-based outpatient departments were statistically significantly “better” quality performers in this category.

*Significance level <0.05.

[†]Significance level <0.01.

[‡]Significance level <0.001.

cataract removals were provided mostly in ASCs, and the remaining seven procedures were performed predominantly in HOPDs.

Overall, a higher proportion of patients in the 18–49 and 50–64 age categories received care in HOPDs (Table 1), but older patients received care

Table 4: Summary Findings of Quality Performance by Facility Type, Reporting Odds Ratios and Confidence Intervals with Risk Adjustment for All Available Diagnoses

	<i>Mortality (1997–2004)</i>		<i>Hospital Admission (1997–2004)</i>	
	<i>7-Day</i>	<i>30-Day</i>	<i>7-Day</i>	<i>30-Day</i>
1. Colonoscopy			HOPD 1.46 (1.34–1.58) [‡]	HOPD 1.16 (1.10–1.22) [‡]
2. Cataract			HOPD 1.14 (1.04–1.25) [‡]	
3. Upper gastrointestinal endoscopy		ASC 0.87 (0.76–0.99)*	HOPD 1.10 (1.02–1.18)*	
4. Debridement of skin and other tissues			HOPD 2.23 (1.77–2.81) [‡]	HOPD 2.19 (1.82–2.64) [‡]
5. Arthroscopy			HOPD 1.30 (1.13–1.49) [‡]	
6. Repair of inguinal hernia			HOPD 1.69 (1.41–2.03) [‡]	HOPD 1.25 (1.10–1.42) [‡]
7. Central venous catheterization			HOPD 1.45 (1.22–1.73) [‡]	
8. Laparoscopic cholecystectomy			HOPD 1.88 (1.26–2.82) [‡]	
9. Biopsy of liver				
10. Laparoscopic occlusion and fulguration of oviducts			HOPD 1.38 (1.03–1.86)*	HOPD 1.39 (1.12–1.73) [‡]
11. Biopsy of prostate				
12. Spinal injection for myelography and/or computed tomography			ASC 0.18 (0.09–0.35) [‡]	ASC 0.18 (0.12–0.27) [‡]

Note: Blank cells denote no statistically significant differences at the 0.05 significance level; ASC denotes that Ambulatory Surgical Centers were statistically significantly “better” quality performers in this category; HOPD denotes that hospital-based outpatient departments were statistically significantly “better” quality performers in this category.

*Significance level <0.05.

[‡]Significance level <0.001.

more often in ASCs. Racial and ethnic distribution also varied by facility type; for example, nonwhites, received surgical care in HOPDs more frequently. Also, a greater percentage of Medicare patients (59.5 percent) and a slightly higher percentage of private patients (51.4 percent) received care at ASCs for the most common outpatient procedures. Patients in managed care plans and those covered by Medicaid were more likely to receive care in HOPDs. Each of these differences were significant at the $p < .01$ level.

The average risk scores by procedure for both types of risk adjustment are displayed in Table 2. The majority of patients (64.8 percent) were relatively healthy, having risk scores below 1.00. Average risk scores were elevated (i.e., above 1.00) for patients undergoing cataract removal, debridement of skin and other tissues, biopsy of prostate, and spinal injection for myelography and/or computed tomography. Patients receiving central venous catheterization had risk scores that were most above the average (Table 2).

Although we found higher risk scores in ASCs for five procedures when calculating risks based only on primary diagnosis (colonoscopy, cataract removal, upper gastrointestinal endoscopy, arthroscopy, and repair of inguinal hernia), the statistical significance of these differences may not be clinically meaningful and are likely due to the large sample sizes (Table 2).

The relationship between risk scores for ASCs and HOPDs for these five procedures (colonoscopy, cataract removal, upper gastrointestinal endoscopy, arthroscopy, and repair of inguinal hernia) reversed when we adjusted for all available diagnoses (Table 2). Also, for procedures in which HOPDs had higher risk scores adjusting for primary diagnosis only, the gap became greater when adjusting for all available diagnoses. These changes may reflect either lower severity of cases treated in ASCs or nonreporting of secondary diagnoses by ASCs, which underscores the importance of risk-adjusting with all available diagnoses.

Logistic Regression Models

Tables 3 and 4 present results generated from the regression models comparing ASC and HOPD quality performance across all studied procedures and both risk-adjustment approaches. For mortality outcomes in the models with both sets of risk scores (i.e., adjusting for primary diagnosis only and for all available diagnoses), there was no difference in performance between ASCs and HOPDs for 10 of the 12 procedures. For the two procedures where a difference existed (cataract removal and upper gastrointestinal endoscopy), the results were sensitive to the risk score used, and are discussed below.

For unexpected hospitalization outcomes, HOPDs performed consistently better in seven out of 12 procedures when risk-adjusted for primary diagnosis only (Table 3), and for nine out of 12 procedures when adjusting for all available diagnoses (Table 4). ASCs performed better for only one procedure (spinal injection for myelography and/or computed tomography), which stayed significant using both risk-adjustment approaches.

Results Sensitive to Risk-Adjustment

This section focuses on five procedures (cataract, colonoscopy, upper endoscopy, arthroscopy, and repair of inguinal hernia) for which the risk-adjustment method changed the results (Tables 3 and 4). For mortality outcomes, ASCs performed better for two procedures (cataract and upper gastrointestinal endoscopy) when risk-adjusted for primary diagnosis only, but the statistically significant results disappeared for certain outcomes when risk-adjustment included all diagnoses. Specifically, ASCs had significantly lower 7-day mortality than HOPDs for upper gastrointestinal endoscopy (OR = 0.66, CI: 0.52, 0.84) with the risk-adjustment for primary diagnosis only. In 30-day mortality models, the odds of dying were lower in ASCs after cataract removal (OR = 0.84, CI: 0.73, 0.98) and upper gastrointestinal endoscopy (OR = 0.73, CI: 0.64, 0.84) (Table 3). However, when we estimated the same models with risk scores adjusting for all available diagnoses, the only statistically significant difference remained for upper gastrointestinal endoscopy at 30 days (OR = 0.87, CI: 0.76, 0.99).

For unexpected hospitalizations risk-adjusted for primary diagnosis only, HOPDs performed better following three procedures (colonoscopy, arthroscopy, and repair of inguinal hernia) at 7-days, and ASCs performed better in the remaining two procedures (i.e., cataract removal and gastrointestinal endoscopy) with respect to 30-day hospitalizations (Table 3). When risk-adjusting with all available diagnoses, HOPDs performed better in all five procedures with respect to 7-day and 30-day hospitalizations (Table 4). Specifically, the odds of 30-day unexpected hospitalizations for procedures performed at ASCs were lower relative to HOPDs for cataract removal (OR = 0.87, CI: 0.82, 0.93) and gastrointestinal endoscopy (OR = 1.10, CI: 1.02, 1.18). These results became statistically insignificant, however, when all diagnoses were included in risk adjustment (Table 4). Furthermore, HOPDs showed outcomes that were significantly better for 7-day hospitalization for these procedures when we risk-adjusted using all available diagnoses (Table 4).

The adjusted odds ratios that suggested fewer hospitalizations in HOPDs increased in magnitude in the models that risk-adjusted for all available diagnoses (Table 4). For example, in the colonoscopy models, the odds ratio of 7-day hospitalization for colonoscopy performed in ASCs relative to HOPDs increased from 1.28 to 1.46 when using all available diagnoses for risk-adjustment (Tables 3 and 4).

DISCUSSION

In this study, there are two major sets of findings. First, we found that although neither organizational type (ASCs or HOPDs) performed better overall, there appear to be important differences in quality outcomes for certain procedures. These differences may be related to variations in organizational structures, processes, and strategies between ASCs and HOPDs. Second, we demonstrated the importance of risk-adjustment for all comorbidities when using administrative data, particularly for procedures that are sensitive to differences in severity of illness.

Differences in quality outcomes between ASCs and HOPDs may be related to the complexity of certain procedures and to the degree of specialization for others. For more complex procedures, HOPDs may have an advantage by being affiliated with hospitals. However, for one procedure, there is an indication that the increased specialization of ASCs may have resulted in decreased unexpected hospitalizations.

Patients treated at HOPDs had lower odds of unexpected hospitalization after undergoing colonoscopy, debridement of skin and other tissues, arthroscopy, repair of inguinal hernia, laparoscopic cholecystectomy, and laparoscopic occlusion and fulguration of oviducts in the models that used both types of risk-adjustment. These procedures require more invasive manipulations with probable involvement of complex clinical services and skills. Therefore, HOPDs may have hospital resources to prevent or decrease complications including unplanned hospitalizations. For example, HOPDs may mobilize emergency, anesthesia, high-tech services, or hospital specialists to care for patients experiencing complications during these outpatient procedures. Additionally, HOPDs may have adopted and followed certain hospital-wide surgical safety initiatives, treatment protocols, or guidelines that could potentially reduce complications requiring hospitalizations for their patients.

Conversely, ASCs had lower hospitalizations for spinal injection for myelography and/or computed tomography when risk-adjusting using both methods. ASCs may solely specialize in diagnostic imaging procedures, which potentially increase the volume of services, improve clinical processes and experiences, and result in better quality performance.

Our findings also make a methodological contribution, highlighting the importance of reporting and utilizing all secondary diagnoses for risk-adjustment. We found that for five procedures in particular, the exclusion of secondary diagnoses from the risk-adjustment method gave unstable results that may lead to misleading conclusions. These mixed findings may be explained

by either the actual lower severity of cases treated in ASCs (possibly due to favorable selection), or by their nonreporting of secondary diagnoses, which would result in different conclusions about ASCs' quality performance relative to HOPDs.

If ASCs did in fact under-report comorbidities, several responses may explain this. ASCs may specialize in certain procedures (e.g., cataract removal), and thus have a narrower clinical outlook and do not need to take comorbid conditions into account in their treatment plan. In addition, ASCs may not have the incentive to report secondary diagnoses (if their payment does not take secondary diagnoses into account), nor the capacity to report more complex diagnostic information (e.g., lacking trained personnel who know how to assess and code comorbidities and procedures). Future research needs to estimate the effects of nonreporting on risk adjustment, and, consequently, on comparisons of quality outcomes for outpatient procedures performed in ASCs. Future research also needs to evaluate the effects of nonreporting of secondary diagnoses on ASC and HOPD payment mechanisms. This is particularly important given the current CMS proposal to change ASC payments from being based on historical costs to being aligned with the HOPD payment system that is based on the costs and clinical similarities of procedures (GAO 2006).

Several limitations should be considered in the interpretation of our results. Mortality and hospitalizations are rare events for patients undergoing an ambulatory procedure. Therefore, as standard errors become large, it becomes increasingly difficult to detect statistical differences when they exist. In addition, unexpected hospitalization may be affected by extraneous factors unrelated to the location of care such as patients' tendencies about when to seek help for adverse events. Moreover, the quality of administrative data relies on the accuracy of provider coding, which may be subject to bias (Romano and Mark 1994; Iezzoni 1997). Finally, despite the robustness of our data, our study is limited to a single state, so future research should validate the current findings using data from additional geographic locations.

Notwithstanding these limitations, several policy recommendations are proposed. Major payers, such as Medicare, should take into consideration providers' quality performance when determining reimbursement strategies and/or when directing beneficiaries to certain types of providers. Based on the results of this study, major purchasers of outpatient services may consider HOPDs for more invasive procedures (e.g., laparoscopic surgeries, repairs of inguinal hernia) in order to reduce costs associated with unplanned hospitalizations. Similarly, ASCs should be used for diagnostic

procedures, such as spinal injection for myelography and/or computed tomography.

Lastly, efforts should be made to facilitate complete administrative data collection and reporting by all outpatient surgical providers, so that it is possible to identify and to direct patients to true high-quality performers. Accurate reporting of secondary diagnoses is also important for development of transparent and fair ambulatory surgical payment systems as major payers may start using diagnoses-based risk-adjustment methods, such as the DCG/HCC, for setting up their payment rates (GAO 2006).

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NOTE

1. In Florida, the majority of ASCs (93 percent) were for-profit organizations: 58.4 percent were corporately owned, 33.5 percent were partnerships, and 1.4 percent were individually owned. Ninety-six percent of ASCs were located in urban areas. During the study period, the number of ASCs increased from 204 to 286. On the other hand, the number of HOPDs has been steady over the same period ($n = 198$). Almost half of HOPDs (45.2 percent) were affiliated with for-profit hospitals. A total of 5.7 percent of HOPDs were part of teaching hospitals. The majority of HOPDs (87 percent) were located in urban areas. This information on ASCs and HOPDs in Florida follow similar trends in the national data (MedPAC, 2004).

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SUPPLEMENTARY MATERIAL

The following supplementary material for this article is available online:

Appendix A. Aggregation of Ambulatory Surgery Procedures into 12 Groups.

This material is available as part of the online article from: <http://www.blackwell-synergy.com/doi/abs/10.1111/j.1475-6773.2007.00809.x> (this link will take you to the article abstract).

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Inpatient Hospital Admission and Death After Outpatient Surgery in Elderly Patients

Importance of Patient and System Characteristics and Location of Care

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Hypothesis: Surgery at different outpatient care locations in the higher-risk elderly (age >65 years) population is associated with similar rates of inpatient hospital admission and death.

Design: Claims analysis of patients undergoing 16 different surgical procedures in a nationally representative (5%) sample of Medicare beneficiaries for the years 1994 through 1999.

Setting: Hospital-based outpatient centers, freestanding ambulatory surgery centers (ASCs), and physicians' office facilities.

Patients: Medicare beneficiaries older than 65 years.

Main Outcome Measures: Rate of death, emergency department risk, and admission to an inpatient hospital within 7 days of outpatient surgery.

Results: We studied 564 267 outpatient surgical procedures: 360 780 at an outpatient hospital, 175 288 at an ASC, and 28 199 at a physician's office. There were no deaths the day of surgery at a physician's office, 4 deaths

the day of surgery at an ASC (2.3 per 100 000 outpatient procedures), and 9 deaths the day of surgery at an outpatient hospital (2.5 per 100 000 outpatient procedures). The 7-day mortality rate was 35 per 100 000 outpatient procedures at a physician's office, 25 per 100 000 outpatient procedures at an ASC, and 50 per 100 000 outpatient procedures at an outpatient hospital. The rate of admission to an inpatient hospital within 7 days of outpatient surgery was 9.08 per 1000 outpatient procedures at a physician's office, 8.41 per 1000 outpatient procedures at an ASC, and 21 per 1000 outpatient procedures at an outpatient hospital. In multivariate models, more advanced age, prior inpatient hospital admission within 6 months, surgical performance at a physician's office or outpatient hospital, and invasiveness of surgery identified those patients who were at increased risk of inpatient hospital admission or death within 7 days of surgery at an outpatient facility.

Conclusion: This study represents an initial effort to demonstrate the risk associated with outpatient surgery in a large, diverse population of elderly individuals.

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IT HAS BEEN ESTIMATED THAT approximately 60% to 70% of all surgical procedures are now being performed on an outpatient basis.¹ As outpatient surgery continues to include a wider range of procedures and is offered to more patients at high risk, it is important to examine its safety in actual settings for high-risk populations.

Although complications in ambulatory surgery are relatively uncommon, little is known about the characteristics of patients or settings that have higher rates of poor outcomes such as death, unplanned hospitalizations, or emergency department (ED) visits following the procedure. Elderly individuals represent a high-risk group for clinical complications during surgery and during the period of recovery.²

We chose 7-day and 30-day periods of follow-up, whereas previous studies have used a 30-day period.^{3,4} A short period is less likely to introduce extraneous factors that may be unrelated to these less invasive procedures.

The ability to assess the absolute rates of inpatient hospital admission and death is limited by the large sample size required given the low rate of events. In the absence of a prospective study, administrative datasets such as Medicare claims allow one to determine current practice patterns and generate hypotheses for future investigation. We therefore used medical claims from a nationally representative sample of Medicare beneficiaries to determine if certain characteristics of patients or facilities were associated with higher adverse occurrences. We chose to evaluate

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16 surgical procedures based on their prevalence in the outpatient setting and their rapid diffusion from the inpatient to the outpatient setting during the last 10 years. To determine the influence of location of care of the initial procedure on outcome, we stratified these procedures into those performed in hospital-based outpatient centers, freestanding ambulatory surgery centers (ASCs), and physicians' office-based practices and attempted to minimize the influence of selection bias by developing models that incorporated both a comorbidity scale and a measure of the propensity to use medical resources. This information could then be used to help identify patients most likely to require direct inpatient hospital admission from an outpatient surgery center and to provide information to patients and families about the potential need for prolonged observation for complications that may occur during the first week after surgery.

METHODS

The investigation involved a retrospective study of surgical procedures performed in Medicare beneficiaries from 1994 through 1999. For each year, individuals aged 65 years and older, living in the United States, and enrolled in the Medicare program with both part A and part B fee-for-service coverage were included.

Data were obtained from 5% of the standard analytic files for the calendar years 1994 through 1999. These files are produced by the Center for Medicare and Medicaid Services, Baltimore, Md, and contain a nationally representative random sample of Medicare beneficiaries, which is commonly used for research purposes. Participants in Medicare managed care programs are not included in the dataset. In 1994, there were 1941453 beneficiaries in the database. By 1999, the number had increased to 2055561 beneficiaries. In all 6 years, 62% were women, and 84% were white.

We monitored 16 outpatient procedures: cataract, transurethral resection of the prostate, inguinal hernia, femoral hernia, umbilical hernia, laparoscopic cholecystectomy, dilation and curettage, simple mastectomy, modified mastectomy, carpal tunnel repair, knee arthroscopy, hysteroscopy, rotator cuff repair, arteriovenous graft placement, hemorrhoidectomy, and vaginal hysterectomy. Each procedure was then mapped to a single code or group of *Current Procedural Terminology*⁵-related codes. The location of care was determined by a place-of-service code on the surgeon's claim. The term *outpatient hospitals* refers to surgery performed in hospitals on an outpatient basis. Because of coding rules, office-based care includes procedures actually performed in a physician's office and those performed at a nonaccredited ASC. The date of surgery was determined from the surgeon's claim. Each operation was considered an independent event so that some patients may have had more than 1 procedure in the analysis.

Death, hospitalizations, and ED visits within 7 days of the outpatient procedure were the 3 outcome variables. Death was assessed from the Medicare enrollment files. Emergency department visits included any new physician claim with the ED as the place of service within 7 days of the outpatient procedure. Hospitalizations within 7 and 30 days of the outpatient procedure were assessed by the presence of a new Medicare part B physician claim with place of service coded as "inpatient." To minimize potential errors resulting from inappropriate coding of service location for any subsequent inpatient hospital admission, we eliminated any encounters related to physicians who do not typically admit patients to the hospital (radiologists, pathologists, and anesthesiologists).

STATISTICAL ANALYSIS

The rates of admission to an inpatient hospital, ED visits, and death within 7 and 30 days of surgery per 1000 outpatient procedures by location of care were calculated. The rates for days 0 to 7 and days 8 to 30 were recalculated to determine the rate per day by dividing the total number of inpatient hospital admissions by the number of days in the interval of interest. Differences in the rates of inpatient hospital admission between locations of care were determined using the χ^2 test. To adjust for severity of illness, several factors previously shown to affect inpatient hospital admission rates were included in the analysis.⁶ Specifically, age (by 5-year cohorts), sex, race, prior admissions to an inpatient hospital, and comorbidity were included in the model. The number of prior admissions to an inpatient hospital within the 2 quarters prior to the quarter in which the outpatient surgery was performed was included as a proxy for the propensity to use medical services.⁷

The effect of coexisting medical conditions was assessed by modification of the Charlson index⁸ by Deyo et al⁹ using information from the previous 2 quarters prior to the quarter of the surgical procedure. The patient without any part A Medicare claims was considered to have a comorbidity index of 0.

Logistic regression equations were individually calculated for each of the outcomes of death, inpatient hospital admission, or ED visits (SAS software version 8.02; SAS Institute Inc, Cary, NC). The logistic regression equations were calculated only for procedures performed between 1995 and 1999 to determine inpatient hospital admission history using the 1994 claims. All of the risk adjustment factors mentioned previously were entered into these models, including either Charlson index or inpatient hospital admission history. The base-case scenario was assumed to be a white man aged 65 to 69 years undergoing cataract surgery at an ASC. An additional set of logistic regression equations was developed for the outcomes of death and inpatient hospital admissions for each surgical procedure. The C statistic (the area under the receiver operating characteristic curve) was calculated for the models. The C statistic ranges from 0.5 to 1, where C = 1 for a perfect model and C = 0.5 for a model no better than random classification.

RESULTS

We studied 564267 outpatient surgical procedures: 360780 (64%) at an outpatient hospital, 175288 (31%) at a freestanding ASC, and 28199 (5%) at a physician's office. For the 16 procedures, there was a trend toward increasing frequency in the outpatient setting from 1994 through 1999, except for cataract surgery, which was already performed in the outpatient setting 98.6% of the time in 1994. For the 16 procedures, the proportion of surgery in the outpatient hospital increased from 80.6% in 1994 to 88.2% in 1999. This is higher than the rate for all surgical procedures because we selected 16 procedures that were more likely to be performed in the outpatient setting.

Table 1 presents the rates of death, ED visits, and inpatient hospital admissions at 7 and 30 days postsur-

Table 1. Rate of Adverse Events per Day (per 100 000 Procedures) by Site of Care for 16 Procedures Performed in Medicare Beneficiaries From 1994 Through 1999*

Adverse Event†	Outpatient Hospital	ASC	Physician's Office	All Outpatient Locations Combined
Death same calendar day as procedure	2.5	2.3	0.0	2.3
Death, 0-7 days	6.2	3.1	4.4	5.1
Death, 8-30 days	7.3	5.6	5.2	6.6
ED visit, 0-7 days	259.1	103.6	109.9	203.3
ED visit, 8-30 days	106.6	79.6	60.3	95.9
Inpatient hospital admission, 0-7 days	432.7	91.3	226.5	316.3
Inpatient hospital admission, 8-30 days	115.3	74.0	74.3	100.4
Total No. of procedures	360 780	175 288	28 199	564 267

Abbreviations: ASC, ambulatory surgery center; ED, emergency department.

*"Days" refers to number of days after outpatient surgery.

†Values expressed as number of occurrences unless otherwise indicated..

gery. The rate of deaths per day was lower during the first 7 days after surgery compared with the subsequent 23 days, and the rate of ED visits and inpatient hospital admissions per day was greatest during the first 7 days.

Multivariate logistic models for all 16 procedures were developed separately for death, ED visits, and inpatient hospital admission within 7 days of outpatient surgery. The statistically significant ($P < .05$) predictors of death within 7 days of outpatient surgery included being older than 85 years (odds ratio [OR], 2.30; 95% confidence interval [CI], 1.41-2.97), being female (OR, 0.69; 95% CI, 0.51-0.93), having surgery initially performed in an outpatient hospital (OR, 1.47; 95% CI, 1.00-2.16), and having prior inpatient hospital admissions (OR per admission, 1.44; 95% CI, 1.29-1.61). During the 5 years used in the multivariate model, there were 156 deaths, none of which were patients who underwent simple mastectomy, femoral hernia, or rotator cuff repair.

The rate of admission to an inpatient hospital within 7 days of surgery increased with the number of inpatient hospital admissions during the previous 2 quarters of care. Similarly, the rates of 1-week outcomes increased with the number of comorbidities included in the modification of the Charlson index by Deyo et al.⁸ Approximately one third of physician Medicare claims associated with inpatient hospital admissions after outpatient surgery were related to the previously defined list of medical complications.

Table 2 presents ED visits, and **Table 3** presents inpatient hospital admissions within 7 days of outpatient surgery. Replacing the continuous prior inpatient hospital admission variable with inpatient hospital admission within 7 days of outpatient surgery with a series of prior inpatient hospital admissions on an ordinal scale demonstrates ORs as follows: 1 prior admission (OR, 1.50; 95% CI, 1.42-1.59), 2 prior admissions (OR, 2.06; 95% CI, 1.89-2.26), 3 prior admissions (OR, 2.43; 95% CI, 2.10-2.82), and 4 or more prior admissions (OR, 3.39; 95% CI, 2.84-4.04). Rerunning the logistic regression equations with the modification of the Charlson index and replacing the variable for prior inpatient hospital admissions did not change the significant predictors of out-

Table 2. Risk Factors for Emergency Department Visit Within 7 Days of Outpatient Surgery for Medicare Beneficiaries Undergoing 16 Procedures From 1995 Through 1999*

Risk Factor	Odds Ratio (95% Confidence Intervals)
African American	1.26 (1.16-1.38)
Hispanic	1.05 (0.85-1.29)
Female	0.93 (0.89-0.98)
Age, y	
70-74	1.01 (0.95-1.09)
75-79	1.08 (1.10-1.16)
80-84	1.19 (1.10-1.28)
≥85	1.39 (1.28-1.51)
Surgery at physician's office	0.71 (0.61-0.84)
Surgery at outpatient hospital	1.80 (1.69-1.92)
Prior inpatient hospital admission (per admission)	1.26 (1.22-1.29)
Type of outpatient surgery	
Carpal tunnel	1.68 (1.49-1.88)
Hysteroscopy	1.68 (1.39-2.03)
Inguinal hernia	2.86 (2.65-3.09)
Dilation and curettage	2.17 (1.85-2.54)
Knee arthroscopy	2.29 (2.08-2.51)
Radical mastectomy	2.40 (1.82-3.15)
Simple mastectomy	2.47 (1.66-3.67)
Hemorrhoidectomy	2.62 (2.25-3.06)
Rotator cuff repair	2.83 (2.34-3.42)
Umbilical hernia repair	2.84 (2.35-3.42)
Laparoscopic cholecystectomy	4.27 (3.93-4.63)
Transurethral resection of prostate	4.70 (4.17-5.29)
Femoral hernia	4.83 (3.62-6.45)
Arteriovenous graft placement	6.27 (5.53-7.11)

*Compared with a white man aged 65 to 69 years undergoing cataract surgery at an ambulatory surgery center. C statistic = 0.70.

comes within 7 days of outpatient surgery or the magnitude of the significance.

When the regression equations for the individual procedures were performed, the importance of age and prior inpatient hospital admissions was similar to the overall findings. The influence of location of care varied by procedure, although the stability and predictive value of the individual models were a function of the total sample size and number of adverse events. For those models with sufficient sample size, the risk-

Table 3. Risk Factors for Inpatient Hospitalization Within 7 Days of Outpatient Surgery for Medicare Beneficiaries Undergoing 16 Procedures From 1995 Through 1999*

Risk Factor	Odds Ratio (95% Confidence Intervals)
African American	1.66 (1.55-1.78)
Hispanic	3.03 (2.67-3.42)
Female	0.92 (0.88-0.96)
Age, y	
70-74	1.12 (1.05-1.18)
75-79	1.30 (1.23-1.38)
80-84	1.51 (1.42-1.61)
≥85	1.89 (1.76-2.02)
Surgery at physician's office	1.59 (1.40-1.81)
Surgery at outpatient hospital	2.66 (2.49-2.84)
Prior inpatient hospital admission (per admission)	1.36 (1.32-1.39)
Type of outpatient surgery	
Transurethral resection of prostate	13.21 (12.12-14.39)
Inguinal hernia	4.45 (4.16-4.75)
Laparoscopic cholecystectomy	12.30 (11.59-13.05)
Dilation and curettage	3.87 (3.43-4.36)
Simple mastectomy	8.99 (7.16-11.29)
Radical mastectomy	16.70 (14.66-19.03)
Carpal tunnel	1.18 (1.03-1.35)
Knee arthroscopy	2.57 (2.35-2.81)
Femoral hernia	6.05 (4.66-7.84)
Hysteroscopy	2.73 (2.35-3.18)
Rotator cuff repair	7.87 (6.94-8.93)
Umbilical hernia repair	5.75 (5.01-6.60)
Arteriovenous graft placement	12.48 (11.30-13.75)
Hemorrhoidectomy	2.35 (2.03-2.72)

*Compared with a white man aged 65 to 69 years undergoing cataract surgery at an ambulatory surgery center. C statistic = 0.80.

adjusted ORs for hospitalization and death within 7 days of outpatient surgery at an office-based care location are presented in **Table 4**.

COMMENT

Our sample of 16 surgical procedures frequently performed in an outpatient setting demonstrates a 7-day mortality rate of 41 people per 100 000 outpatient procedures, a rate of ED visits of 1630 per 100 000 outpatient procedures, and an inpatient hospital admission rate of 2530 people per 100 000 outpatient procedures. The rate varied among the procedures, with higher rates found either with greater invasiveness or based on an underlying indication for the surgery. The higher rate of inpatient hospital admissions and deaths for surgeries performed at an outpatient hospital supports the contention that physicians perform an adequate preoperative evaluation and appropriately perform surgery in patients at the highest risk in the location with the greatest available resources.

The rate of operative mortality associated with anesthesia and surgery in the outpatient setting (either in the operating room or postanesthesia care unit) has been estimated to be 0.25 to 0.50 per 100 000 outpatient procedures.¹⁰ These estimates were based on insurance claims of intraoperative mortality rates related to anesthesia in healthy individuals undergoing elective inpatient sur-

Table 4. Increased Risk Associated With Physician's Office Care Compared With Ambulatory Surgery Center Care for a Given Procedure When Risk for Each Procedure Was Evaluated Individually*

Procedure	Odds Ratio (95% Confidence Intervals)
Hemorrhoidectomy	0.15 (0.08-0.28)
Cataract	1.56 (1.29-1.88)
Hysteroscopy	2.31 (1.09-4.89)
Inguinal hernia	3.82 (2.34-6.24)
Arteriovenous graft placement	4.05 (1.58-10.36)
Knee arthroscopy	4.72 (2.47-9.01)
Transurethral resection of prostate	7.49 (4.16-13.48)
Umbilical hernia repair	10.79 (3.73-31.22)

*Adjusted for age, sex, race, and inpatient hospital admission history.

gery.¹⁰ The ability to generalize from this select inpatient sample to the outpatient arena is questionable. We estimated the same-day mortality rate in a population older than 65 years to be 2.5 per 100 000 outpatient surgeries or 5 to 10 times greater than these insurance claim estimates. The cause of mortality in our dataset could not be assessed and therefore includes deaths associated with anesthesia, surgery, patient disease, a combination of factors, or nonsurgical factors (eg, automobile accident). Of note, the death rate for this population was actually lowest on the day of surgery.

Patient-specific factors were important predictors of adverse events. Advanced age (>85 years) and significant comorbidity were associated with increased risk of inpatient hospital admission, similar to previous studies.^{4,11} The strongest predictor of inpatient hospital admission was the inpatient hospitalization history. In our study, we observed more than a 2-fold increased risk associated with multiple prior inpatient hospital admissions and a nearly 2-fold increased risk associated with the oldest age cohort. African American and Hispanic individuals also had a markedly elevated risk of inpatient hospital admission, possibly related to issues of access to care.¹² Additional analysis of the factors associated with poorer outcome in certain ethnic groups is clearly warranted.

There has been a great deal of interest in the safety of outpatient surgery.¹³⁻¹⁵ Recently, the US Department of Health and Human Services Office of Inspector General suggested that oversight of freestanding ASCs should be strengthened.¹³ However, our data suggest that ASCs have among the lowest adverse outcome rates of the 3 sites of care, even after controlling for factors associated with patients with higher risk. This most likely reflects strong physician and patient selection with regard to location of care and limitations in our risk adjustment.

During the late 1990s, physicians' office-based surgical procedures became much more common, with an estimated 5% to 8% of procedures being performed in a physician's office in 2000.¹⁶ Unlike the regulated environment of the outpatient hospital or freestanding ASC, most states have minimal regulations or standards regarding surgical care delivered in a physician's office. Therefore, the ability to respond to emergencies may be

diminished because of fewer personnel and equipment. There are currently no federal regulations or Medicare mandates regarding standards for outpatient surgeries performed in physicians' offices. For this reason, it is critical for physicians, patients, and insurers to understand the risks associated with different settings for patients with different risk profiles. We observed no deaths the day of surgery in a physician's office, although the precise rate cannot be determined given the small sample size. We observed an increased risk-adjusted rate of inpatient hospital admission or death within 7 days of surgery for procedures initially performed in a physician's office compared with an outpatient hospital, suggesting the need for continued surveillance. The rates were highly dependent on the surgical procedure, with hemorrhoidectomy associated with lower rates of adverse events in a physician's office, whereas increased rates of inpatient hospital admissions were observed for cataract extraction, hysteroscopy, inguinal hernia repair, arteriovenous graft placement, knee arthroscopy, transurethral resection of the prostate, and umbilical hernia repair performed in a physician's office.

Our rates of inpatient hospital admission after outpatient surgery were consistent with other studies. Twersky et al¹⁷ studied 6243 patients who underwent ambulatory surgery across 12 consecutive months and described 187 patients (2.9%) who returned to the same hospital, 1.3% of whom returned for complications from outpatient surgery. Mezei and Chung⁶ reported a 1.1% rate of inpatient hospital admission within 30 days of outpatient surgery.

From a clinical perspective, this suggests that the intersection of a patient with advanced age, with a history of inpatient hospital admission within the previous 2 quarters of the year, and who is undergoing a planned outpatient procedure with a higher risk for inpatient hospital admission warrants the institution of plans both to directly transfer that patient to a hospital if a complication arises in a freestanding or office-based facility or to monitor the patient at home after facility discharge for potential complications that warrant return to a hospital setting. The absolute rate of inpatient hospital admission, ED visits, and death within 7 days of outpatient surgery in this group at baseline was approximately 0.1%, but that may increase if performed in patients with multiple prior inpatient hospital admissions, advanced age, and procedures with greater risk (eg, transurethral resection of the prostate). The ability to identify specific subgroups of patients at greatest risk will allow a cost-effective approach for targeting care for a vulnerable population.

Our study had several limitations related to the use of an administrative database. We did not have patient-specific data such as type of anesthesia, operating room time, or monitoring. We could not determine the cause of the inpatient hospital admission or death. The accuracy of our analysis was limited to the accuracy and completeness of the coding in the standard analytic files. There may have been discrepancies in clinical codes as well as place of service coded as "office," which included both physicians' offices and unaccredited ASCs. Our assessment of dates was based on Medicare part B data including a physician claim with an inpatient hospital as the

location of care. Because some of these claims may reflect incorrectly coded outpatient visits, our data may reflect the upper limits of the number of inpatient hospital admissions. Some outpatient hospital-based facilities may perform surgery on patients for whom inpatient hospital admission is planned as part of their protocol. Our data also may be biased by underreporting, because claims may not be submitted for patients who die in the outpatient setting.

The strength of our conclusions with regard to location of care may represent an additional limitation because there is a clear selection bias with respect to which patients are appropriate for the different care locations. Physicians may recommend certain settings based on information not available in the claims data. We attempted to adjust for severity of illness using both prior inpatient hospital admission and the Charlson comorbidity index. Despite the multivariate models, there were higher rates of risk-adjusted outcomes in hospital-based outpatient surgery, suggesting that there may be additional selection criteria that were not measured by either of our established methods. Alternatively, the higher rates may be related to surgical complexity not reflected in *Current Procedural Terminology* codes. Selection may be the result of a wide array of ad hoc systems and protocols by which physicians make these judgments. This indicates a need for both standardization of data and an appropriate instrument for determining risk that can be used by the busy physician. Finally, our study is limited to the Medicare population and cannot be generalized to a younger population or procedures not covered by Medicare (eg, cosmetic procedures).

This study represents an initial effort to demonstrate in a large, diverse population the risks associated with outpatient surgery. It also demonstrates that patient outcomes are a function of patient characteristics independent of the surgical procedure, confirming the current perception of risk as a multivariate phenomenon. The accelerated pace at which more complex procedures are being performed in locations increasingly removed from sophisticated support facilities requires that this effort be structured to permit appropriate assessment of these trends. The lack of such analyses could encourage the inappropriate movement of patients and procedures to lower-intensity settings or, conversely, inhibit the appropriate movement of some of these procedures to lower-cost facilities that may be more accessible to patients. The ability to identify high-risk subsets would suggest that systems to ensure timely access to the health care system for complications that occur at home should be considered and allow for more appropriate preoperative evaluation and patient selection. As the trend toward increasingly complex procedures continues in the outpatient arena, the approach used here could be used to monitor the safety of the procedures performed in one setting when follow-up care may occur in a separate setting.

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Surgical Anatomy

The cutaneous nerves of the front of the thigh are derived from segments L. 1, 2, 3, 4. The lateral, intermediate, and medial cutaneous nerves of the thigh and the (long) saphenous nerve are derived from the femoral nerve. They pierce the deep fascia along an oblique line that roughly marks the Sartorius.

Source: Boileau Grant JC. *A Method of Anatomy: Descriptive and Deductive*. 5th ed. Baltimore, Md: Williams & Wilkins Co; 1952:382.

Clinical Science

A comparison of ambulatory perioperative times in hospitals and freestanding centers

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KEYWORDS:

Ambulatory surgery;
Ambulatory surgery
center;
Hospital outpatient
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Anesthesia use;
Surgical time

Abstract

BACKGROUND: The volume of surgical procedures performed in ambulatory surgical centers has increased rapidly.

METHODS: Ambulatory surgical visits of Medicare beneficiaries were compared for hospital-based and freestanding ambulatory surgical centers (ASCs). The main outcomes were time in surgery, time in operating room, time in postoperative care, and total perioperative time.

RESULTS: The mean total perioperative time for all procedures examined was 39% shorter in freestanding ASCs than in hospital-based ASCs (83 vs 135 min; $P < .01$); surgery time was 37% shorter (19 vs 30 min; $P < .01$), operating room time was 37% shorter (34 vs 54 min; $P < .01$), and postoperative time was 35% shorter (48 vs 74 min; $P < .01$).

CONCLUSIONS: Perioperative times were significantly shorter in freestanding ASCs than in hospital-based ASCs. It is unclear how much of the difference was the result of efficiency versus patient selection.

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The past 3 decades have seen substantial growth in ambulatory surgery performed in freestanding ambulatory surgery centers (ASCs) in the United States.^{1,2} In 2006, approximately 43% of 34.7 million ambulatory surgery visits took place in freestanding ASCs.² This growth has been attributed in part to the degree of control that freestanding ASCs afford surgeons over their professional lives through authority over staffing, surgical equipment, and scheduling.^{1,3} Freestanding ASCs may function as “focused factories,” allowing surgeons to achieve greater productivity relative to practicing in hospital outpatient departments.¹

Some differences in productivity also may be owing to physicians with ownership stakes in freestanding ASCs systematically referring lower-risk patients or more profitable procedures to freestanding ASCs instead of hospital outpatient departments.^{4,5}

Medicare payment policy implicitly recognizes that freestanding ASCs perform surgical procedures at a lower cost than hospital outpatient departments. Since 2008, freestanding ASCs have been reimbursed at a fixed percentage (61% in 2011) of the hospital rate for equivalent services. However, the payment differential is calculated on the basis of budget neutrality with previous payment systems and not on the basis of estimates of the cost of providing services in each setting.

Previous studies have found that for selected procedures freestanding ASCs provide care with equivalent safety and shorter surgical times relative to hospital outpatient departments.^{6–9} However, no studies have compared surgical times for a comprehensive set of ambulatory procedures

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performed in both hospitals and freestanding ASCs. The objective of this study was to compare surgical times for ambulatory procedures commonly performed in both hospitals and freestanding ASCs. A secondary objective was to compare anesthesia use by facility type.

Methods

The 2006 National Survey of Ambulatory Surgery (NSAS) public use data file, a survey of ambulatory procedures performed in hospitals and freestanding ASCs in the United States, was used for all analyses. A detailed description of the design and methodology used by the survey has been described previously.¹⁰ Briefly, the NSAS uses a multistage probability design to sample hospitals and freestanding ASCs.¹¹ An ASC was considered hospital-based if it was a facility that was licensed as a hospital and offered ambulatory surgery. The surgery could have occurred in a general operating room, in a room or facility dedicated to ambulatory surgery, or in a room dedicated to specialized procedures.¹⁰ A freestanding ASC was considered eligible for NSAS if it was either regulated by one of the states in the U.S. or was certified for participation in Medicare. In the 2006 survey, 142 of 189 eligible hospitals and 295 of 397 eligible freestanding ASCs responded. For each sampled facility, systematic random sampling was used to select a sample of ambulatory surgery visits. Data were abstracted for selected visits using a medical abstract form.

All analyses in this study were restricted to visits in which a single surgical procedure was performed, in which Medicare was the principle source of payment, and in which the patient routinely was discharged home. We compared hospital-based ASCs and freestanding ASCs on procedures in the following anatomic systems: nervous system (International Classification of Diseases, 9th revision, Clinical Modification [ICD-9-CM] procedure codes 01–05), eye system (ICD-9-CM procedure codes 08–16), cardiovascular system (ICD-9-CM procedure codes 35–39), digestive system (ICD-9-CM procedure codes 42–54), musculoskeletal system (ICD-9-CM procedure codes 76–84), integumentary system (ICD-9-CM procedure codes 85–86), and miscellaneous diagnostic and therapeutic procedures (ICD-9-CM procedure codes 87–99); and by the following selected procedures: release of carpal tunnel (ICD-9-CM procedure code 04.44), extraction of lens (ICD-9-CM procedure codes 13.1–13.6), other endoscopy of the small intestine (ICD-9-CM procedure code 45.13), endoscopic polypectomy of the large intestine (ICD-9-CM procedure code 45.42), closed (endoscopic) biopsy of the large intestine (ICD-9-CM procedure code 45.25), other local excision or destruction of lesion or tissue of skin and subcutaneous tissue (ICD-9-CM procedure code 86.3), upper-gastrointestinal endoscopy, biopsy (ICD-9-CM procedure codes 45.16 and 44.14), and diagnostic colonoscopy (ICD-9-CM procedure codes 45.22, 45.23, and 46.85). Only procedures that had at least 25 unweighted observations for both facility types were analyzed.

Table 1 Characteristics of patient visits by facility type

	Total	Hospital	FASC	P value
Total*	5,510,493	3,108,896	2,401,597	
Age				
Mean, y (SE)	71.0 (.4)	70.6 (.4)	71.4 (.8)	.42
<15 y, n (%)	17,018 (.3)	8,363 (.3)	8,655 (.4)	
15–44 y, n (%)	166,528 (3.0)	108,699 (3.5)	57,829 (2.4)	
45–64 y, n (%)	698,755 (12.7)	435,878 (14.0)	262,877 (10.9)	
65–74 y, n (%)	2,430,491 (44.1)	1,312,266 (42.2)	1,118,225 (46.6)	
≥75 y, n (%)	2,197,701 (39.9)	1,243,690 (40.0)	954,011 (39.7)	
Male, n (%)	2,444,348 (44.4)	1,407,478 (45.3)	1,036,870 (43.2)	.23
Diagnoses, n				
Mean (SE)	2.1 (.1)	2.4 (.2)	1.7 (.1)	<.001
1	2,729,429 (49.5)	1,374,572 (44.2)	1,354,857 (56.4)	
2	1,270,468 (23.1)	660,401 (21.2)	610,067 (25.4)	
3	687,929 (12.5)	381,413 (12.3)	306,516 (12.8)	
4	294,840 (5.4)	207,240 (6.7)	87,600 (3.6)	
5	200,521 (3.6)	173,810 (5.6)	26,711 (1.1)	
6	155,797 (2.8)	146,049 (4.7)	9,748 (.4)	
7	171,509 (3.1)	165,411 (5.3)	6,098 (.3)	
Symptoms, n				
Mean (SE)	.04 (.01)	.04 (.01)	.04 (.01)	.99
0	5,293,377 (96.1)	2,986,316 (96.1)	2,307,061 (96.1)	
1	204,865 (3.7)	115,702 (3.7)	89,163 (3.7)	
2	10,022 (.2)	5,830 (.2)	4,192 (.2)	
3	2,229 (.0)	1,048 (.0)	1,181 (.0)	

FASC = freestanding ambulatory surgery center; SE = standard error.

*Total number of visits, based on weighted frequencies, for Medicare beneficiaries who underwent one procedure and were discharged home.

Our main outcome of interest was surgical time. We assessed 4 time periods in our analyses: total time, the time between when the patient entered the operating room and left postoperative care; surgery time, the time between when surgery began and when surgery ended; operating room time, the length of time spent in the operating room; and postoperative time, the length of time spent in postoperative care.

Descriptive statistics were used to compare the hospital-based and freestanding ASC visits by age distribution, sex, number of diagnoses reported at the time of visit, number of symptoms occurring during the procedure, and anesthesia use overall and for select procedures. The *t* test was used to test differences in mean surgical times by facility type, accounting for the survey design. SAS 9.2 (SAS Institute, Cary, NC) and SUDAAN 10.0 (RTI, Research Triangle Park, NC) were used to perform statistical analyses.

Results

Our sample included a total of 5,510,493 visits listing a single procedure performed on routinely discharged patients with Medicare as the principal payer. Table 1 presents a comparison of selected characteristics of the visits by facility type. The age and gender distribution of the visits were

not significantly different between the facility types. Hospital-based ASCs reported a higher number of diagnoses per patient than freestanding ASCs (2.4 vs 1.7 diagnoses; $P < .01$). There were no marked differences in the reporting of symptoms related to the surgery. The most common symptoms reported were hypertension, nausea, and hypotension (data not shown).

Freestanding ASCs were more likely to report using intravenous (IV) sedation during patient visits (49% vs 41%) than hospital-based centers overall, but were less likely to report use of general anesthesia (15% vs 21%) (Table 2). The use of anesthesia between the facility types also varied for upper-gastrointestinal endoscopy and diagnostic colonoscopy, procedures for which moderate sedation is indicated based on Appendix G of the Current Procedural Terminology code book. For upper-gastrointestinal endoscopy, freestanding ASCs reported more frequent use of IV sedation and monitored anesthesia care; for diagnostic colonoscopy, freestanding ASCs reported more frequent use of monitored anesthesia care and general anesthesia, but similar uses of IV sedation.

Table 3 presents comparisons of surgical times for procedures with at least 25 unweighted observations by facility type. The mean total time for all procedures was 39% shorter in freestanding ASCs than hospital-based ASCs (83 vs 135 min; $P < .01$). The mean total time was shorter in freestanding

Table 2 Anesthesia use by facility type, overall, and for select procedures

	Total	Hospital	FASC
Total visits*, n [†]	5,510,493	3,108,896	2,401,597
Topical, n (%)	1,020,561 (19)	530,006 (17)	490,555 (20)
IV sedation, n (%)	2,450,245 (44)	1,273,752 (41)	1,176,493 (49)
Monitored anesthesia care, n (%)	1,275,314 (23)	691,043 (22)	584,271 (24)
Regional epidural, n (%)	28,487 (1)	11,458 (0)	17,029 (1)
Regional spinal, n (%)	47,918 (1)	46,044 (1)	1,874 (0)
Regional retrobulbar block, n (%)	39,228 (1)	14,473 (0)	24,755 (1)
Regional peribulbar block, n (%)	7,294 (0)	2,395 (0)	4,899 (0)
Regional block, n (%)	106,509 (2)	51,483 (2)	55,026 (2)
General, n (%)	1,002,930 (18)	650,095 (21)	352,835 (15)
Other, n (%)	114,045 (2)	59,932 (2)	54,113 (2)
None specified, n (%)	389,548 (7)	258,727 (8)	130,821 (5)
Upper GI endoscopy biopsy			
Total, n [‡]	382,955	210,817	172,138
Topical, n (%)	32,444 (8)	18,570 (9)	13,874 (8)
IV sedation, n (%)	281,212 (73)	147,136 (70)	134,076 (78)
Monitored anesthesia care, n (%)	97,790 (26)	40,318 (19)	57,472 (33)
General, n (%)	23,575 (6)	17,520 (8)	6,055 (4)
Diagnostic colonoscopy			
Total, n [§]	1,121,017	446,154	674,863
Topical, n (%)	57,947 (5)	31,012 (7)	26,935 (4)
IV sedation, n (%)	786,228 (70)	312,267 (70)	473,961 (70)
Monitored anesthesia care, n (%)	273,938 (24)	893,44 (20)	184,594 (27)
General, n (%)	106,243 (9)	15,344 (3)	90,899 (13)

FASC = freestanding ambulatory surgery center.

*Based on weighted frequencies.

†Total number of surgical visits for Medicare beneficiaries who underwent one procedure and were discharged home.

‡Total number of visits during which an upper-gastrointestinal endoscopy was performed.

§Total number of visits during which a diagnostic colonoscopy was performed.

Percentages total more than 100% when more than one type of anesthesia was used per visit.

Table 3 Surgical times by anatomic site/procedures and facility type

		Mean total time, min			Mean surgery time, min			Mean time in operating room, min			Mean time in postoperative care, min		
		Hospital	FASC	<i>P</i> value	Hospital	FASC	<i>P</i> value	Hospital	FASC	<i>P</i> value	Hospital	FASC	<i>P</i> value
Total*	N	135	83	<.001	30	19	<.001	54	34	<.001	74	48	<.001
Nervous system	385,255	91	55	<.001	19	12	.006	38	24	.002	52	30	.001
Release of carpal tunnel	102,295	107	80	<.001	18	18	.93	42	36	.06	63	45	<.001
Eye	552,723	96	77	.08	29	23	.17	48	43	.30	45	40	.40
Extraction of lens	322,730	69	66	.81	15	15	.97	33	34	.80	37	37	.94
Cardiovascular system	261,642	227	230	.89	49	27	.002	80	43	<.001	126	185	.04
Digestive system	2,761,703	111	78	<.001	23	16	.001	44	29	<.001	63	46	<.001
Other endoscopy of small intestine	287,007	99	74	.02	11	11	.68	32	25	.04	64	45	.07
Endoscopic polypectomy of large intestine	320,955	97	81	.04	24	19	.02	42	38	.38	54	42	.02
Closed (endoscopic) biopsy of large intestine	246,171	116	79	<.001	25	18	<.001	44	28	<.001	75	51	.02
Musculoskeletal system	358,510	175	132	.02	39	37	.79	69	63	.28	86	68	.02
Integumentary system	370,455	138	106	.003	31	26	.09	56	48	.04	81	59	.01
Other local excision or destruction of lesion or tissue of skin and subcutaneous tissue	107,781	108	93	.17	28	23	.22	54	41	.007	49	54	.46
Miscellaneous diagnostic and therapeutic procedures and new technologies	317,064	183	78	<.001	47	18	.02	70	40	.03	87	38	.003

FASC = freestanding ambulatory surgery center.

*Weighted number of visits for each procedure.

ASCs for most categories of procedures. The exceptions were procedures for the eye, cardiovascular system, and local excisions, for which there was no statistically significant difference in the mean total time between settings. The mean time was shorter in freestanding ASCs than hospital-based ASCs across 3 subperiods of time: compared with hospitals, ASC surgery time was 37% shorter (19 vs 30 min; $P < .01$), operating room time was 37% shorter (34 vs 54 min; $P < .01$), and postoperative time was 35% shorter (48 vs 74 min; $P < .01$).

Comments

This study found that in the Medicare population with visits resulting in discharge to home, freestanding ASCs perform surgeries in less time than hospital-based ASCs

overall and for procedures on various anatomic systems. The difference in average surgical times was approximately equal to the difference in 2011 Medicare payment amounts per relative value unit (freestanding ASCs at 56% of hospitals). Our results corroborate the notion that freestanding ASCs tend to be more efficient than hospital-based surgery centers. Trentman et al⁶ examined breast surgeries in a freestanding ASC and in the hospital setting and reported that in their freestanding ASC the total time in the facility was 69 minutes shorter than when the same procedures were performed in a hospital setting, although surgeries in the hospital consisted of both inpatient and outpatient surgeries. Most of the reduction in time was during the preoperative phase, which differed from our results that indicated freestanding ASCs were shorter in actual surgery time, time in the operating room, and in postoperative time; data were not

available on preoperation surgical time in the NSAS. Trentman et al⁶ did find that freestanding ASC patients spent less time in the postanesthesia care unit than hospital patients (112 vs 121 min; $P = .16$), which was not as substantial a difference as the time spent in postoperative care that our study found (74 vs 48 min; $P < .01$).

Our analyses also suggest that there are differences in practice between ASCs and hospital-based ambulatory surgery with regards to the use of anesthesia during surgery. Freestanding ASCs were more likely to use IV sedation and monitored anesthesia care for upper-gastrointestinal biopsy, and were more likely to use IV sedation overall. The Trentman et al⁶ study found that use of anesthesia was similar in the freestanding ASCs and the hospital, although they reported that during surgery higher doses of fentanyl and ketorolac were used. The differences in anesthesia use in freestanding ASCs partially may explain the shorter time spent in postoperative care found in our study because there was a shorter recovery time associated with the use of moderate sedation than with the use of general anesthesia.^{12,13}

Our study had several important limitations. The NSAS definition of ambulatory surgery results in the grouping together of a variety of surgical styles among the hospital-based ASCs. We were unable to distinguish between ambulatory surgeries that occurred in the main operating room of a hospital, which may have been more likely to be influenced by the operational logistics associated with hospital outpatient surgery, and surgeries that occurred in a hospital-owned facility located in a site distinct from the hospital, which may be more likely to be run in a fashion similar to freestanding ASCs. This mixing of surgical styles among the hospital-based ASCs may have diluted the estimated differences in surgical times between facility types.

There were little detailed patient-level data available. Although the age and gender distribution of patient visits served by the 2 facility types were similar, our analyses were unable to account for possible differences in the case mix between the 2 facility types, although the number of diagnoses, which were somewhat higher in the hospital-based ambulatory surgery visits, may be used as a proxy for comorbidity. Evidence suggests that freestanding ASCs see patients with less comorbidity and complexity than hospitals.^{7,14} We also were unable to analyze facility-level factors, such as patient volume, facility ownership, teaching status of the hospital, and characteristics of the surgeons performing procedures, which may have affected the comparability of surgeries performed in this study. Also, because of small unweighted sample sizes, we were unable to examine surgical times for more specific procedures, which would have facilitated more apt comparisons between freestanding and hospital-based ASCs.

Despite the limitations, our study adds to the evidence that ambulatory surgeries performed in freestanding centers are more efficient than surgery performed in hospital-based centers. It is important to understand what drives the higher

efficiency of freestanding ASCs so the successful elements of their practice can be adopted by other facility types, as appropriate. As the population of the United States ages and more citizens become eligible for Medicare, more efficient, high-quality care will be essential. Future research should address how to improve efficiency in hospital-based ambulatory surgery centers while containing costs.

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Medicare Payments for Outpatient Urological Surgery by Location of Care

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Purpose: The cost implications associated with offloading outpatient surgery from hospitals to ambulatory surgery centers and the physician office remain poorly defined. Therefore, we determined whether payments for outpatient surgery vary by location of care.

Materials and Methods: Using national Medicare claims from 1998 to 2006, we identified elderly patients who underwent 1 of 22 common outpatient urological procedures. For each procedure we measured all relevant payments (in United States dollars) made during the 30-day claims window that encompassed the procedure date. We then categorized payment types (hospital, physician and outpatient facility). Finally, we used multivariable regression to compare price standardized payments across hospitals, ambulatory surgery centers and the physician office.

Results: Average total payments for outpatient surgery episodes varied widely from \$200 for urethral dilation in the physician office to \$5,688 for hospital based shock wave lithotripsy. For all but 2 procedure groups, ambulatory surgery centers and physician offices were associated with lower overall episode payments than hospitals. For instance, average total payments for urodynamic procedures performed at ambulatory surgery centers were less than a third of those done at hospitals ($p < 0.001$). Compared to hospitals, office based prostate biopsies were nearly 75% less costly ($p < 0.001$). Outpatient facility payments were the biggest driver of these differences.

Conclusions: These data support policies that encourage the provision of outpatient surgery in less resource intensive settings.

Key Words: episode of care; insurance, health, reimbursement; surgical procedures, operative; economics

NEARLY 53 million outpatient procedures are performed annually in the United States.¹ While most of these procedures traditionally occur in HOPDs, more and more are now being done at nonhospital based facilities such as freestanding ASCs and physician offices.² In fact, the rate of ambulatory surgery visits to these facilities has

increased by 300% during the last decade.³ Surgical care delivered at an ASC or the physician office has several advantages. More rapid case turnaround leads to less time in the health care setting,⁴ which may enhance patient satisfaction. Furthermore, these facilities allow physicians greater administrative control over

Abbreviations and Acronyms

ASC = ambulatory surgery center

CMS = Centers for Medicare & Medicaid Services

HOPD = hospital outpatient department

PO = physician office

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the practice environment, which allows for increased productivity.⁵

However, the cost implications for payers associated with offloading outpatient surgery from the hospital remain poorly defined. On one hand, ASCs and POs may be associated with lower costs per surgical episode. Unlike hospitals, which must maintain sufficient infrastructure to support inpatient care, these facilities furnish exclusively outpatient services and, thus, can provide streamlined treatment.⁶ Conversely, there are circumstances under which ASCs and physician offices might not be as cost-efficient. For instance, these facilities have less capacity than hospitals to manage unforeseen emergencies. If complications requiring postoperative admission and/or professional care occur frequently,^{7,8} surgery at an ASC or in the physician office may be more expensive.

In this context we used national Medicare claims to examine episode payments around 22 common outpatient urological procedures. In addition to providing a detailed description of how payments are currently dispersed across hospitals, ASCs and POs, we explored the extent to which different types of payments vary by the ambulatory care setting where a procedure is performed.

METHODS

Subjects and Databases

For our study we used the 5% national sample of Medicare standard analytic files, including hospital inpatient, hospital outpatient and carrier claims. We obtained all files for calendar years 1998 through 2006 from CMS. We excluded from our study population Medicare Advantage patients because services provided to them are not consistently captured in claims files. We also excluded patients younger than 65 years old as well as those not enrolled in Medicare parts A and B for 6 months before and after surgery.

We used HCPCS (Healthcare Common Procedure Coding System) codes to identify patients within the carrier claims file undergoing endoscopic bladder, urethral or ureteral surgery; microwave therapy for prostate enlargement; prostate biopsy; shock wave lithotripsy; urethral dilation or urodynamic procedures. We selected these procedures because they can be performed in hospitals, ASCs or POs, and because they capture approximately 95% of outpatient procedures performed by urologists.

Ambulatory Surgery Setting

Through the unique Medicare provider number we assigned all patients to the facility where their procedure was performed. Next, we constructed a 3-level categorical variable specifying the type of ambulatory care setting. To distinguish between procedures performed at hospitals from those done at ASCs and the physician office, we used appropriate Place of Service codes from the carrier line item file.

Assessing Episode

Payments for Ambulatory Surgery

We measured actual Medicare payments at the patient level. A fundamental step in defining our outcome was deciding which payments were reasonably attributed to the surgical episode. Consistent with MedPAC (Medicare Payment Advisory Commission) recommendations,⁹ we used a claims window, extracting payment data for all services from the date of surgery to 30 days after the index procedure. This time frame allowed us to capture costs related to issues such as postoperative complications and unexpected hospital admissions before average payments returned to the preoperative baseline.¹⁰ We standardized all payments to 2005 United States dollars and price adjusted amounts to account for regional differences in Medicare reimbursement.¹¹

To better understand the source of any differences in payments we also characterized the major component payments. Specifically, we measured hospital payments, payments for physician services and outpatient facility payments. Hospital payments included those related to same day admissions and hospitalizations occurring within 30 days. Payments for physician services included professional fees as well as those for laboratory and imaging services. Facility payments for surgical services rendered at the physician office are packaged. Whereas Medicare collects separate facility claims from hospital and ASC based outpatient procedures, supplies and equipment payments for those procedures performed in the physician office are bundled into the practice expense component and paid via the physician fee schedule. Thus, under our accounting system, physician office facility payments are captured in the physician services component of total episode payments.

Statistical Analysis

For our initial analytic step, we made comparisons between patients based on the ambulatory setting where the procedure was performed. In particular, we examined differences among patients with respect to age, gender, race (white, black or other), comorbid status (assessed with an adaptation of the Charlson index¹²) and area of residence (Northeast, Midwest, South or West) using appropriate parametric and nonparametric statistics. We then compared, by procedure type, episode payments for patients (total and component) across ambulatory care settings. We accounted for case mix differences using multiple linear regression. Specifically, we adjusted our models for those patient characteristics described. Because our payment data were positively skewed, we had to apply a logarithmic transformation to normalize them. Given the potential correlation of observations (ie patients clustered within facilities), we used robust variance estimators.¹³ To derive predicted payments, we had to retransform our predicted values back to their original scale.¹⁴

We performed all analyses using SAS® version 9.1. All tests were 2-tailed and we set the probability of Type 1 error at 0.05. The institutional review boards of the University of California at Los Angeles and the University of Michigan approved this study.

Table 1. Differences in case mix across ambulatory care settings

	HOPD	ASC	PO
No. pts	33,802	16,798	233,971
Mean age (SD)	75.4 (6.8)	74.9 (6.5)	75.4 (6.7)
% Female	38.2	31.5	33.8
% Race:			
White	89.6	91.0	90.2
Black	7.7	7.2	5.6
Other	2.7	1.8	4.2
% Charlson score:			
0	59.1	82.6	62.9
1	23.1	9.4	22.3
2	9.9	4.6	8.7
3 or Greater	7.9	3.4	6.1
% Area of residence:			
Northeast	19.7	11.4	20.4
Midwest	37.8	17.0	24.4
South	34.2	59.1	38.5
West	8.3	12.5	16.7

All values $p < 0.001$.

RESULTS

During the study interval 88% of the procedures examined were performed at an ASC or a physician office. As shown in table 1 there were disproportionately more ambulatory surgery visits to these facilities among patients who resided in the South ($p < 0.001$). Women and black patients were less likely than men and white patients, respectively, to receive care at a nonhospital based facility ($p < 0.001$ for each comparison). In addition, the average Charlson score of a patient who underwent a procedure at an ASC or a physician office was lower than that of a patient treated at a hospital ($p < 0.001$).

Average unadjusted total payments for outpatient surgery episodes varied widely, from \$200 for urethral dilation at a physician office to \$5,688 for shock wave lithotripsy at a hospital. After accounting for case mix differences, ASCs and POs were less costly than hospitals for all but 2 procedure groups (table 2). For instance, average adjusted total payments for urodynamic procedures performed at ASCs were less than a third of those done in hospitals ($p < 0.001$). Compared to hospitals, office based prostate biopsies were nearly 75% less costly ($p < 0.001$). While the physician office tended to be more cost-efficient than ASCs, the absolute magnitude of this difference was small.

Outpatient facility payments were noted to be the biggest driver of the payment differences among hospitals, ASCs and the physician office (see figure). For example, outpatient facility payments accounted for 88% of the 30-day payments following shock wave lithotripsy at a hospital. Physician payments ranged from \$117 (urethral dilation at a physician office) to \$3,438 (microwave therapy at a physician office). Relative to hospitals, physician services constituted

a larger proportion of average total payments at ASCs and physician offices.

DISCUSSION

Our findings indicate that average total payments around outpatient surgical episodes for urological surgery vary by location of care. For comparable procedures, hospitals were associated with significantly higher 30-day payments than ASCs and the physician office. These differentials persisted even after case mix adjustment. In fact, offloading 50% of the procedures examined from hospitals to ASCs would save the Medicare program nearly \$66 million annually. While the physician office tended to be more cost-efficient than ASCs, the absolute magnitude of this difference was small. Outpatient facility payments were noted to be the biggest driver of the payment differences across ambulatory care settings.

To date, much of the literature on ambulatory surgical care at nonhospital based facilities has focused on the issue of physician ownership and overuse.^{15,16} Little work has examined their cost efficiency. Prior studies characterizing overall episode payments have been limited to common inpatient procedures.¹⁰ However, few have examined payments related to outpatient procedures. Wynn et al reported on payment differentials among ambulatory care settings for the facility related components of care.¹⁷ Their results showed that payment rates for similar services varied among hospitals, ASCs and the physician office, with the size of the differential varying by the service. Our findings suggest that these differences continue (and may even widen) well beyond the date of the index procedure, highlighting one of the advantages of ASCs and the physician office.

Our study must be considered in the context of several limitations. Several studies have compared

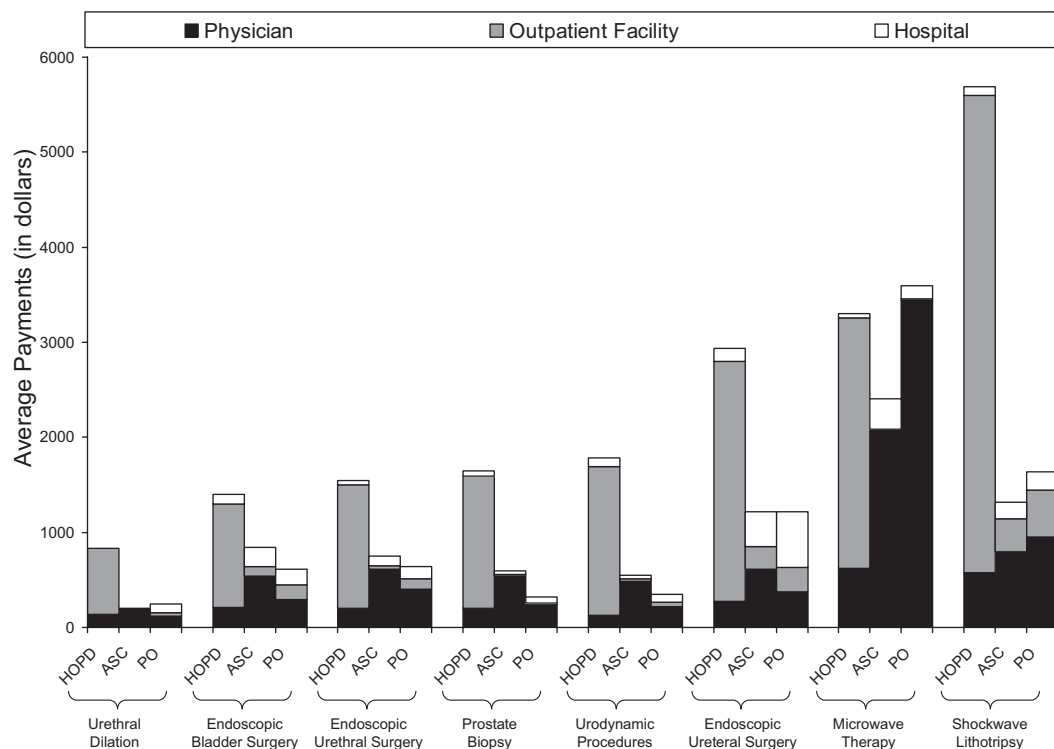
Table 2. Predicted episode payments

	Av Predicted 30-Day Payments (SD)		
	HOPD	ASC	PO
Urethral dilation	578 (47)	204 (27)	94 (7)
Endoscopic bladder surgery	908 (28)	519 (14)*	251 (11)†
Endoscopic urethral surgery	1,215 (47)	577 (20)*	338 (17)†
Urodynamic procedures	1,311 (78)	407 (21)*	152 (12)†
Prostate biopsy	868 (42)	521 (19)*	222 (11)†
Endoscopic ureteral surgery	2,129 (149)	634 (39)*	413 (31)†
Microwave therapy	3,029 (208)	2,084 (118)	3,174 (357)
Shock wave lithotripsy	4,754 (417)	943 (69)*	1,095 (77)†

All payments standardized to 2005 U.S. dollars. Adjustments made for case mix as well as regional differences in Medicare reimbursement.

* Predicted 30-day payments for given procedures performed at an ASC were significantly lower than for those performed at a HOPD ($p < 0.05$).

† Predicted 30-day payments for given procedures performed at a PO were significantly lower than for those performed at a HOPD ($p < 0.05$).



Differences in average total and component Medicare payments around episodes of urological procedures across ambulatory care settings.

the health status of patients treated across ambulatory care settings, demonstrating lower case complexity at nonhospital based facilities.^{18,19} To the extent that the treatment of low risk patients is also less expensive, our results might reflect patient clinical differences. We addressed this potential limitation in 2 ways. 1) We performed case mix adjustment using a well developed approach to measure comorbidity. 2) Because of potential heterogeneity among procedure groups, we also looked at total and component payments within them. In addition, we based our analysis on Medicare claims data and our results may not be generalizable to other payers. That said, the Medicare program accounts for 19% of total national spending on personal health services,²⁰ making it the single largest payer in the United States. Therefore, with regard to health care financing, as goes Medicare, so goes the nation. Finally, Medicare coverage for services provided at an ASC was recently changed.²¹ Since 2008 CMS has reimbursed facility fees for ASCs at two-thirds the rate of hospitals. Because our study was limited to claims through 2006, we could not assess the impact of this policy change on average 30-day payments. However, the differences that we observed across locations of care are likely to be more pronounced.

Limitations notwithstanding, our findings have possible implications for the Medicare program. If the observed differences among hospitals, ASCs and physician offices in average total payments around outpatient surgical episodes are unjustified (ie due to inefficiencies rather than case mix, service or content), CMS might base payment rates on costs at the least expensive setting. Alternatively, CMS may bundle reimbursements to facilities and physicians involved in care around an outpatient surgical episode into a single payment. Indeed the observed variation in outpatient facility payments suggests opportunities for improvement. Such a policy has been recommended by MedPAC for inpatient surgical procedures in the hopes that it will help align providers around the common goal of improving quality and cost efficiency.

Collectively our data support policies that encourage the provision of outpatient surgical care in less resource intensive settings. Moving forward, further research should consider how indirect costs are dispersed across hospitals, ASCs and physician offices. Moreover, additional studies are needed to determine whether the savings accrued by ASCs with lower episode costs are mitigated by increases in the total number of procedures associated with them.

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Outpatient Cholecystectomy at Hospitals Versus Freestanding Ambulatory Surgical Centers

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- BACKGROUND:** Because of safety concerns, some payers do not reimburse for laparoscopic cholecystectomy performed in freestanding ambulatory surgical centers (ASCs). This policy has been controversial because of increasing competition between ASCs and hospitals for low risk surgical patients.
- STUDY DESIGN:** We performed a retrospective cohort study of patients undergoing elective outpatient laparoscopic cholecystectomy in the state of Florida in 2002 and 2003 (n = 40,040), using the Agency for Healthcare Research and Quality State Ambulatory Surgery Database. Patients treated in hospitals and ASCs were compared with respect to patient characteristics, charges, outcomes, and processes of care.
- RESULTS:** For both hospital-based and ASC-based laparoscopic cholecystectomy patients, greater than 99% were successfully discharged home, and there were no reported deaths. Compared with those treated in hospitals, patients in ASCs had a higher rate of intraoperative cholangiogram (39% versus 36%, $p = 0.008$). There was no difference in the proportion of procedures converted to open cholecystectomy. ASC-based patients were slightly younger (mean age 45 years versus 49 years, $p < 0.001$), were less often diagnosed with acute cholecystitis (4.8% versus 8.3%, $p < 0.001$), and had fewer comorbidities on average than hospital-based patients, but both cohorts had few comorbidities overall (99% had Charlson scores of 0 or 1). ASC patients were more likely to be Caucasian (86% versus 75%, $p < 0.001$) and were more likely to have private insurance (92% versus 67%, $p < 0.001$). For patients who had ambulatory laparoscopic cholecystectomy as the only procedure, the median charges were \$6,028 at ASCs, compared with \$10,876 at hospitals.
- CONCLUSIONS:** In a population of slightly younger, healthier patients, laparoscopic cholecystectomy in freestanding ASCs appears to be performed safely and with substantially lower charges than in hospitals. (J Am Coll Surg 2008;206:301–305. © 2008 by the American College of Surgeons)
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In recent years, a debate has emerged between advocates of hospitals and freestanding ambulatory surgical centers (ASCs) over where certain outpatient surgical procedures should be performed. Hospital advocates are concerned about losing their lowest risk (and most profitable) patients to ASCs, leaving the more complicated, and less profitable cases to be performed in hospitals.^{1–3} ASC advocates view freestanding ambulatory surgery centers as a favorable alternative to traditional hospitals for selected outpatient procedures. They commonly cite greater efficiency and cost-effectiveness as the chief advantages.^{3–6}

Competing Interests Declared: None.

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Citing safety concerns, some payers do not reimburse for laparoscopic cholecystectomy performed in freestanding ASCs. For example, Medicare has not approved laparoscopic cholecystectomy in ASCs, although it does reimburse for outpatient cholecystectomy performed in the hospital setting.^{4,5} Some private insurance companies have followed Medicare's lead, and also do not reimburse for laparoscopic cholecystectomy in freestanding ASCs.^{4,5} Additionally, in 2004, the state of Pennsylvania's Department of Health categorically prohibited all outpatient cholecystectomy in freestanding ASCs, citing safety concerns as the reason.^{4,5}

To date, there have been no studies comparing patients who underwent laparoscopic cholecystectomy in hospitals versus freestanding ASCs. This study compares these two cohorts of patients with respect to safety (disposition, cholangiogram rates, and rates of conversion to open surgery), patient selection (social demographics, diagnoses, comorbidities, and payment source), and charges.

Abbreviations and Acronyms

AHRQ = Agency for Healthcare Research and Quality
 ASC = ambulatory surgery center
 SASD = State Ambulatory Surgery Databases

METHODS

We performed a retrospective cohort study of all patients undergoing elective outpatient cholecystectomy in the state of Florida in 2002 and 2003 ($n = 40,040$), using the Agency for Healthcare Research and Quality State Ambulatory Surgery Database (SASD). We chose Florida because of the states for which State Ambulatory Surgery Databases are available. Florida is the most populous of those that provide a relatively high volume of procedures in the database, have a substantial number of procedures performed in surgicenters, and provide CPT codes (as opposed to less specific ICD-9 procedure codes).

State Ambulatory Surgery Database

The SASDs are part of the Healthcare Cost and Utilization Project (HCUP), a family of health care databases developed through a federal-state-industry partnership and sponsored by the Agency for Healthcare Research and Quality. The SASDs consist of individual data files from 21 participating states. The SASDs represent 100% of each state's ambulatory surgery discharge records, and include records from both hospital-affiliated and freestanding surgery centers.⁷ SASDs do not include information for patients who undergo procedures performed in an inpatient hospital setting.

From the SASD from Florida, we selected all patients who had undergone laparoscopic cholecystectomy (CPT codes 47562, 47563, 47564) in 2002 and 2003. Analysis was restricted to adult patients, 18 years of age or older. Patients who presented through the emergency department ($n = 149$) and patients who had surgery on the weekend ($n = 3,135$) were excluded from the analysis to better approximate a truly elective caseload. Data abstracted included age, gender, race, payment source, CPT codes (up to 15 per patient), ICD-9 disease codes (up to 5 per patient), disposition, and financial charges. Patient files were linked to Florida's American Hospital Association linkage file to determine whether the surgery was performed in a hospital or a freestanding ASC. A Charlson comorbidity index was calculated for all patients using the ICD-9 diagnosis codes. (The Charlson index is a weighted measure of comorbidity that was developed by modeling the effect of various comorbidities on the risk of death within 1 year of admission to a general medical unit.)⁸ Patients treated in

Table 1. Patient Characteristics

Characteristics	ASC (n = 1,496)	Hospital (n = 38,544)	p Value
Age, mean, y	45.1	49.4	<0.001
Women, %	82.7	78.4	0.006
Men, %	17.3	21.6	0.006
Caucasian, %	85.6	74.8	<0.001
African-American, %	7.0	7.9	0.194
Hispanic, %	3.9	14.2	<0.001
Acute cholecystitis, %	4.8	8.3	<0.001

ACS, ambulatory surgical center.

hospitals were compared with those treated in freestanding ASCs with respect to outcomes and processes of care (disposition, cholangiogram rates, and rate of conversion to open surgery), evidence of patient selection (social demographics, diagnoses, comorbidities, and payment source), and charges (Florida SASD provides data only for charges, not costs). By SASD convention, cases converted to open cholecystectomy are coded using the CPT codes for open cholecystectomy (47600, 47605, 47610).

To compare financial charges between hospital-based and freestanding ASCs, we simply calculated and compared the average financial charge for laparoscopic cholecystectomies performed in these two settings. In recognition of the possibility that patients undergoing procedures in hospitals might be more complex (so might generate more charges), we also compared average charges for the sub-cohort of hospital and ASC patients who had only a single CPT code for laparoscopic cholecystectomy (47562), a single ICD-9 diagnosis code for biliary colic (574.2), no Charlson comorbidities (Charlson index = 0), and were discharged home on the same day of their operation.

Statistical analysis

STATA version 8.2 was used to compile data and perform statistical analyses. Chi-square tests were used to compare categorical variables, and Student's *t*-tests were used to compare continuous variables. All tests of statistical significance are at the 5% level, and all *p* values are two-tailed.

RESULTS

A total of 40,040 patients who underwent elective outpatient cholecystectomy were identified. Of these, 38,544 were treated in hospitals and 1,496 were treated in ASCs (Table 1). The ASC patients were younger (mean 45.1 years versus 49.4 years, $p = <0.001$), more likely to be Caucasian (85.6% versus 78.4%, $p = <0.001$), and more likely to be women (82.7% versus 74.8%, $p = 0.006$). ASC patients also had a lower incidence of acute cholecystitis (4.8% versus 8.3%, $p = <0.001$) when compared

Table 2. Comorbidities

Comorbidity	ASC, %	Hospital, %	p Value
Myocardial infarction	0.07	0.92	0.001
Coronary artery disease	0.47	3.04	<0.001
Hypertension	5.21	22.51	<0.001
Pulmonary disease	2.34	5.46	<0.001
Diabetes	1.27	6.39	<0.001
Mild liver disease	0.74	2.13	<0.001

ASC, ambulatory surgical center.

with the hospital-based patients, although in both cases, the absolute incidence of acute cholecystitis was low. (ICD-9 codes used to indicate acute cholecystitis were 574.0, 574.1, 574.3, 574.6, 574.7, 574.8, 575.0, 575.1, and 575.12.) Comparison of ICD-9 codes revealed that the hospital-based group was slightly more likely to have coronary artery disease, diabetes, mild liver disease, pulmonary disease, or history of myocardial infarction (Table 2). Charlson score differences between the two cohorts are shown in Table 3. Although the ASC patients were more likely to have a Charlson score of 0, greater than 98% of the patients in both groups had Charlson scores of 0 or 1.

Records were reviewed for other procedures most commonly coded along with laparoscopic cholecystectomy (Table 4). Performance of intraoperative cholangiogram, a practice associated with lower common bile duct injury rates, was more common at ASCs compared with hospitals (39.2% versus 35.8%, $p = 0.008$). There were no other marked differences in other secondary procedures performed. There was no difference in the rate of conversion to open cholecystectomy between ASCs and hospitals (0.72% versus 0.95%, $p = 0.228$). There was no notable difference in patient disposition between the two groups (Table 5). In both groups, more than 99% of the patients were discharged home on the day of operation, and there were no deaths in either group.

When compared for method of payment, the ASC-based patients were much more likely to have private insurance (92.3% versus 66.6%, $p = <0.001$; Table 6), reflecting Medicare's policy of not reimbursing for cholecystectomy performed in ASCs. Table 7 compares charges between the two groups. When all patients are included, the ASC patients had substantially lower median

Table 4. Additional Procedures

Procedure	ASC, %	Hospital, %	p Value
Cholangiogram	39.2	35.8	0.008
Common duct exploration	0.2	0.3	0.278
Umbilical herniorrhaphy	2.4	2.1	0.392
Liver biopsy	1.2	1.3	0.654

ASC, ambulatory surgical center.

Table 3. Charlson Index*

Charlson index	ASC, %	Hospital, %	p Value
0	95.8	85.2	<0.001
1	3.8	12.8	<0.001
2	0.3	1.7	<0.001
3	0.1	0.2	0.327
4	0.0	0.0	0.789
6	0.0	0.1	0.255
7	0.0	0.0	0.616

*Charlson index is based on data coded during this hospitalization.

ASC, ambulatory surgical center.

charges (\$6,402 versus \$11,744). In an attempt to control for case mix, charges were then compared between hospital and ASC patients who met the following criteria: single CPT code (47562 laparoscopic cholecystectomy), single ICD-9 diagnosis (574.5 biliary colic), no comorbidities (Charlson index = 0), and discharged home on the day of operation. In these patients, laparoscopic cholecystectomy was still performed with substantially lower median charges at ASCs compared with hospitals (\$6,028 versus \$10,876).

DISCUSSION

In this study of outpatient cholecystectomies in Florida in 2002 and 2003, we found that both ASCs and hospitals performed these procedures safely. Patients treated at ASCs tended to be slightly younger and healthier. ASC patients were more likely to undergo cholangiogram, and overall charges at ASCs were notably lower.

Several smaller studies have confirmed the relative safety of laparoscopic cholecystectomy as an outpatient procedure.^{5,6,9-13} In 1992, Voitk⁹ reported an 87% same-day discharge rate in a prospective study of 100 patients in Canada. Factors associated with admission to the hospital were age greater than 70 years, acute cholecystitis, major comorbid diseases (American Society of Anesthesiologists class 3 or above), or conversion to an open procedure. In 1995, Voitk¹⁰ published a validation study of 100 consecutive patients in need of elective cholecystectomy. Of these, 94% were able to be discharged home the day of operation. Four patients were admitted because of conversion to open surgery, and two were admitted because of comorbid disease. In 1997, Lam and colleagues¹³ published a series of

Table 5. Disposition

Disposition	ASC, %	Hospital, %	p Value
Admitted	0.0	0.30	<0.001
Discharged home	99.9	99.5	<0.001
Transferred	0.1	0.2	0.043

ASC, ambulatory surgical center.

Table 6. Payment Method

Payment method	ASC, %	Hospital, %	p Value
Medicare	3.4	20.4	<0.001
Medicaid	1.5	6.8	<0.001
Private insurance	92.3	66.6	<0.001
Self pay	2.1	2.2	0.0911

ASC, ambulatory surgical center.

213 elective outpatient laparoscopic cholecystectomies in a freestanding ASC in California. The patient population was carefully selected to have no evidence of acute cholecystitis, no laboratory or ultrasonography evidence of choledocholithiasis, and no evidence of major comorbid systemic diseases. There was a 2.8% rate of conversion to open cholecystectomy, and overall, a 97% rate of discharge home on the day of surgery. The seven patients needing admission were admitted to the hospital facility nearby. In 1998, Bashnagel and associates⁶ reported a small series of 66 patients aged 15 to 62 years with minimal medical comorbidities, who underwent laparoscopic cholecystectomy in a South Dakota ASC. The authors reported a 100% same-day discharge rate despite two conversions to open surgery in this highly selected patient group. Our study is the first to use a large, administrative database to compare patient characteristics and outcomes after cholecystectomy in hospitals versus freestanding ASCs. Our results echo those of earlier studies, in that more than 99% of patients in our study were discharged home on the day of operation. There was no difference in the rate of conversion to open surgery, and in both cases, the rate of conversion was less than 1%.

Although there are isolated reports from both hospitals⁹⁻¹² and ASCs^{5,6,13} showing that the typical patient selected for outpatient cholecystectomy has minimal comorbidities and no cholecystitis, hospital advocates often describe having a sicker, so more costly, population of patients for outpatient surgery compared with ASCs.¹⁻³ Winter² compared the case mix differences of patients undergoing several common outpatient procedures in hospitals and ASCs. The author used a "hierarchical condition category" model to assess Medicare beneficiaries for costliness based on age, gender, and diagnoses. He reported slightly lower hierarchical condition category scores in the ASC patients, and used this information to argue that hospitals should be reimbursed at higher rates than ASCs because of case mix differences. In our comparison of case mix differences between hospitals and ASCs, we found that although hospital patients had slightly higher rates of common comorbidities and a higher incidence of acute cholecystitis, both groups were generally healthy. In each group, more than 98% of patients had Charlson scores of 0 or 1, and very few had acute cholecystitis. Our finding of a relatively low rate of acute cholecystitis among ambulatory patients suggests

Table 7. Charges

Patients	Median, \$	Mean, \$	SD, \$
All patients			
Ambulatory surgical center	6,402	6,391	2,035
Hospital	11,744	12,978	5,149
Single diagnosis*			
Ambulatory surgical center	6,028	6,106	1,902
Hospital	10,876	11,785	4,283

*Single CPT code (47562), Charlson index 0, discharged home same day.

good patient selection in both hospital-based and freestanding ambulatory surgical centers.

Our findings also suggest that patients may be selected for treatment in ASCs based on nonmedical factors. Demographically, the ASC patients were younger, more likely to be Caucasian, and more likely to carry private medical insurance than hospital patients. The younger age and higher proportion with private insurance may primarily reflect the fact that Medicare, the largest nonprivate payer, does not cover ambulatory cholecystectomy outside of a hospital setting, but it is also possible that some ASCs specifically target more affluent, better insured populations.

This study also highlights a substantial difference in charges for laparoscopic cholecystectomy between hospitals and ASCs. Hospital charges were much higher, even when controlling for case mix by comparing patients with no comorbidities and laparoscopic cholecystectomy as the only CPT code. Hospitals typically incur high operating expenses because of their costly emergency departments and ICUs, their need to remain open at all times, charity work, and a sicker patient population.^{2,3} So higher charges for ambulatory cholecystectomy may reflect more "cost-shifting" (higher charges to private payers to offset low payments from public payers) or "charge compression" (marking up inexpensive products) on the part of hospitals.¹ If this is true, the large discrepancy in charges may exaggerate the discrepancy in actual costs of ambulatory cholecystectomy. But even if our comparison of charges overestimates the difference in costs, it is still likely that higher costs are experienced in hospital settings because of greater overhead expenses. Although some have suggested that directing more common procedures to ASCs may save health care expenditures,³ one must not overlook the negative impact such a policy would have on hospitals whose financial well-being is important to broader health care goals.

This study has several limitations. First, it represents an analysis of patient data from a single state (Florida). It is possible that there are geographic variations within the US with regard to preoperative patient selection, disposition, and charges. Although this is the first study to compare hospital-based versus ASC-based laparoscopic cholecystec-

tomy on a large scale, there remains no reliable way to make this comparison on a national basis because of limitations in available data. Second, this database provides no information about patient outcomes after discharge. So we were unable to compare hospital and ASC-based cohorts in terms of postoperative safety measures such as bile leak, bile duct injury, wound infection, or postdischarge hospital readmission. Because of the inability to measure these outcomes in this study, we cannot preclude the possibility that clinical outcomes may, in fact, be superior at either hospitals or at ASCs. Last, although we were able to report a large difference in average charges in hospitals versus ASCs, the SASD does not provide actual costs of care in hospitals versus ASCs. Although there is good reason to suspect that costs of care in hospital settings exceed costs in ASCs, we could not measure this using the SASD, and the difference in charges we observed may not accurately reflect the magnitude of any difference in costs.

The debate over whether ambulatory cholecystectomy can be performed safely in freestanding ASCs is highly charged because cholecystectomy is the most common elective abdominal operation performed in the US, and major financial interests are at stake. The magnitude of these stakes are not known, because no one knows just how much movement away from hospitals toward surgical centers would occur were current barriers removed. The question of how much movement would occur is complicated by differences of opinion with regard to who is and who is not a candidate for laparoscopic cholecystectomy in an ASC, and by market issues such as current and future ASC capacity.

In this study of outpatient cholecystectomy performed in hospitals and ASCs in Florida in 2002 and 2003, we found that ASCs performed these procedures safely in selected patients who were appropriately younger and healthier than patients treated in hospital settings. These results suggest that disallowing payments for ambulatory cholecystectomy in ASCs may not be justified on the basis of safety. Payment policy discussions should instead address the underlying problem that has intensified the current debate: the fairness of reimbursement structures that reward selection of low risk patients. Allowing more low risk

patients to undergo cholecystectomy in ASCs may be a rational and effective way to control the costs associated with cholecystectomy in the US, but the economic interests of hospitals may require additional protection if such a policy change is to occur.

Author Contributions

Study conception and design: Paquette, Smink, Finlayson

Acquisition of data: Paquette

Analysis and interpretation of data: Paquette, Smink, Finlayson

Drafting of manuscript: Paquette

Critical revision: Paquette, Smink, Finlayson

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A commentary by Kern Singh, MD, and Junyoung Ahn, BS, is linked to the online version of this article at jbjs.org.

Consumer Choice Between Hospital-Based and Freestanding Facilities for Arthroscopy

Impact on Prices, Spending, and Surgical Complications

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Investigation performed at the University of California, Berkeley, California

Background: Hospital-based outpatient departments traditionally charge higher prices for ambulatory procedures, compared with freestanding surgery centers. Under emerging reference-based benefit designs, insurers establish a contribution limit that they will pay, requiring the patient to pay the difference between that contribution limit and the actual price charged by the facility. The purpose of this study was to evaluate the impact of reference-based benefits on consumer choices, facility prices, employer spending, and surgical outcomes for orthopaedic procedures performed at ambulatory surgery centers.

Methods: We obtained data on 3962 patients covered by the California Public Employees' Retirement System (CalPERS) who underwent arthroscopy of the knee or shoulder in the three years prior to the implementation of reference-based benefits in January 2012 and on 2505 patients covered by CalPERS who underwent arthroscopy in the two years after implementation. Control group data were obtained on 57,791 patients who underwent arthroscopy and were not subject to reference-based benefits. The impact of reference-based benefits on consumer choices between hospital-based and freestanding facilities, facility prices, employer spending, and surgical complications was assessed with use of difference-in-differences multivariable regressions to adjust for patient demographic characteristics, comorbidities, and geographic location.

Results: By the second year of the program, the shift to reference-based benefits was associated with an increase in the utilization of freestanding ambulatory surgery centers by 14.3 percentage points (95% confidence interval, 8.1 to 20.5 percentage points) for knee arthroscopy and by 9.9 percentage points (95% confidence interval, 3.2 to 16.7 percentage points) for shoulder arthroscopy and a corresponding decrease in the use of hospital-based facilities. The mean price paid by CalPERS fell by 17.6% (95% confidence interval, -24.9% to -9.6%) for knee procedures and by 17.0% (95% confidence interval, -29.3% to -2.5%) for shoulder procedures. The shift to reference-based benefits was not associated with a change in the rate of surgical complications. In the first two years after the implementation of reference-based benefits, CalPERS saved \$2.3 million (13%) on these two orthopaedic procedures.

continued

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Disclaimer: The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality (AHRQ). California Public Employees' Retirement System (CalPERS) and AHRQ played no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Conclusions: Reference-based benefits increase consumer sensitivity to price differences between freestanding and hospital-based surgical facilities.

Clinical Relevance: This study shows that the implementation of reference-based benefits does not result in a significant increase in measured complication rates for those subject to reference-based benefits.

The prices charged for similar health-care services vary widely across different clinical settings, partly because of the indifference of well-insured consumers to price differences when selecting providers. In particular, the prices paid for ambulatory surgical procedures by private insurers are often much higher in hospital outpatient departments than in freestanding ambulatory surgery centers¹. Medicare also pays substantially higher rates to hospital outpatient departments than to ambulatory surgery centers for similar services².

Consumers are being expected to take a more active role in their own health-care decision-making, especially for acute treatments such as arthroplasty and arthroscopy. Patient choices increasingly benefit from price transparency³, the inclusion of patient-reported outcomes in quality measurement⁴, and mechanisms to encourage shared decision-making with physicians⁵. Patients also are facing greater cost sharing at the time of receiving care, in part as an encouragement to select lower-priced providers. Some employers and insurers are establishing reference-based

TABLE I Knee Arthroscopy Descriptive Characteristics

	2009	2010	2011	2012	2013
CalPERS					
No. of procedures	884	856	953	828	808
Performed at ambulatory surgery center	529	532	593	559	598
Performed at hospital outpatient department: not exempt	355	324	360	186	131
Performed at hospital outpatient department: exempt	0	0	0	83	79
Procedure payment*	\$5146	\$5412	\$5638	\$5395	\$5402
Hospital outpatient departments*	\$6717	\$7016	\$7565	\$6640	\$7534
Ambulatory surgery centers*	\$4092	\$4435	\$4469	\$4795	\$4653
Charlson Comorbidity Index score*	0.3	1.2	1	0.1	0.7
Male patients	47.70%	47.40%	46.80%	46.60%	49.90%
Patient age* (yr)	50.7	50.6	50.2	50.3	50.7
Ninety-day complications					
Complication rate*	1.92%	1.40%	1.89%	1.69%	2.48%
No. of complications	17	12	18	14	20
Anthem					
No. of procedures	7997	7830	7667	7925	8347
Performed at ambulatory surgery center	2824	2658	2541	2616	2913
Performed at hospital outpatient department	5173	5172	5126	5309	5434
Procedure payment*	\$4824	\$4946	\$5205	\$5378	\$5568
Hospital outpatient departments*	\$6380	\$7056	\$7158	\$7139	\$7409
Ambulatory surgery centers*	\$3975	\$3862	\$4236	\$4510	\$4581
Charlson Comorbidity Index score*	0.8	0.6	0.6	0.7	0.6
Male patients	58.30%	57.00%	57.10%	56.40%	57.00%
Patient age* (yr)	45.8	46.4	46.2	46.1	46.3
Ninety-day complications					
Complication rate*	1.90%	1.86%	1.71%	1.83%	1.76%
No. of complications	152	146	131	145	147

*The values are given as the mean.

TABLE II Shoulder Arthroscopy Descriptive Characteristics

	2009	2010	2011	2012	2013
CalPERS					
No. of procedures	432	433	404	456	413
Performed at ambulatory surgery center	266	239	245	291	293
Performed at hospital outpatient department: not exempt	166	194	159	97	56
Performed at hospital outpatient department: exempt	0	0	0	68	64
Procedure payment*	\$8233	\$8146	\$8504	\$7626	\$8657
Hospital outpatient departments*	\$10,955	\$10,059	\$11,837	\$9361	\$11,808
Ambulatory surgery centers*	\$6534	\$6594	\$6340	\$6642	\$7367
Charlson Comorbidity Index score*	2.1	0.5	0.5	0.7	0.2
Male patients	56.50%	57.50%	57.20%	52.60%	55.00%
Patient age* (yr)	53.1	52.1	53	53.3	52.6
Ninety-day complications					
Complication rate*	1.39%	1.39%	0.99%	0.44%	0.73%
No. of complications	6	6	4	2	3
Anthem					
No. of procedures	3634	3588	3458	3602	3743
Performed at ambulatory surgery center	1425	1368	1272	1318	1309
Performed at hospital outpatient department	2209	2220	2186	2284	2434
Procedure payment*	\$6420	\$6925	\$6984	\$7430	\$7449
Hospital outpatient departments*	\$8158	\$9298	\$9247	\$9483	\$9323
Ambulatory surgery centers*	\$5298	\$5463	\$5667	\$6245	\$6440
Charlson Comorbidity Index score*	1	1.1	0.5	0.6	1
Male patients	61.50%	62.40%	60.50%	60.90%	61.80%
Patient age* (yr)	48.7	48.9	49.6	49.6	49.9
Ninety-day complications					
Complication rate*	1.13%	0.84%	1.01%	1.05%	0.83%
No. of complications	41	30	35	38	31
*The values are given as the mean.					

benefits that require the patient to pay the difference between a defined contribution limit and the price actually charged, if a higher-priced facility is chosen⁶⁻⁸. Reference-based benefits often are referred to as reference pricing⁹. Previous research has documented strong associations between reference-based benefit designs and consumer choices and spending for inpatient knee and hip arthroplasty¹⁰ as well as for drugs^{11,12}, laboratory tests¹³, and cataract removal¹.

Materials and Methods

Data on Patients

Insurance claims data were obtained for patients undergoing shoulder or knee arthroscopy who were enrolled in the self-insured health benefits plan maintained by the California Public Employees' Retirement System (CalPERS) between January 2009 and December 2013. CalPERS covers 1.3 million individuals, of whom 450,000 are enrolled in its self-insured Preferred Provider Organization (PPO) product. A control group was obtained consisting of all enrollees covered by Anthem Blue Cross insurance who underwent arthroscopy during these five years in California but who were not subject to reference-based benefits.

In January 2012, CalPERS shifted to reference-based benefits for arthroscopy, building on its reference-based benefit program for inpatient knee and hip replacement surgery^{10,14}. All enrollees in the CalPERS PPO insurance faced deductible and coinsurance requirements. Under its reference-based benefit initiative, CalPERS continued to pay the facility's allowed charge, subject to these deductible and coinsurance provisions, if the patient selected an ambulatory surgery center. However, for patients selecting a hospital outpatient department, CalPERS limited its payment contribution to \$6000 and continued to require deductibles and coinsurance.

Patients were exempted from the reference-based benefit initiative if their surgeon presented a clinical case for needing services in a hospital outpatient department, based on patient age and comorbid conditions, or if the patient lived in a rural area more than thirty miles from an ambulatory surgery center. For patients exempted from the reference-based benefit initiative, CalPERS paid the hospital outpatient department's allowed charge, less the standard patient's deductible and coinsurance, and did not require the patient to pay the difference between the hospital outpatient department price and the \$6000 reference-based benefit contribution limit.

The measured characteristics of the patients included age, sex, and the diagnostic and procedure codes according to the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM)¹⁵ from claims

TABLE III Knee Arthroscopy Multivariable Regression Results*

	Probability of Selecting Ambulatory Surgery Center	Procedure Price Paid (Percent Difference)	Procedure Price Paid (Dollar Difference)	Probability of Ninety-Day Complication
CalPERS × 2013	0.143† ± 0.0317	−17.61† ± 4.850	−1009† ± 261.0	0.00236 ± 0.00773
CalPERS × 2012	0.0568† ± 0.0232	−11.45† ± 4.926	−633.6† ± 260.6	−0.00509 ± 0.00588
CalPERS × 2010	0.0219 ± 0.0264	3.978 ± 4.916	203.2 ± 247.7	−0.00594 ± 0.00609
CalPERS × 2009	−0.0110 ± 0.0244	3.195 ± 4.159	163.8 ± 212.3	−0.00125 ± 0.00690
CalPERS	−0.0408§ ± 0.0217	3.586 ± 3.463	183.5 ± 177.1	0.00130 ± 0.00427
2013	−0.0224 ± 0.0170	9.673† ± 2.833	481.0† ± 145.9	0.000442 ± 0.00210
2012	−0.00322 ± 0.0113	3.677 ± 2.476	188.1 ± 127.9	0.00112 ± 0.00227
2011	Reference	Reference	Reference	Reference
2010	−0.00767 ± 0.0118	−5.486† ± 2.190	−293.9† ± 111.9	0.00131 ± 0.00221
2009	−0.0228 ± 0.0170	−8.017† ± 2.814	−435.3† ± 146.3	0.00173 ± 0.00222
Male patients	0.00507 ± 0.00587	−0.0426 ± 0.945	−2.219 ± 48.97	0.00373† ± 0.00143
Charlson Comorbidity Index	−0.241† ± 0.0367	10.24† ± 4.061	507.6† ± 212.2	0.0202§ ± 0.0112
Age in years				
30 to 39	−0.0164 ± 0.0117	−14.07† ± 2.739	−953.7† ± 175.3	0.00747† ± 0.00306
40 to 49	−0.00101 ± 0.0154	−24.95† ± 2.881	−1692† ± 184.7	0.00421§ ± 0.00221
50 to 59	0.00646 ± 0.0166	−30.94† ± 2.832	−2098† ± 192.7	0.00275 ± 0.00203
60 to 64	−0.00541 ± 0.0179	−31.14† ± 2.845	−2111† ± 187.6	0.00883† ± 0.00252

*The values are given as the mean and the standard error based on 44,068 observations in each group. †Significant at $p < 0.01$. ‡Significant at $p < 0.05$. §Not significant at $p < 0.1$.

incurred for all purposes, not merely arthroscopic procedures. The diagnostic and procedure codes were used to develop a measure of patient health status and comorbidities with use of the Charlson Comorbidity Index¹⁶. The study population was limited to adults under the age of sixty-five years. All physician office visit, inpatient, outpatient, emergency department, and ambulatory service claims were included in the analysis.

Our measure of procedure price was the allowed charge negotiated between the payer and the facility and actually paid to the facility. We did not use the facility's billed charge, which is typically much higher than the allowed charge and is not actually paid.

The rates of surgical complications were calculated for thirty and ninety days after the arthroscopy date. The measurement period for some types of complications was limited to thirty days so as not to attribute to the arthroscopy adverse events due to other causes. Complications measured only for thirty days after the procedure consisted of bleeding (ICD-9-CM codes 39.98, 719.10, 719.16, 719.17, and 998.1), postoperative deep vein thrombosis (ICD-9-CM codes 453.40-453.42, 453.50-453.52, and 453.9), and pulmonary embolism (ICD-9-CM code 415.1). Complications measured for the full ninety days after the procedure consisted of mechanical failure (ICD-9-CM codes 996.4, 996.40, and 996.49), wound infection (ICD-9-CM codes 682.1-682.9, 686.9, 996.66, 996.67, 998.3, 998.5, 998.6, 998.7, and 998.83 and Current Procedural Terminology [CPT] codes 00.70-00.73, 00.80-00.82, 00.84, 80.05, 80.06, 80.09, 81.53, 81.55, 81.59, 86.04, 86.22, and 86.28), and postoperative nerve injury (ICD-9-CM codes 955, 956, 957.8, and 957.9).

Analytic Methods

We analyzed trends in facility choice, prices paid, employer spending, and clinical complications for the three years prior and the two years subsequent to reference-based benefit implementation.

For each year before and after implementation of reference-based benefits, we calculated the percentage of patients selecting an ambulatory surgery center, the percentage of patients selecting a hospital outpatient department, the mean

price paid per procedure, and the rate of complications. These calculations were made for CalPERS and Anthem patients separately. We then conducted multivariable difference-in-differences regressions with use of the individual patient as the unit of observation. These regressions analyze the association between the implementation of the reference-based benefit and facility choice, prices, and complications after adjusting for changes in demographic characteristics, comorbidities, and other factors over the five-year period. Covariates in the regression analyses included year, payer (CalPERS compared with Anthem), interaction terms between year and payer, an indicator variable for whether the patient was exempted from the reference-based benefit initiative because of clinical or geographic considerations, the Charlson Comorbidity Index, patient age categories, patient sex, and indicators for each hospital referral region¹⁷.

Difference-in-differences analysis, which is commonly used to identify causal effects in observational studies, uses the same analytic logic that is used in clinical trials featuring a treatment and a comparison group. There are two differences that are computed with respect to the outcome variable of interest: the mean change over time in the outcome of the treatment group and the mean change over time in the comparison group; the difference in differences is the difference between the mean change over time in the outcome in the treatment group and the mean change over time in the comparison group. The difference in differences reflects the extent to which the treatment group differs from the comparison group in the post-treatment period, compared with the extent to which the treatment group differs from the comparison group in the pre-treatment period¹⁸.

The regression parameters for the probability of selecting an ambulatory surgery center and the probability of complications were estimated with use of both linear probability and logistic regression, as the dependent variables are dichotomous. The two models generated similar results. For easier interpretation, we reported the linear probability model results. All analyses were performed with use of Stata 11.0 (StataCorp, College Station, Texas) and all standard errors were clustered at the provider level and were robust to heteroskedasticity¹⁹.

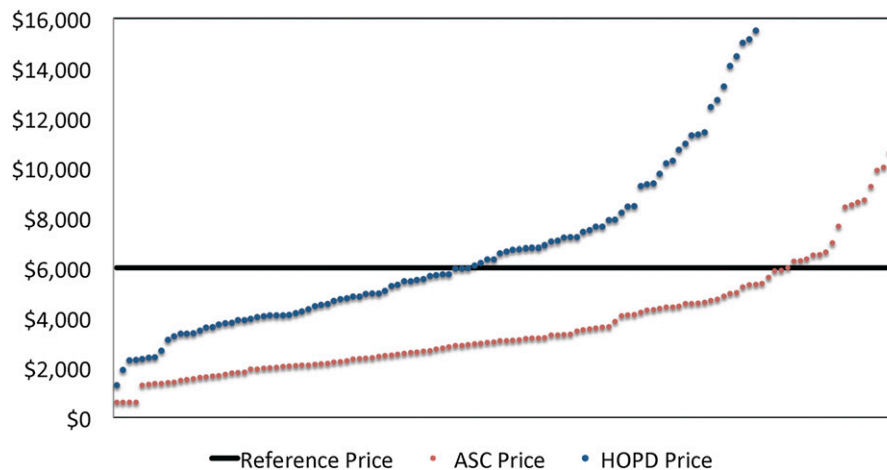


Fig. 1
Distribution of the prices in hospital outpatient departments (HOPD) and freestanding ambulatory surgery centers (ASC) prior to implementation of reference-based benefits: knee arthroscopy.

The study was approved by the institutional review board at the University of California, Berkeley.

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Results

Trends in Choice, Payments, and Complications

Figures 1 and 2 present the distribution of prices (allowed charges) for arthroscopy across ambulatory surgery centers and hospital outpatient departments in 2011, the year prior to the implementation of reference-based benefits by CalPERS. The wide variability of prices was the main impetus for the shift to reference-based benefits by CalPERS. The median price for

knee arthroscopy was \$5668 (range, \$1280 to \$15,503) for the hospital outpatient departments and \$3083 (range, \$604 to \$10,803) for the ambulatory surgery centers. The median price for shoulder arthroscopy was \$6522 (range, \$2618 to \$15,130) for the hospital outpatient departments and \$4153 (range, \$605 to \$11,549) for the ambulatory surgery centers.

Figure 3 presents the percentage of CalPERS and Anthem enrollees selecting an ambulatory surgery center (as distinct from a hospital outpatient department) for their procedure in each year. From 2009 to 2011, prior to implementation of reference-based benefits, the share of CalPERS members who underwent a knee arthroscopy at an ambulatory surgery center remained unchanged at approximately 60%. After the reference-based benefit implementation, the share of members selecting an ambulatory surgery center increased to 82%. For Anthem enrollees not subject to reference-based benefits, the use of an

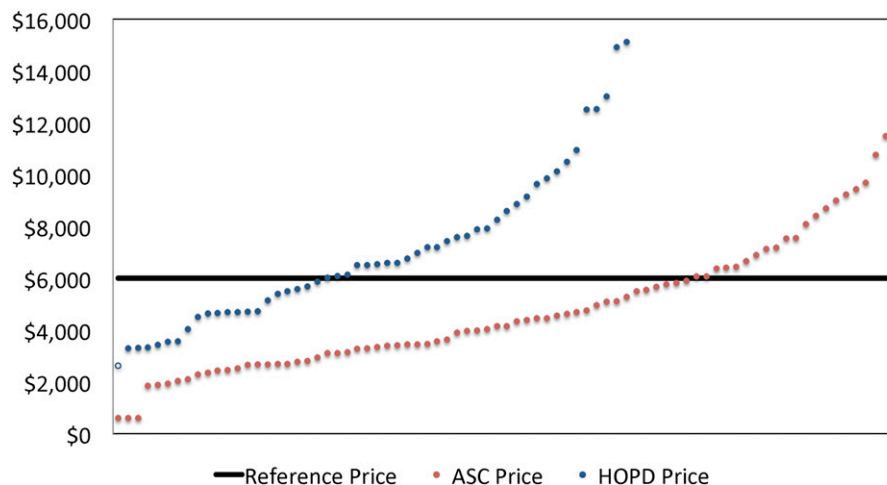


Fig. 2
Distribution of the prices in hospital outpatient departments (HOPD) and freestanding ambulatory surgery centers (ASC) prior to implementation of reference-based benefits: shoulder arthroscopy.

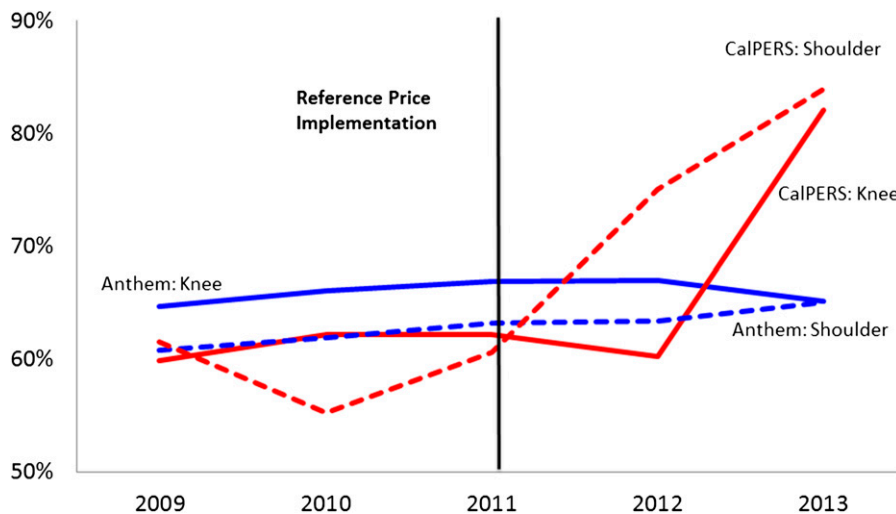


Fig. 3
Line graph showing the percentage of patients selecting ambulatory surgery centers instead of hospital outpatient departments before and after implementation of reference-based benefits: knee and shoulder arthroscopy.

ambulatory surgery center remained unchanged at approximately 66% during the entire period. The bivariate difference between CalPERS and Anthem enrollees in use of an ambulatory surgery center changed by 22 percentage points, from 5 percentage points lower for CalPERS than Anthem in 2009 to 17 percentage points higher in 2013. Similar differences are evident in Figure 3 for shoulder arthroscopy.

Figure 4 presents the mean prices (allowed charges) paid per procedure between 2009 and 2013 by CalPERS and Anthem for the two forms of arthroscopy. Prior to reference-based benefit implementation, the mean prices paid by CalPERS were higher than prices paid by Anthem, because of the concentration of public employees in the state capital of Sacramento. Healthcare market consolidation in Sacramento has fostered high prices²⁰. In the year after the reference-based benefit implementation, the mean price charged to CalPERS declined by 8.8% for knee arthroscopy and by 19.0% for shoulder arthroscopy, although it continued to rise by 3.3% for knee arthroscopy and

by 6.4% for shoulder arthroscopy for Anthem. The mean price charged to CalPERS patients in 2013 was 12.3% below that charged to Anthem enrollees for knee arthroplasty and 2.8% below that charged for shoulder arthroscopy.

Figure 5 presents the 2009 to 2013 rates of complications during the ninety days after the arthroscopy. The rates of complications for CalPERS members declined in the first year after the reference-based benefit implementation and then rose in the second year, but the differences were small. The rates of complications did not change over time for the Anthem members.

Multivariable Statistical Analyses

Tables I and II present descriptive statistics on the patients and procedures included in the study. Tables III and IV present difference-in-differences regression analyses of the association between reference-based benefits and ambulatory surgery center choice, procedure prices, and surgical complications for arthroscopy of the knee and shoulder.

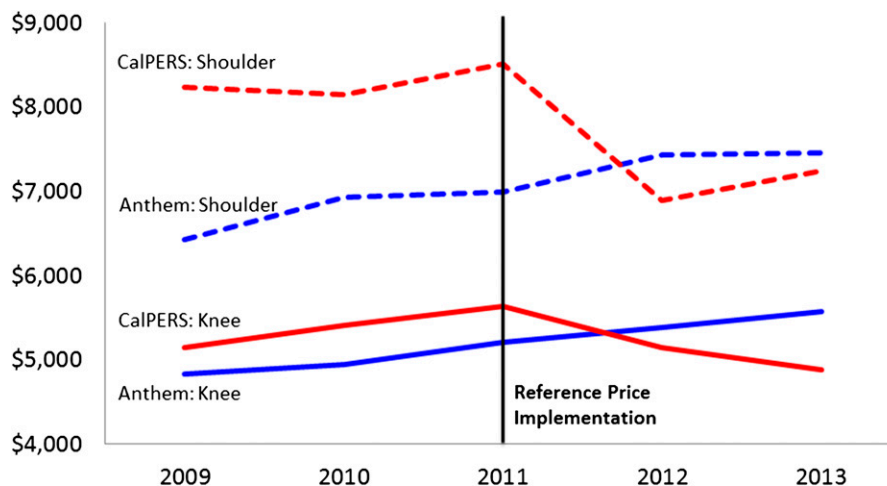


Fig. 4
Line graph showing the total payment before and after implementation of reference-based benefits: knee and shoulder arthroscopy.

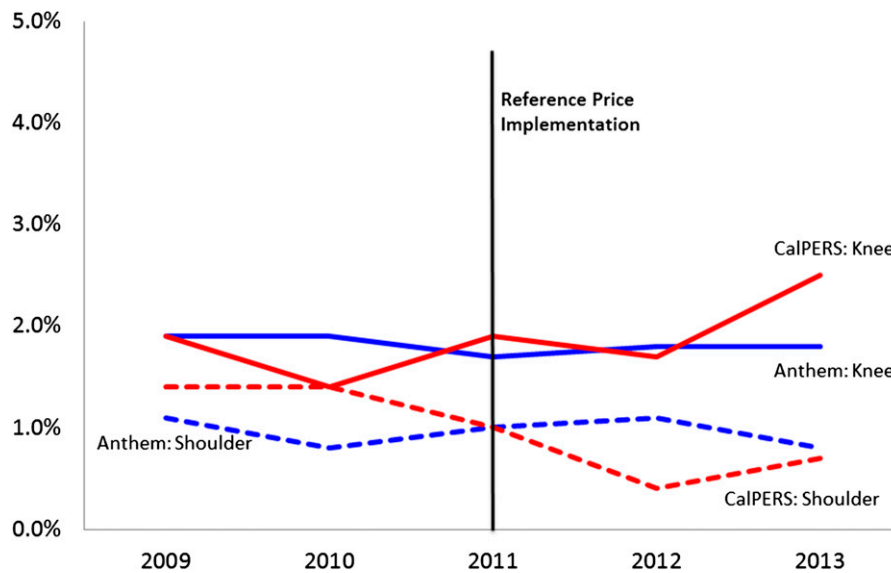


Fig. 5
Line graph showing the ninety-day complication rates before and after implementation of reference-based benefits: knee and shoulder arthroscopy.

Tables III and IV present results from multivariable difference-in-differences regressions. Each table presents regressions with four outcome variables: choice of ambulatory surgery center (compared with hospital outpatient department), price measured in logarithmic units, price measured in dollar units, and surgical complications within ninety days of the original arthroscopy.

The difference-in-differences models were tested for violations of the parallel trends assumption via the 2009 and 2010 interaction terms^{18,21}. The regressions for procedure prices used a generalized linear model with a log-link and a gamma distribution, because the dependent variables are continuous²². Park tests supported using a gamma distribution²³.

The multivariable analyses generate an estimate of reference-based benefit impact on selection of an ambulatory surgery center instead of a hospital outpatient department that is similar in magnitude to the bivariate estimates presented in Figure 4. As indicated in the Probability of Selecting Ambulatory Surgery Center column of Table III, the shift by CalPERS to reference-based benefits was associated with an increase in the probability of ambulatory surgery center utilization by 5.7 percentage points (95% confidence interval [95% CI], 1.1 to 10.2 percentage points; $p < 0.05$) in 2012 and by 14.3 percentage points (95% CI, 8.1 to 20.5 percentage points; $p < 0.001$) in 2013, compared with the probability of utilization by Anthem enrollees.

The changes in the prices paid for knee arthroscopy are presented in percentage terms in the Procedure Price Paid (Percent Difference) column of Table III. The mean price paid fell in the first year after implementation of reference-based benefits by -11.5% (95% CI, -19.4% to -2.7% ; $p = 0.01$), controlling for other relevant factors. The prices paid in the second year after reference-based benefit implementation were lower than those paid prior to implementation by 17.6% (95% CI, -24.9% to -9.6% ; $p < 0.001$).

Knee arthroscopy prices are analyzed in dollar terms in the Procedure Price Paid (Dollar Difference) column of

Table III. The multivariable analyses generate an estimate of the reference-based benefit impact that is similar in magnitude to the bivariate estimates presented in Figure 5. In 2012, procedure payments for CalPERS enrollees were \$634 less per procedure (95% CI, $-\$1144$ to $-\$121$; $p = 0.01$) than for Anthem enrollees, after adjusting for other relevant factors. The prices paid continued to decrease in the second year after implementation and in 2013 were below 2011 levels by \$1009 (95% CI, $-\$1520$ to $-\$597$; $p < 0.001$).

As indicated in the Probability of Ninety-Day Complication column of Table III, the multivariable statistical analyses found no significant association between implementation of reference-based benefits and the probability of a surgical complication. The multivariable results thus are similar to the bivariate results presented in Figure 5.

Table IV presents analogous multivariable regression analyses for shoulder arthroscopy. As indicated in the Probability of Selecting Ambulatory Surgery Center column of Table IV, the shift by CalPERS to reference-based benefits was associated with an increase in the probability of ambulatory surgery center utilization by 4.4 percentage points (95% CI, -1.8 to 10.7 percentage points; $p = 0.16$) in 2012 and by 9.9 percentage points (95% CI, 3.2 to 16.7 percentage points; $p < 0.01$) in 2013, after controlling for differences in patient demographic characteristics, comorbidities, and other factors.

In Table IV, the changes in the prices paid for shoulder arthroscopy are presented in percentage terms in the Procedure Price Paid (Percent Difference) column and in dollar terms in the Procedure Price Paid (Dollar Difference) column. In the first year after implementation of reference-based benefits, the mean price paid fell by 21.9% (95% CI, -32.1% to -10.1% ; $p < 0.001$), controlling for other relevant factors. Prices paid remained decreased in the second year after implementation and in 2013 were below 2011 levels by \$1336 (95% CI, $-\$2524$ to $-\$149$;

TABLE IV Shoulder Arthroscopy Multivariable Regression Results*

	Probability of Selecting Ambulatory Surgery Center	Procedure Price Paid (Percent Difference)	Procedure Price Paid (Dollar Difference)	Probability of Ninety-Day Complication
CalPERS × 2013	0.0995† ± 0.0343	−17.02† ± 8.549	−1336† ± 605.9	0.000999 ± 0.00700
CalPERS × 2012	0.0444 ± 0.0320	−21.87† ± 7.447	−1768† ± 547.6	−0.00493 ± 0.00654
CalPERS × 2010	−0.0219 ± 0.0308	−0.718 ± 5.346	−51.64 ± 373.3	0.00638 ± 0.00793
CalPERS × 2009	0.0382 ± 0.0318	3.144 ± 7.493	221.8 ± 517.5	0.00302 ± 0.00798
CalPERS	−0.0401§ ± 0.0235	9.999† ± 4.162	682.7† ± 294.8	−0.00150 ± 0.00532
2013	0.00810 ± 0.0260	9.111† ± 4.082	624.6† ± 281.9	−0.00198 ± 0.00218
2012	−0.00249 ± 0.0180	6.554† ± 3.059	454.8† ± 213.8	0.000447 ± 0.00242
2011	Reference	Reference	Reference	Reference
2010	−0.0158 ± 0.0151	−1.547 ± 2.591	−111.7 ± 183.5	−0.00187 ± 0.00228
2009	−0.0322 ± 0.0212	−8.424† ± 3.302	−630.4† ± 242.0	0.00144 ± 0.00242
Male patients	−0.00362 ± 0.00771	8.332† ± 1.550	573.3† ± 119.0	0.00138 ± 0.00143
Charlson Comorbidity Index	−0.238† ± 0.0570	12.55§ ± 7.239	846.8§ ± 500.5	0.00128 ± 0.00639
Age in years				
30 to 39	−0.0373§ ± 0.0207	−0.105 ± 4.086	−6.807 ± 260.7	8.23×10 ^{−5} ± 0.00270
40 to 49	−0.0230 ± 0.0224	6.955§ ± 3.697	452.9§ ± 241.5	0.00142 ± 0.00224
50 to 59	−0.0196 ± 0.0230	11.60† ± 3.530	755.6† ± 233.3	0.00508† ± 0.00217
60 to 64	−0.0317 ± 0.0235	18.53† ± 3.933	1206† ± 277.9	0.00864† ± 0.00274

*The values are given as the mean and the standard error based on 20,142 observations in each group. †Significant at $p < 0.01$. ‡Significant at $p < 0.05$. §Not significant at $p < 0.1$.

$p = 0.03$), which is equivalent to a 17.0% (95% CI, −29.3% to −2.5%) reduced payment per procedure. As indicated in the Probability of Ninety-Day Complication column of Table IV, the multivariable statistical analyses found no significant association between the implementation of the reference-based benefit and the probability of a surgical complication for shoulder arthroscopy.

Discussion

Employers, insurers, governmental programs, and individuals who pay for health care face wide variation in the prices charged for similar services. As illustrated in Figures 1 and 2, the prices charged to CalPERS for arthroscopy ranged more than tenfold. Negotiated rates for hospital-based outpatient departments exceeded those charged by freestanding centers by a mean of 73% (\$2714) for knee arthroplasty and 48% (\$2262) for shoulder arthroplasty. Medicare also pays substantially more for ambulatory procedures if they occur in a hospital outpatient department than if they occur in a freestanding ambulatory surgery center^{2,24}.

The findings of this study should be interpreted in light of its limitations. The data reflected the experience of working-age individuals covered by employment-based health insurance and may not have been generalizable to an older, Medicare-eligible population.

We were not able to measure whether implementation of reference-based benefits influenced the propensity of CalPERS members to undergo an arthroscopy, as we did not have data on

age-adjusted total CalPERS enrollment. There is no strong reason to assume that the reference-based benefit initiative would affect the probability of undergoing a procedure, as the patient faced no reference-based benefit-related cost sharing at any ambulatory surgery center. The patient also faced no reference-based benefit-related cost sharing at a hospital outpatient department if the treating physician indicated a clinical reason for needing hospital-based care or if the patient resided in a geographic area without convenient access to an ambulatory surgery center.

Our measures of patient outcomes were limited to complications reported on inpatient, outpatient, emergency department, or physician office visit claims within ninety days after the arthroscopy. Our ninety-day window for complications was consistent with the global outcomes measurement period used for most shoulder and knee arthroscopic procedures²⁵. We did not have access to patient-reported outcome measures, which were not collected by CalPERS or Anthem. Future research should include patient-reported outcomes wherever possible.

Reference-based benefit designs represent a strategy by employers and insurers to counter variable health-care pricing that cannot be justified by differences in quality or outcomes. The employer or insurer establishes a limit to what it will contribute toward payment for a procedure, requiring the patient to pay the difference between this limit and what the provider actually charges. The contribution limit is established at a level sufficiently high to ensure access at a sufficient number of facilities in each

geographic region. Patients who need to use a high-priced provider for special clinical reasons or who live in a remote rural area are exempted from the reference-based benefit cost sharing.

As documented in this study, patients requiring an arthroscopy of the knee or shoulder respond strongly to the economic incentives embodied in reference-based benefit designs. Use of the lower-priced ambulatory surgery centers by CalPERS members grew substantially after the implementation of reference-based benefits, although Anthem enrollees not subject to reference-based benefits did not change their facility choices. The shift toward freestanding ambulatory surgery centers reduced CalPERS spending in the first two years after reference-based benefit implementation by \$2.3 million (13%), compared with what it would have spent on these two procedures in the absence of the new benefit design. These reduced payments were not accompanied by any increased rates of procedural complications.

The consumer is being accorded an ever-greater decision-making role in the U.S. health-care system, especially for acute interventions such as orthopaedic surgery. Patient-reported experience and outcomes increasingly are being included in quality measurements and rewards²⁶. Physicians and patients are being encouraged to engage in shared decision-making with respect to treatment options⁵. Health plans and independent technology

vendors are making available information on price and quality at the level of the individual provider and procedure^{3,27}.

Patients are being asked to pay a substantial portion of the cost of the services that they select. In much of the non-health economy, the value of a product or service is the amount that the consumer is willing to pay for it, given the consumer's expectations of performance. This definition of value now is being applied to musculoskeletal health care as well. ■

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Clinical Science

Outpatient surgery performed in an ambulatory surgery center versus a hospital: comparison of perioperative time intervals

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KEYWORDS:

Ambulatory surgery;
Perioperative care;
Efficiency;
Patient discharge

Abstract

BACKGROUND: In 2005, the authors' ambulatory surgery center (ASC) was closed, and the breast operations performed there were integrated into the hospital. This change allowed a comparison of perioperative time intervals for patients undergoing these procedures at an outpatient facility versus a hospital.

METHODS: The records of 92 patients who underwent breast operations at the ASC between January 2004 and December 2005 were compared with those of 92 patients who underwent outpatient breast operations at the hospital starting January 2006. Anesthetic techniques, recovery room events, and perioperative time intervals were analyzed.

RESULTS: Age and recovery room times were similar. Complications were negligible at both facilities. The preoperative, operating room entry to incision, and total facility time intervals significantly increased when breast cases were moved back to the hospital setting.

CONCLUSIONS: These data demonstrate significantly shorter perioperative time intervals at the ASC. Incorporating time-saving practices from the outpatient setting could contribute to greater hospital productivity.

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Operating rooms (ORs) generate substantial cost and revenue for health care facilities. In an economic environment characterized by shrinking reimbursement, perioperative managers are challenged to protect operating margins while maintaining quality, safety, and service. An aging, sicker patient population only exacerbates this challenge.

Examples of improved perioperative productivity ("work completed per dollar cost"¹) include completing more cases in a given time period (or the same number of cases in less time) and completing a given workload with fewer employ-

ees. A number of recent studies and reviews have examined methods to increase perioperative efficiency.^{2–10} These methods include parallel processing to reduce turnover time, redesigning perioperative processes, and insuring that preoperative paperwork and medical examinations are completed well before the day of surgery.

Our current hospital surgical practice includes both inpatient and outpatient procedures. However, a few years ago, certain procedures, including segmental mastectomies and other breast operations, were performed at a physically separate, dedicated ambulatory surgery center (ASC). In December 2005, our ASC was closed, and the outpatient surgical practice was integrated into our hospital. This change in location provided us with a unique opportunity to

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analyze the time intervals associated with performing the same outpatient procedures at an ASC compared with a hospital perioperative environment that includes a mix of inpatients and outpatients.

The primary purpose of this study was to compare perioperative time intervals for outpatient breast operations performed at an ASC versus a hospital. By comparing these time intervals, our aim was to gain an appreciation of the potential efficiencies of ASCs compared with hospital ORs. These data may guide planning by surgeons, anesthesiologists, and perioperative managers that results in greater OR productivity.

Methods

After institutional review board approval, we retrospectively reviewed the medical, surgical, and anesthetic records of 92 consecutive patients who underwent their primary outpatient breast operations at our ASC between January 2004 and December 2005. We then reviewed the records of 92 consecutive patients who underwent their primary outpatient breast operations in our hospital OR starting January 2006. Specifically, the procedures were unilateral segmental mastectomies, with or without sentinel lymph node biopsy, with or without axillary dissection. Before the perioperative period, some patients had undergone radioactive seed localization. Excluded were patients who underwent total mastectomies, bilateral procedures, and any combination procedure, such as segmental mastectomy followed by a hysterectomy. Also excluded were patients who returned to the ASC or hospital for further breast operations, such as breast reexcision (ie, each patient appears in the database only once).

The procedures were performed by two staff surgeons at a tertiary care teaching medical center that includes a general surgery residency. All staff physicians are salaried, without productivity bonuses. Our ASC consisted of a 4 bay preoperative area, 4 ORs, and a recovery room. At the time of this study, our hospital contained 208 beds with an 18-OR surgical suite. The preoperative check-in and nursing assessment procedures for the two sites were essentially identical, including the waiting room check-in times. For all patients at the ASC and hospital, perioperative time intervals were recorded, including preoperative time, defined as the time from entrance into the holding area to entrance into the OR, OR entry to surgical incision time, incision to surgical closure time, closure to OR exit time, postanesthesia care unit (PACU) time, and total facility time (from entrance into the holding area to exit from the PACU). Phase I and II recovery occurred in a single location at both facilities.

Anesthetic technique and medication use were also recorded, in addition to PACU medication use and adverse events. At our practice, anesthesiologists medically direct up to 4 certified registered nurse anesthetists simultaneously; anesthesia residents are also supervised at no more than

Table 1 Patient demographics and surgical procedures

Variable	ASC (n = 92)	Hospital (n = 92)	P
Age (y)	63.8 ± 11.4 (36–89)	66.8 ± 12.6 (31–88)	.10
Cases			
Surgeon 1	38	47	
Surgeon 2	54	45	
Segmental mastectomy	92	92	
Radioactive seed localization	52	64	
Sentinel lymph node biopsy	88	84	
Axillary dissection	11	17	

Data are expressed as mean ± SD (range) or as number. All patients were women.

a 2:1 ratio. Adverse events noted were PACU bleeding, hypotension requiring fluid boluses and/or pressors, low oxygen saturation (defined as saturation ≤92% with supplemental oxygen), dizziness or gait problems, or excessive pain (defined as pain >5 on a numeric pain scale ranging from 0 to 10 and the need for ≥3 doses of pain medication).

Continuous measures were summarized using descriptive statistics including mean and standard deviation and analyzed using a two-sample *t* test. Categorical measures were assessed using a χ^2 test. *P* values <.05 were considered statistically significant.

Results

Table 1 summarizes patient demographics and the surgical procedures. There was no significant difference in the age of the patients, all of whom were women. Table 2 compares perioperative time intervals for the ASC versus the hospital. The preoperative time interval was significantly shorter at the ASC than at the hospital (75 ± 34.3 vs 130 ± 56.9 minutes, *P* <.001). Total facility time was on average 69 minutes shorter at the ASC (343 ± 63.9 vs 412 ± 87.2 minutes, *P* <.001). OR entry to incision time was also significantly shorter (by a mean of 7 minutes) at the ASC.

In terms of anesthesia management, preoperative midazolam, propofol induction, and PACU fentanyl use were similar between the facilities. Some of the patients received both sevoflurane and a low-dose propofol infusion (eg, 25 µg/kg/min) as prophylaxis against postoperative nausea and vomiting. Intraoperative fentanyl doses were greater at the ASC than at the hospital (222 ± 99 vs 191 ± 69 µg, *P* = .015), as was the use of ketorolac (*P* = .004). Significantly more patients at the ASC were managed with laryngeal mask airways (LMA North America, San Diego, CA; 82% vs 66%, *P* = .02) and propofol infusions (48% vs 16%, *P* <.001). In terms of PACU problems, there were no serious complications. Most notable were 10 patients at the hospital

Table 2 Perioperative time intervals

Time interval	ASC (n = 92)	Hospital (n = 92)	Mean change, ASC vs hospital (min)	P
Preoperative time (min)*	75 ± 34.3 (14–186)	130 ± 56.9 (35–293)	–55	<.001
OR entry to incision time (min)	26 ± 5.7 (16–41)	32 ± 9.1 (11–92)	–7	<.001
Incision to closure time (min)†	120 ± 33.8 (52–248)	117 ± 32.7 (53–194)	+3	.42
Closure to OR exit time (min)	6 ± 2.8 (1–10)	6 ± 4.3 (1–15)	0	.17
PACU time (min)	112 ± 36.1 (62–258)	121 ± 49.9 (25–280)	–9	.16
Total time, holding area entrance to exit from PACU (min)‡	343 ± 63.9 (209–596)	412 ± 87.2 (251–658)	–69	<.001

Data are expressed as mean ± SD (range).

*Time from entrance into the holding area to entrance into the operating room.

†Surgical time or time to perform the operation.

‡Total time also includes time for transport from operating room to PACU, typically about 1 minute.

compared with 3 at the ASC with excessive pain. None of the patients at either facility required hospital admission.

Comments

The primary finding of this study is that the preoperative, OR entry to incision, and total facility time intervals were significantly shorter in the ASC compared with the same procedures performed at the hospital. The ASC's mean reduced total facility time of 69 minutes was primarily composed of preoperative time (55 minutes), with much less ASC time savings in the in OR to incision, closure to exit, and PACU intervals. These findings support a common perception, namely, that outpatient surgery can be more efficiently performed at a dedicated outpatient center rather than at a hospital setting. Surgeons, anesthesiologists, perioperative managers, and hospital administrators may find these data useful for planning and process improvement purposes.

The ASC preoperative time savings we found may be the result of several factors. At our ASC, the preoperative nurse only prepped outpatients, as opposed to the hospital environment, in which the nurse may process both outpatients and critically ill inpatients. Our ASC practice was limited to a fairly small and uniform set of cases, whereas the hospital includes a more varied and complex case mix, including emergency “add-on” cases, unscheduled organ transplantations, and “bring-back” cases for various indications. These complex hospital cases (including unscheduled surgeries) can easily delay scheduled surgery. At the ASC, one surgeon was assigned to one room, and cases could flow one after another. At the hospital, this does not always happen; a surgeon may start in one room but then be scheduled in a different room to follow another surgeon, resulting in delays. Our ASC preoperative area was also physically closer to the OR compared with our hospital preoperative area. The proximity of the OR may have enhanced communication between providers (ie, it was easier to get everyone

together at the bedside when the patient was ready for transport).

In addition to those mentioned above, a number of other factors may contribute to more efficient patient flow in an ASC compared to a hospital. Surgeons are more likely to be involved in “combination cases” with other surgeons in a hospital, placing their subsequent cases at risk for delays, although this scenario would be unusual at our practice. In our practice, hospital anesthesiologists are occasionally delayed in their preoperative assessments of “to follow” cases by involvement with high-acuity patients in the OR. Our data suggest that once outpatients at an ASC or hospital reach the OR, patient throughput becomes essentially identical.

A smaller ASC physical facility with shorter distances to move patients and equipment may simplify patient flow and tracking of supplies. Smaller, more consistent staffing at an ASC with clear and consistent roles can result in greater efficiency compared with a large hospital surgical suite at which turnover of personnel may be more frequent. Of note, our ASC was not staffed by shifts (ie, the staff at the ASC could not rely on relief; they went home only when all the work was done). More than any other factor, this staffing model may have led to many small improvements (eg, parallel processing) and teamwork that resulted in greater efficiency.

Although the anesthetic techniques at the ASC appear to have been geared toward rapid awakening and discharge (more laryngeal mask airways, more propofol infusions), the time intervals most sensitive to anesthetic management (surgical close to OR exit and PACU) did not differ significantly (Table 2). The greatest ASC time savings came in the preoperative period, suggesting that anesthetic technique is less important than preoperative processes in efficient patient throughput. However, the anesthetic techniques were similar in that short-acting agents such as propofol and sevoflurane were used at both facilities. It has been demonstrated that anesthesia technique can affect discharge time. For instance, spinal anesthesia has been implicated as a factor in delayed discharge after ambulatory surgery, although the type of surgery can be a risk factor as well.¹¹

A number of studies have examined perioperative processes in an effort to understand and avoid delays, including minimizing delays in PACU entry by optimizing nurse staffing,¹² “fast tracking” perioperative care,^{13–15} and bypassing the PACU,¹⁶ although bypassing the PACU does not necessarily reduce nursing workload.¹⁷ In our study, patient age, surgical times, and PACU problems were very similar, again supporting the notion that preoperative processing is the greatest contributor to ASC efficiency.

Although a substantial body of literature exists on perioperative efficiency, there are very few available data that compare the efficiency of the same cases performed by the same surgeons in an ASC versus a hospital. ASC efficiency has recently been reviewed,¹⁸ and a hospital OR efficiency scoring system is available.¹⁹ Although various definitions of efficiency exist,^{20,21} ideal OR allocation must be considered to optimize throughput. Decisions regarding OR allocation, scheduling, and staffing can be driven by many factors, including case duration, profit margin, and patient and surgeon preference.²² In a smaller (vs hospital) ASC environment, these decisions may be simplified because there is less competition for resources from high-acuity inpatients and emergency surgery. Ultimately, the goal of a facility is to neither overuse nor underuse its OR resources, summarized by some as 85% to 90% efficient.¹⁸

Limitations of our study arose primarily from its retrospective nature. There may be unknown and therefore uncontrolled factors that explain the shorter time intervals seen at the ASC, such as variation in nurse or other allied health staffing levels that permitted faster preoperative patient processing. We do not have turnover time data for the specific surgeries we have studied; it is likely that a portion of the shorter preoperative time at the ASC was due to shorter room turnover compared with the hospital, but we cannot quantify this. Also, we do not have waiting area arrival times (before entrance into the holding area). Therefore, our analysis does not include a comparison of waiting room time for the two facilities. However, we are not aware of any differences in check-in processes at the two facilities that would lead to a difference in waiting room times.

In conclusion, we have compared anesthetic techniques and time segments for patients undergoing outpatient breast operations at an ASC versus a hospital. Our data demonstrate significantly shorter preoperative, OR entry to incision, and overall (total) time segments at the ASC. Incorporating these significant time saving procedures from the outpatient setting could contribute to greater productivity; health care facilities may obtain the greatest efficiency gains by focusing on streamlining their preoperative processes. The potential efficiency advantage of an ASC over a hospital has implications for patient and staff satisfaction, facility expense, and surgeon productivity. Hospital administrators, perioperative managers, surgeons, and anesthesiologists may consider these results when planning hospital versus ASC utilization, staffing, and construction.

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THE
University of Vermont
MEDICAL CENTER

Via First Class Mail & Email

EXECUTIVE OFFICE

November 11, 2015

MAIN CAMPUS

Patrick 3
111 Colchester Avenue
Burlington, VT 05401

Amy Cooper
1 Mill Street, No. 310
Burlington, VT 05401

Re: *Transfer Agreement*

Dear Ms. Cooper,

Your October 29th letter was forwarded to me. I understand from your letter that you would like the University of Vermont Medical Center to enter into a Transfer Agreement with Green Mountain Surgery Center (GMSC), a proposed multispecialty ambulatory surgery center that would be located in Colchester, Vermont, if its CON application is approved by the Green Mountain Care Board.

As Chief Medical Officer of UVM Medical Center, it falls within my purview to make decisions about whether we should enter into transfer agreements with other health care facilities. In that regard, I evaluate the quality of care and operational efficiency of the facility that is requesting the transfer agreement. I also evaluate the requesting facility's commitment to patient safety, to ensure that it has the capability to adequately stabilize patients and initiate safe patient transfers to UVM Medical Center.

Since GMSC is not currently in operation and is still in the early stages of the CON review process, I do not yet have sufficient information to evaluate your request. However, we are closely following your application and we are working with the Vermont Association of Hospitals and Health Systems, an interested party to your application, to better understand the nature of and need for your proposed surgery center, as well as its impact on the Medical Center, other hospitals, and Vermont's health care system as a whole.

We intend to monitor these issues during the course of the CON proceeding. If your application for a CON is approved, we would be happy to engage in discussions with you about the feasibility and parameters of a potential Transfer Agreement. In the meantime, please feel free to contact me if you have any additional questions about this matter.

Sincerely,



Stephen Leffler, MD
Chief Medical Officer

cc: Al Gobeille, Chair, *Green Mountain Care Board*

Colchester EMS Department

687 Blakely Road

PO Box 55

Colchester, VT 05446

(802) 264-5590

Amy Akerlind, Head of EMS Department

MEMORANDUM OF AGREEMENT*between***Green Mountain Surgery Center***and***Colchester EMS Department**

This agreement is entered into this 11th day of October 2015 by and between Green Mountain Surgery Center and Colchester EMS Department located 687 Blakely Road, Colchester, Vermont.

Whereas Green Mountain Surgery Center is located at 535 Hercules Drive, Colchester, Vermont 05446, and whereas Colchester EMS Department provides emergency ambulance service to patients requiring emergency transport from 535 Hercules Drive, Colchester, Vermont.

Now therefore, in consideration for the mutual covenants and agreements contained in this agreement, the parties agree as follows:

EMERGENCY AMBULANCE SERVICE

- Colchester EMS Department will provide emergency ambulance transfer service between Green Mountain Surgery Center and the University of Vermont Medical Center.
- Green Mountain Surgery Center shall notify the Colchester EMS Department of their need for assistance by calling 9-1-1.
- In certain circumstances, Green Mountain Surgery Center will furnish personnel to assist Colchester EMS and to ride with a patient to the University of Vermont Medical Center.
- Colchester EMS Department will respond to all emergency calls for assistance at Green Mountain Surgery Center per established department policies regarding the use of emergency lights and audible warning devices.

INDEPENDENT CONTRACTOR

The Colchester EMS Department is performing the services and duties required hereunder as an independent contractor and not as an employee, agent, partner, or joint venture with Green Mountain Surgery Center. Colchester EMS is responsible for billing the patient or his/her insurance for any charges incurred. Green Mountain Surgery Center will provide Colchester EMS Department with the patients' insurance information.

ACCESS TO RECORDS

In the event fees payable hereunder shall exceed \$10,000, Colchester EMS agrees to make available to the Secretary of Health and Human Services records pertaining to this agreement.

No patient records will be released by Colchester EMS Department without a signed patient record release form.

TERMINATION

Whereas, Colchester EMS Department is the ambulance service that provides emergency ambulance service within the governmental boundaries of the Town of Colchester, Vermont, this agreement will forever be in force, or until such time that Colchester EMS Department no longer provides EMS services.

BACK-UP COVERAGE

In the event that multiple calls for emergency ambulance service occurs, Colchester EMS Department maintains a written back-up response matrix to assure that adequate back-up coverage will be provided in a timely fashion.

IN WITNESS WHEREOF; Green Mountain Surgery Center and Colchester EMS Department have duly executed this agreement on the first day written above.

Thomas P. Dowhan, MD
Thomas P. Dowhan, MD
For: Green Mountain Surgery Center

12/17/15
Date

Amy Akerlind
Amy Akerlind
For: Colchester EMS Department

10/15/2015
Date

**Green Mountain Surgery Center
535 Hercules Drive, Colchester VT
September 9, 2015**

SYSTEMS NARRATIVE - PLUMBING HVAC ELECTRICAL

GENERAL DESCRIPTION

The proposed ambulatory surgery center will be a single story 12,879 square foot facility located at the above address. Please see floor plan, facility compliance checklist and systems narratives for further information on the facility's scope and functions.

PLUMBING SYSTEMS

SANITARY DRAIN & VENT

A gravity drainage system will be provided for waste discharge from plumbing fixtures and floor drains within the building. Waste piping will be provided to collect fixture drains. The various fixture drains will be combined in a 6" sanitary building drain which will exit the building and connect to the sanitary sewer on site.

Sanitary vent systems will be provided to protect the traps and control pressure fluctuations within the sanitary piping network. Vent stacks will be provided at columns. Vents from fixtures will connect to the vent stacks. The vent stacks will terminate through the roof at each of the main stack locations.

STORM AND CLEARWATER DRAINAGE

Roof drains will be located at low points on the roof and the rainwater will be conveyed through vertical conductors. Vertical conductors will be provided at columns to collect the horizontal conductors from the roof drains. The conductors will connect underground to a building drain. The various conductors will be combined and connect to a 10" building drain which will exit the building and connect to a storm water retention pond or the storm sewer on site.

Secondary overflow roof drains will be provided as required by code. The drains will discharge through the side of the building with a decorative nozzle.

SUBSOIL/FOUNDATION DRAINAGE

A subsoil/foundation drainage system will be provided around the entire perimeter of the building as well as below any floor slabs and around any depressions in floor slabs if required by the geotechnical investigation report. The subsoil drainage system will be collected in a clear water sump and gravity drain to municipal storm sewers or storm water retention pond.

DOMESTIC WATER

A 4" domestic water supply lateral will be provided with a riser located in the mechanical room. The water supply lateral will connect to the water main in the street. A domestic water supply with meter and by-pass will be provided. A reduced pressure zone backflow preventer will be provided on the domestic water supply downstream of the water meter.

A domestic booster pump system will be provided in the mechanical room if municipal water pressure is inadequate. The booster pumps will boost the pressure in the domestic cold water system.

Domestic cold water will be distributed throughout the building via both horizontal and vertical piping. One vertical riser will be provided with horizontal piping above the ceiling to supply the surgery center. Cold water will connect to plumbing fixtures, water heater, and equipment. Cross connection control devices will be provided for all connections.

A central water heating system will be provided. It will consist of sealed combustion high efficiency natural gas water heaters and hot water circulation piping with a circulating pump to maintain hot water temperature. Hot water will be distributed to fixtures and equipment using horizontal piping above ceilings.

Based on municipal water quality reports when they become available, a water softening system may be required for the entire building.

FIRE PROTECTION SYSTEMS

GENERAL

The fire protection system for the building will be an automatic sprinkler system.

The fire protection systems will be designed and installed in conformance with:

- NFPA 13, Automatic Sprinkler Systems
- NFPA 24, Private Fire Service Mains
- Vermont Fire and Building Safety Code
- Other State of Vermont Regulations

SPRINKLER SYSTEM

Specification Criteria:

Sprinkler system shall be designed by hydraulically calculating the system based on Light Hazard Occupancy in general areas.

General

- Density - 0.10 gal/min/ft².
- Area - 1500 ft²
- Hose Allowance - 100 gal/min
- Maximum Velocity - 20 feet/sec
- Duration of Water Supply - 60 minutes

Mechanical/Equipment Rooms

- Density - 0.15 gal/min/ft².
- Area - 1500 ft²
- Hose Allowance - 250 gal/min
- Maximum Velocity - 20 feet/sec
- Duration of Water Supply - 90 minutes

The entire building will be protected by an automatic, wet-pipe sprinkler system. A fire protection riser will be located in the mechanical room and connected to a 6" lateral from the street. A double check valve/double detector check valve assembly will be provided. The fire department connection will be located adjacent to the mechanical room in an accessible location, pending approval by the local Fire Marshall. All shut-off valves will include flow and tamper switches.

Sprinkler heads will be located in every room. Sprinkler heads in finished rooms will be semi-recessed pendant type. Sprinkler heads in mechanical and unfinished spaces will be upright type.

If City water pressure is inadequate a fire pump will be provided to boost pressure in the sprinkler system. The fire pump, jockey pump, control panel and accessories will be located in the lower level mechanical room. A fire pump test connection will be provided near the fire department connection in an accessible location, pending approval by the local Fire Marshall.

HVAC SYSTEMS

The facility will have a constant volume air handling unit located on the roof of the building. This unit will consist of return/exhaust fans, an economizer section, 30% efficient angled front-loading pre-filters, gas fired heating section, direct expansion cooling coils, supply fans, a steam humidification section, 90% efficient front-loading cartridge-type final filters, and a discharge plenum. The surgery center area will be designed to provide constant airflow to ensure that recommended airflow rates are maintained for asepsis control, air quality, and pressurization requirements.

The supply air, exhaust air and return air in the ambulatory surgery will all be ducted.

A sealed combustion gas-fired packaged steam generating humidifier will be provided for the surgery center air handling unit. This unit will be able to modulate the amount of humidification as required to maintain the desired indoor environment for the surgery center.

There will be gas fired heating within the roof top units and duct-mounted electric resistance coils at terminal units throughout the various spaces for zoned temperature control, cabinet unit heaters at each entrance vestibule, and perimeter radiation at areas with large expanses of glazing.

Surgical centers are inherently sensitive to vibration. To address this, the packaged roof top unit will be mounted on a vibration isolation curb and a concrete inertia pad on the roof.

Rooftop exhaust fans will be utilized to provide the anticipated required exhaust airflow for the building. This would include restrooms, janitor's closets, and other general areas that would require negative pressure to prevent the migration of odors and other contaminants. These fans will be indexed to operate by the building control system when the building is occupied. A dedicated inline exhaust fan will exhaust the medical gas storage area. The medical gas exhaust fan will operate continuously to provide constant ventilation for this storage room. Any additional specialized exhaust requirements will be addressed as part of the surgery center improvement.

The building will incorporate a direct digital control building automation system. The system will include a computer workstation with a graphical user interface to control the mechanical equipment such as fans, roof top units, etc. The system will include a time clock to cycle the building between "occupied" to "unoccupied" and will also initiate night setback and morning warm-up operation. The control work station will be located in the mechanical room. The building automation system will be capable of being monitored via an internet web browser accessing the internet.

ELECTRICAL SYSTEMS

ELECTRICAL SERVICE

A new underground primary electrical service will be extended to the building by the local utility. Secondary service will terminate in an indoor freestanding switchboard. Preliminary service size is 800 amps at 480/277 volts. Final capacity will be determined as improvements are designed. Surge protection will be provided at the main switchboard. The main switchboard will consist of a number of individual sections as required; one for the main service breaker, a fire pump section if required and distribution sections for surgery center loads. A mechanical panel will be installed to serve the packaged rooftop unit and another section will provide power for the electric resistance heating.

The electrical gear will be installed in an electrical room. Motors 1/2 horsepower and larger will be fed at 480 volt, 3 phase. Motors smaller than 1/2 horsepower will be fed at 120-volt single phase.

Typical power distribution will consist of the appropriately sized over current device, utility meter socket and step-down transformer with secondary over-current protection devices (enclosed circuit breakers) preferably all located in the electrical room. Distribution panel(s) and/or local panel boards will be located within the surgery center. Normally one 208/120-volt panel is required for about 5000 sq. ft. of floor space. For the surgery center three or more panels will be provided. The surgery center will require an electrical room located where a step-down transformer and Main Distribution Panel will be located. A separate room will be required for emergency distribution equipment: transfer switches and distribution panels.

Raceways for feeders and branch circuits shall be metallic, rigid metal conduit, intermediate metal conduit (IMC) or electrical metallic tubing (EMT) subject to the restrictions of the National Electrical Code, minimum size 1/2". EMT shall not be used in concrete construction or where subjected to mechanical damage. Exterior duct banks shall be comprised of PVC Schedule 40 conduit encased in concrete. Where duct banks penetrate foundation walls or manholes, galvanized rigid conduit (GRC) shall be used. Duct bank elbows shall be GRC. 600V feeders shall be a single conductor, copper or aluminum, 600V rated with XHHW or XHHW-2 insulation, feeders shall be color coded using color type at all connections and in all pull and junction boxes. All feeders shall be installed in conduit. Branch circuit conductors shall be a single conductor copper 600V rated with THWN or THHN insulation with continuous color-coding. Branch circuit conductor shall be designed to utilize the advantages of a multi-wire distribution; however, no more than 5 conductors (3-phase, 1 neutral and 1 ground) shall be installed in a common conduit.

A complete equipment grounding system shall be provided such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, metal fences, and all other conductive items operate continuously at ground potential and provide a low impedance path to ground for possible fault currents.

The main electric equipment room shall be provided with continuous copper ground bus around the perimeter of the room for properly bonding and grounding all main switchgear. The ground bus shall be bonded to the incoming water service pipe and other system grounding electrodes and ground rods.

A separate insulated green grounding conductor shall be provided for each single and 3-phase feeder and branch circuit. Grounding conductor shall be run with the related phase and neutral conductors. Panel feeders installed in more than (1) raceway shall have individual, full sized, green grounding conductor in each raceway. The equipment grounding system shall not rely on the metallic raceways for grounding continuity.

EMERGENCY POWER

Emergency power for the surgery center will be provided from a new standby outdoor generator set. Power will be generated at 480Y/277 volts. The power source will be diesel or natural gas.

Three branches of emergency power distribution will be provided: one for life safety (code required emergency), one for critical loads and one for equipment loads.

The life safety branch of emergency power will feed all exit lighting, emergency egress lighting, medical gas system alarms, operating room panels and fire alarm systems.

The critical branch will feed operating room outlets (partial), surgical lights, medical gas columns, medical gas manifolds, the vacuum pump, recovery outlets (partial), nurse call system, a flash sterilizer, and the telecom equipment

The equipment branch of emergency power will feed all required HVAC motors to maintain heat and air circulation. Other equipment that will be fed from this branch would be medical equipment including lasers and sterilizers, and loads that the building codes require to be on emergency. Air conditioning equipment will not be connected to the generator.

LIGHTING

Lighting will be provided to meet the requirements of State of Vermont Illumination code, with foot-candle levels as recommended by the Illuminating Engineering Society (IES). Lighting for the "house" and tenants will be served at 120 volt. Light sources indoors will primarily be energy saving 4' T8 or 2' bi-x fluorescent with electronic ballasts. LED down lights will be provided for smaller areas. Outdoor lighting lamp source will be metal halide. Incandescent light sources will not be utilized.

Lighting controls will consist of occupancy sensors for small offices and exam rooms, and low voltage lighting control system will be provided for all common corridors, lobbies and etc. Low voltage relay cabinets will be installed in electrical closet adjacent to the lighting panels.

RECEPTACLES

Receptacles will be provided as required and dictated by furniture and equipment needs. Outlets shall be hospital grade. Exterior outlets and outlets in toilets will be GFI type. Receptacles for PC's shall be standard receptacles, not isolated ground receptacles. Ground wires shall be pulled with all receptacle circuits.

Cover plates will be primarily nylon or polycarbonate throughout the facility.

FIRE ALARM AND SMOKE DETECTION SYSTEM

The fire alarm system will be an addressable multiplex system manufactured by Simplex, Notifier or EST. The main panel will be located in the main electrical service room with a remote annunciator located at the designated fire department response location. The fire alarm response location has to be identified by the State Fire Marshall and the Architect. Fire Alarm panels shall be supplied with emergency battery for a minimum of 24 hours operation.

All initiating devices will be individually identified on the system as to its device type and location. Pull stations at locations accessible to the general public will be break glass type. Alarm devices will consist of chimes and strobes to meet the requirements of the Americans with Disabilities Act (ADA) and NFPA 72.

Fire Alarm system shall be interfaced with Building automation system.

Manual pull station shall be provided at each egress and shall be spaced such the travel distance to each pull station is less than 200'.

Smoke detectors shall be photoelectric type. Duct smoke detectors shall be located at the roof top unit and shall be the ionization type.

Heat detectors shall be provided in mechanical rooms.

LIGHTNING PROTECTION SYSTEM

Assessment of risk will be made in accordance with NFPA Chapter 780. After review with the Owner, a determination will be made as to the need for a lightning protection system. Should a system be required, a complete Master Labeled Lightning Protection System meeting all requirements of UL shall be provided, complete with air terminals on the roof, bonding of all mechanical equipment and stacks, bonding of structure and all metal parts, ground conductors, ground rods, connectors, straps, etc.

Form A – Verification Form

STATE OF VERMONT
GREEN MOUNTAIN CARE BOARD

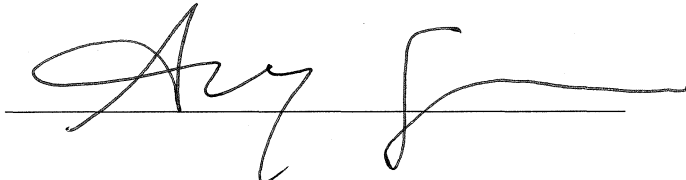
In re: ACTD LLC MULTI-SPECIALTY)
AMBULATORY SURGERY CENTER) Docket No. GMCB-010-15con
)
)
)

Verification Under Oath – Responses and Supplemental Exhibits

Amy Cooper, being duly sworn, states on oath as follows:

1. My name is Amy Cooper. I am the manager of ACTD LLC. I have reviewed the Responses and Supplemental Exhibits being submitted with this Verification to support the Certificate of Need Application for the Green Mountain Surgery Center (“Responses”).
2. Based on my personal knowledge, after diligent inquiry, the information contained in the Responses is true, accurate and complete, does not contain any untrue statement of a material fact, and does not omit to state a material fact necessary to make the statement made therein not misleading, except as specifically noted in the Responses.
3. My personal knowledge of the truth, accuracy and completeness of the information contained in the Responses is based upon either my actual knowledge of the subject information or, where identified below, upon information reasonably believed by me to be reliable and provided to me by the individuals identified below who have certified that the information they have provided is true, accurate and complete, does not contain any untrue statement of a material fact, and does not omit to state a material fact necessary to make the statement made therein not misleading.
4. I have evaluated, within the 12 months preceding the date of this affidavit, the policies and procedures by which information has been provided by the certifying individuals identified below, and I have determined that such policies and procedures are effective in ensuring that all information submitted or used by ACTD LLC in connection with the Certificate of Need program is true, accurate and complete. I have disclosed to ACTD LLC all significant deficiencies, of which I have personal knowledge after diligent inquiry, in such policies and procedures, and I have disclosed to ACTD LLC any misrepresentation of facts, whether or not material, that involves management or any other employee participating in providing information submitted or used by ACTD LLC in connection with the Certificate of Need program.

5. The following certifying individuals have provided information or documents to me in connection with the Responses, and each such individual has certified, based on his or her actual knowledge of the subject information or, where specifically identified in such certification, based on information reasonably believed by the certifying individual to be reliable, that the information or documents they have provided are true, accurate and complete, do not contain any untrue statement of a material fact, and do not omit to state a material fact necessary to make the statement made therein not misleading:
- a. Joan Dentler – Avanza Strategies; provided the financial and clinical projections and assumptions underlying the proposed ASC
 - b. Maria Serafine - Avanza Strategies; provided the financial and clinical projections and assumptions underlying the proposed ASC
 - c. Erin P. Carr - Avanza Strategies, provided financial assumptions underlying the proposed ASC
 - d. Jack Amormino - AMB Development Group, provided the systems narrative required in response to Question 21.
 - e. Physicians practicing in the area who wish to remain anonymous.
6. In the event that the information contained in the Responses becomes untrue, inaccurate or incomplete in any material respect, I acknowledge my obligation to notify the Green Mountain Care Board and to supplement the Responses, as soon as I know, or reasonably should know, that the information or document has become untrue, inaccurate or incomplete in any material respect.



On December 23 2015, Amy Cooper appeared before me and swore to the truth, accuracy and completeness of the foregoing.

Notary public 

My commission expires February 10, 2019