



Providence|Health System

Certificate of Need Application
for
Two Catheterization Laboratories

Providence Alaska Medical Center
Anchorage Alaska

January 2007

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Section I. General Applicant Information

	CERTIFICATE OF NEED APPLICATION APPLICANT IDENTIFICATION AND CERTIFICATION OF ACCURACY	
1. Applicant Identification		
Facility Name Providence Alaska Medical Center	Medicaid Provider Number HP111P; HS11OP	
Facility Address (Street/City/State/Zip Code) 3200 Providence Drive, Anchorage, AK 99508	Medicare Provider Number 020001	
Name and mailing address of organization that operates the facility (if different from above) P.O. Box 196604, Anchorage, AK 99519-6604		
Facility Administrator (Name, title, mailing address, including City/State/Zip Code) Bruce Lamoureux; CEO/Administrator, Providence Alaska Medical Center P.O. Box 196604, Anchorage, AK 99519-6604	Telephone 907-261-3675 Facsimile 907-261-3041 E-mail: blamoureux@provak.org	
Applicant (Name, title, mailing address, including City/State/Zip Code) Bruce Lamoureux; CEO/Administrator, Providence Alaska Medical Center P.O. Box 196604, Anchorage, AK 99519-6604	Telephone 907-261-3675 Facsimile 907-261-3041 E-mail: blamoureux@provak.org	
Principal Contact Person (Name, title, physical address, mailing address, including City/State/Zip Code) Lisa Wolf, Director of Planning, Providence Health System in Alaska P.O. Box 196604, Anchorage, AK 99519-6604	Telephone 907-261-3037 Mobile Phone 907-227-8746 Facsimile 907-261-2884 E-mail lwolf@provak.org	
2. Ownership Information		
A. Type of Ownership (check applicable category) <input type="checkbox"/> For profit: individual <input type="checkbox"/> Not for profit: government <input type="checkbox"/> For profit: partnership <input checked="" type="checkbox"/> Not for profit: corporation <input type="checkbox"/> For profit: corporation <input type="checkbox"/> Other (specify): _____ B. List of all Owners (Page 2 of application) C. Accreditation Information (Page 2 of application)		
3. Certification of Accuracy by Certifying Officer of the Organization		
I hereby certify that the information contained in this application, including all documents that form any part of it, is true, to the best of my knowledge and belief. I agree to provide, within 60 days from receipt of a request from the department under 7 AAC 07.050(b), any additional information needed by the department to make a decision.		
Name Bruce Lamoureux	Title Administrator, Providence Alaska Medical Center	
Signature 	Date 1-4-07	

Part 2.B., provide the following ownership information under each requirement, using as much space as necessary to provide complete information:

(1) For individual owners and partnerships, list the names, titles, organizational name, mailing and street addresses, and telephone and facsimile numbers of the owners or partners.

(2) For corporations, list the names, titles, and addresses of the corporate officers and Board of Directors. If the facility is a subsidiary of another company or has multiple owners, provide the names and addresses of the all of companies that have ownership in the facility.

(3) For governmental or other nonprofit owners, list the names and addresses of hospital board members.

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Dana Rasmussen	Consultant	Seattle, WA
Paul A. Redmond	Retired	Spokane, WA
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Steven Smith, M.D.
Chief, Medical Staff
Providence Kodiak Island Medical Center

David G. Wright
Anchorage, Alaska 99516

For Part 2.C.

Is this facility accredited or certified by a recognized national organization? Yes

If yes, identify the organization, the date of accreditation or certification, and attach as an appendix to this application a copy of the most current accreditation or certification.

Providence Alaska Medical Center (PAMC) is accredited by the Joint Commission of Accreditation of Hospitals. PAMC was surveyed in October of 2005 and received accreditation through October 2008. A copy of the recent survey accreditation from JCAHO is in the appendices.

Section II. Summary Project Description

- 1) A brief description of each proposed service, including whether equipment will be purchased or replaced.**

This project is to purchase two catheterization laboratories.

- 2) The number of square feet of construction/renovation.**

The proposed project is to remodel 750 SF for the catheterization lab #5 and 862 SF for catheterization lab #6.

- 3) The number and type of beds/surgery suites/specialty rooms.**

This project will add two catheterization labs. No additional patient beds or operating suites will be added.

- 4) Services to be expanded, added, replaced, or reduced.**

The services to be expanded include two additional catheterization labs.

- 5) The total cost of the project.**

The total cost of the project is \$5,001,614, including \$1.9 million for construction and \$3.1 million for equipment.

- 6) How the project will be financed.**

The project will be paid for through accumulated revenues.

- 7) Completion date.**

The catheterization lab #5 should be operational in May 2007. Catheterization lab #6 will be operational in January 2008.

Section III. Description of Facilities and Services

A. Proposed changes in service capacity. Provide either the number of beds, surgery suites, rooms, pieces of equipment, or other service.

Type of Service	Current Capacity	Added, Expanded, or Replacement Capacity	TOTAL PROPOSED CAPACITY
IN-PATIENT ACUTE CARE HOSPITALS			
Med/Surg Beds			
1-bed room/unit	152	0	152
2-bed room/unit	16	0	16
Other (list): NICU	38	0	38
ICU Beds	37	0	37
Obstetrics Beds	36	0	36
Pediatric Beds	32	0	32
Acute Rehab Beds	10	0	10
Ancillary Services (list)	0	0	0
BEHAVIORAL HEALTH CARE			
In-patient Acute Psychiatric Beds	27	0	27
RPTC Beds	0	0	0
In-patient Substance Abuse Beds	0	0	0
LONG-TERM CARE			
Acute Beds	0	0	0
Nursing Beds	0	0	0
DIAGNOSTIC AND DIAGNOSTIC IMAGING SERVICES			
CT Scanner	2	0	2
MRI	1	0	1
PET or PET/CT	0	0	0
Catherization Laboratory	4	2	6
SURGICAL CARE			
Dedicated OP	0	0	0
Dedicated IP	0	0	0
Both IP & OP	15	0	15
Endoscopy	4	0	4
Open-Heart Surgery	1	0	1
Organ Transplantation	0	0	0
Ambulatory Surgery	0	0	0
Other Services (list): Cysto Dedicated OR	1	0	1
THERAPEUTIC CARE			
Radiation Therapy	2	0	2
Lithotripsy	0	0	0
Renal Dialysis	6	0	6
Other (List)			
Total Capacity	326 licensed beds	0	326 licensed beds

B. Provide a detailed narrative description of each service identified in "A" above, including the type of change (addition, expansion, conversion, reduction, replacement,

elimination). Include, as appropriate, detailed information relative to the scope and level of service.

PAMC currently has 4 catheterization labs:

- Two cardiac catheterization labs used by cardiologists for adult and pediatric diagnostic and interventional cardiac catheterizations, stents and PTCA's. These labs came into service in 2000 and 2001. One lab was replaced in 2006.
- One electrophysiology lab which has a different system. It uses electrocardiograms and 3D mapping equipment to perform electrical mapping of the heart. It is also used for pacemaker and defibrillator implants. This lab was replaced in 2005.
- One interventional radiology lab which came into service in 2001. It has a different imaging system with a larger lens to view blockages in arms, legs, brain, for example. It is used on all parts of the body, except the heart.

The proposed project is to add a two catheterization labs. Existing space will be remodeled to house the labs, near the recovery area. The current four labs are operating beyond the State's target capacity guideline of 750 procedures a year or 75% capacity. In fact, in 2005, they were operating at over 100% capacity. The 2005 volume justifies a need for 5.6 labs, or 1.6 labs above the 4 existing labs to handle the current volume at target capacity. Two additional labs are needed to accommodate the current volumes and volumes generated by a growing and aging population, new procedures and new physicians. The additional labs will reduce the amount of overtime currently needed to handle growing volumes. These additional catheterization labs will be able to perform interventional radiology and cardiac catheterizations.

Table A
Providence Alaska Medical Center
Catheterization Lab Volumes, 2003-2005

	2003	2004	2005
Patients	3539	3401	4203
Number of Catheterization Labs	4	4	4
Capacity based on 1000 procedures per lab as maximum capacity	88%	85%	105%
Number of labs needed based on State target capacity of 750	4.72	4.54	5.60

C. Provide in the following table information regarding equipment to be purchased.

Description	Make	Model	Cost
C-arm Digital Imaging System x 2	Phillips	Allura Xper FD20	2,074,574
Hemodynamics (w/remote Operator Terminal) x 2	General Electric	MACLAB	196,070
Intravascular Ultrasound x 2	Boston Scientific Lab		170,000
Ultrasound x 2	Sonosite		100,000
Pyxis Med Storage Unit x 2	Pyxis/Cardinal		77,160
Pressure Injector x 2	Medrad	Mark V Plus	60,000
Defibrillator x 2	Zoll	M-series	36,000
Codecart x 2	Armstrong		4,590
Undercounter Lab Refrigerator x 2	Marvel		3,116
Desk Chairs x 6	Hon	7754	2,400
PC x 2	Dell		1,200
Surgical Table (Scrub Table) x 2	Alimed	HE 93-0559	1,110
IV Pole x 4	Alimed	HE 92-4422	920
Mayo Stand x 2	Alimed	HE 91-639	354
Total			\$ 2,727,494

D. Provide in the following table information regarding equipment to be replaced or retired.

NA

E. Describe replacement or upgrading of utilities including the electrical, heating, ventilation, and air conditioning systems.

An existing air handler is being upgraded by an unrelated project; this new handler will accommodate the added air requirements for the catheterization labs. The electrical infrastructure will be enhanced by adding a new main panel to accommodate the demands of the new catheterization labs emergency power needs.

F. Describe the structural framing, floor system, and number of floors (including the basement).

This project is a remodel of existing space. The catheterization labs' construction will include steel studs, lead lined sheet rock and a new unistrut ceiling system.

G. Total square footage in current facility/project.

The square footage of Providence Alaska Medical Center is 747,025 SF.
There will be no additional square footage added to PAMC.

H. Total square footage of proposed facility/project.

The space being remodeled is about 1500 SF. The total square footage of Providence Alaska Medical Center after this project will be 747,025 SF.

I. Area per bed, service unit, or surgery suite (if applicable).

Square footage per lab is 750 SF.

J. Percentage of total floor area used for direct service (non-bed activity).

In this project, 100% of this area will be used for direct patient care.

K. Additional volume of service (non-bed activity) expected.

Catheterization lab volumes over the last five years has increase 5% per year. The projected volume for the next three years is expected to continue to increase – 6% in 2007, 9% in 2008 and 9% in 2009. This growth is supported by the growing population, the aging population, continued new procedures and the large number of physicians using the catheterization labs.

L. Provide a brief history of expansion and construction for the past five years, including new equipment purchases, additional beds, and new services. Describe how this project fits into the facility's long-range plans, including potential projects planned for development within the next five years.

Over the last five years, PAMC has:

- Upgraded radiology services (2000)
- Upgraded NICU (2001)
- Upgraded Pharmacy (2005)
- Replacement of Linear Accelerator (2005) and
- Replacement of Catheterization Lab (2005)
- Replacement of Catheterization Lab (2006)

Through the Certificate of Need process, PAMC has completed:

- Relocation of the Laboratory (2000)
- Addition of 19 Acute Care beds (2002)
- Magnetic Resonance Imaging System (2004) and
- Long Term Acute Care Hospital as a Joint Venture (2005)

Providence Health System in Alaska has a three year Strategic Plan that is updated each year. The current plan acknowledges the population growth of Anchorage and Alaska, especially in the age cohorts of 45-64 and 65 plus. These populations are large users of health care services, especially of heart, cancer and surgery programs. All three of these areas will need to expand their capacity to continue to meet the demand of the population.

Alaska has also had a short supply of physicians. In order to serve the growing population, efforts to recruit additional physicians to our state will continue to be a priority. Additional medical office space is being constructed to support these new physicians. Additional physicians and the associated increase in patient levels requires additional space for both diagnostic areas as well as inpatient beds.

Section IV. Narrative Review Questions

A. RELATIONSHIP TO APPLICABLE PLANS AND NATIONAL TRENDS

Indicate how the application relates to any relevant plans, including the applicant's long-range plans, appropriate local, regional, or state government plans, the current *Alaska Certificate of Need Review Standards and Methodologies*, adopted by reference in 7 AAC 07.025, and current planning guidelines of recognized national medical and health care groups. If the proposal is at variance with any of these documents, explain why.

Providence Alaska Medical Center Strategic Plan

As stated in the previous question, the new catheterization labs are part of the 2007-2009 Strategic Plan. This three-year plan is reviewed annually and updated as the health care environment changes. This plan is completed in coordination with our Long Range Financial Plan to assure that funding for projects will be available. The catheterization labs help to support the growing population need in heart, oncology and diabetes services.

Alaska Certificate of Need Review Standards and Methodologies

The State's cardiac catheterization guideline sets the target capacity at 750 procedures a year per catheterization laboratory. The guideline states that 1000 procedures is the maximum capacity for a catheterization lab or 100% capacity. See page 26 of the *Alaska Certificate of Need Review Standards and Methodologies*. In a meeting in the Spring of 2006, DHSS, Providence and Alaska Regional clarified that the term "procedure" in the State's methodology equates to "patient" (there are typically multiple procedures per patient). Following this guideline, the term "patient" is used in this CON to more accurately reflect volumes.

With volumes at PAMC reaching 4203 in 2005, the current four labs are operating 105% of maximum capacity (based on 1000 patients per lab). This is well over the target capacity of 75%. Using the State's target capacity of 750 procedures, Table B shows that there is currently a need for six catheterization labs at PAMC.

Table B
Providence Alaska Medical Center
Catheterization Lab Volumes, 2003-2005

	2003	2004	2005
Patients	3539	3401	4203
Number of Catheterization Labs	4	4	4
Capacity based on 1000 procedures as maximum capacity	88%	85%	105%
Number of labs needed based on State target capacity of 750	4.72	4.54	5.60

State Methodology

The State methodology for projecting volumes is based on an historic three-year use rate, and then applies the use rate to population projections in the third year of operation to determine future volume and the need for labs. Table C below shows the State's methodology to project volumes based on PAMC and Alaska Regional volumes, which are only available for 2004-2005. Using this methodology, the projected volume for 2009 is 5142 patients, resulting in the need for 6.86 labs at target capacity.

Table C
State Methodology - Average Historic Use Rates for Combined (PAMC + ARH) Volumes

Year	AK Population	Combined Volume	Use Rate: Patients per 1000 Population	Current Capacity: 1000 Patients per Lab (4 labs)	Labs Needed: based on Target Capacity (750 Patients per lab)
2003	648510	na	na	na	na
2004	657755	4479	6.81	75%	5.97
2005	663661	5272	7.94	88%	7.03
Actual Growth Rate 2004-2005			16.7%		
2 yr Avg			7.38		
2009	692,001	5142	7.43	86%	6.86

However, this methodology projects a 2.5% decline in volume from 2005-2009, with a reduction of 130 patients. The methodology is flawed as it does not take into account volume growth as a result of: new physicians, new types of procedures, and increasing use rates driven by population increases in people over age 45. Both internal and external data sources provide evidence of significant growth in catheterization lab volumes proving the State's methodology is inconsistent with what is happening in the marketplace. A more appropriate methodology would use trends rather than averages. Unfortunately, the growth rate based on only two years of data is 16.7%, which is potentially an anomaly and unreliable.

Methodologies Using Compound Growth Rates

To determine a more reasonable growth rate using more data, Table D illustrates a compound growth rate of 7.7% based on PAMC volumes from 2003-2005. This results in 5903 patients in 2009 and a need for 7.87 cath labs at PAMC alone; this is 3.87 more than currently available.

Table D
2009 Demand Based on 2003-2005 PAMC Volumes

Year	AK Population	PAMC Volume	Use Rate: Patients per 1000 Population	Current Capacity: 1000 Patients per Lab (4 labs)	PAMC Labs Needed: based on Target Capacity (750 Patients per lab)
2003	648,510	3539	5.46	88%	4.72
2004	657,755	3401	5.17	85%	4.53
2005	663,661	4203	6.33	105%	5.60
-5% Change in use rate '03-'04					
22% Change in use rate '04-'05					
16.05% Change from '03-'05 (2 years)					
7.7% Compound growth in PAMC use rate					
2006			6.82		
2007			7.35		
2008			7.92		
2009	692,001	5903	8.53	148%	7.87

Assuming that the PAMC compound growth rate is more reasonable, and applying it to the combined volumes of both PAMC and Alaska Regional, Table E illustrates a 2009 combined volume of 7403, and a need for 9.87 catheterization labs in Anchorage.

Table E
2009 Demand Based on 2003-2005 PAMC Compound Growth of 7.7%

Year	AK Population	Combined Volume	Use Rate: Patients per 1000 Population	Current Capacity: 1000 Patients per Lab (4 labs)	Labs Needed: based on Target Capacity (750 Patients per lab)
2003	648,510	na	na	na	na
2004	657,755	4479	6.81	75%	5.97
2005	663,661	5272	7.94	88%	7.03
Volumes assuming 7.7% compound growth rate (based on PAMC Actuals 2003-2005)					
2006	669,977	5733	8.56	96%	7.64
2007	677,362	6245	9.22	104%	8.33
2008	684,714	6800	9.93	113%	9.07
2009	692,001	7403	10.70	123%	9.87

Methodology using a National Database

There are national databases that track health care utilization in order to help the industry keep up with the demands. These sources project future utilization based on population growth and aging, current utilization and new advancements in technology. *Solucient*, a national database that also does projections on a statewide level, was used to compare to local growth estimates in cardiovascular services in Alaska. Table F shows projections for 2005- 2010, with an increase in volumes of 51.4% over five years and a compound growth rate of 8.7%.

Table F
2009 Demand Based on Solucient Technology Trends

Year	AK Population	Combined Volume	Use Rate: Patients per 1000 Population	Current Capacity: 1000 Patients per Lab (4 labs)	Labs Needed: based on Target Capacity (750 Patients per lab)
2003	648,510	na	na	na	na
2004	657,755	4479	6.81	75%	5.97
2005	663,661	5272	7.94	88%	7.03
Technology Trends for Outpatient Cardiac Procedures in Alaska (Solucient):					
	2005	159,529			
	2010	241,561			
		51.40% increase 2005-2010			
		8.7% Compound Growth Rate			
Volume Assuming 8.7% Compound Growth Rates (Solucient)					
2006	669,977	5783	8.63	96%	7.71
2007	677,362	6352	9.38	106%	8.47
2008	684,714	6977	10.19	116%	9.30
2009	692,001	7661	11.07	128%	10.21

Using this compound growth rate, the volumes in 2009 are 7661 demonstrating a need for 10.21 labs. This scenario is consistent with the forecast in Table E, and is far more realistic than the State's methodology that projects 2009 volumes below 2005 actuals. All of these formulas highlight the flawed result under the State's methodology, and support the use of alternative analysis.

B. DEMONSTRATION OF NEED

1. Identify the problems being addressed by the project. For example, identify whether this project is for (a) a new service; (b) an expanded service; or (c) an upgrade of an existing service.

This project is an expansion of an existing service.

Capacity of Current Catheterization Labs

The current four catheterization labs at Providence were used for more than 4200 cases in 2005. This is beyond the State's review standard of a maximum of 1000 cases per lab or the target capacity of 750 cases per lab. In 2005, the PAMC catheterization labs were at 105% capacity based on the maximum standard of 1000 procedures per lab. Volumes performed in 2005 would require 5.6 catheterization labs operating at the target capacity. Additional physicians with catheterization credentials have responded to the growing demand and led to the growth in volume. The current labs are insufficient for current needs and cannot handle additional demand without additional capacity.

Table G
Providence Alaska Medical Center
Catheterization Volume and Lab Capacity
2001-2005

	2001	2002	2003	2004	2005
Volume	3517	3593	3539	3401	4203
Number of Catheterization Labs	4	4	4	4	4
Capacity based on 1000 patients	88%	90%	88%	85%	105%
Labs needed based on 750 patients per Lab	4.69	4.79	4.72	4.54	5.60

Increasing number of physicians using the Catheterization Labs

The number of physicians trained in this field has greatly increased in response to patient needs and advances in technical procedures, creating a high demand on the current labs. Three additional physicians began practice in 2005 which is an 18% increase in the number of physicians served by the catheterization labs. Consequently volumes increased 24% in that year.

Table H
Providence Alaska Medical Center
Number of Physicians with Catheterization Lab Privileges

Year	Number of Physicians	% Increase
2001	15	na
2002	15	0%
2003	16	7%
2004	17	6%
2005	20	18%

Increasing patient demand

As the Alaskan population ages, its use of medical facilities increases. Disease categories that are increasing include heart, cancer, and diabetes. Many of these types of patients will need use of a catheterization lab.

- Alaskans are at risk for peripheral vascular disease, and often develop blockages in leg and peripheral arteries. The blockages are located using the imaging from a catheterization lab.
- Alaskans have a high incidence of kidney disease that require insertion and maintenance of their fistulas or dialysis catheters. Catheterization labs are used to image these sites.
- Cancer patients also have a need for insertion and maintenance of infusion catheters or ports for chemotherapy.
- New technologies are constantly evolving. Conditions which formerly required surgery can be done using minimally invasive techniques which are now done in a catheterization lab.
For example,
 - chronic total occlusions which used to require bypass surgery, can now be opened using new devices in the catheterization lab;
 - carotid angioplasties are done in place of edarterectomy surgeries;
 - abdominal aortic aneurysm repairs are done in a catheterization lab instead of surgery;
 - PFO closures (holes between the chambers of the heart) can be repaired in the catheterization lab;
 - new technology allows for ablations in the catheterization lab to correct rhythm disorders;
- High risk patients, who might not be eligible for surgery, can receive less invasive care in the catheterization lab.

2. Describe whether (and how) this project (a) addresses an unmet community need; (b) satisfies an increasing demand for services; (c) follows a national trend in providing this type of service; or (d) meets a higher quality or efficiency standard.

Unmet Community Need

This is not a new service to Alaska or Anchorage. Catheterization procedures are provided at PAMC and Alaska Regional. Both facilities can do diagnostic, complex, elective and emergent cases as they have a surgical service as well. Mat-Su Regional Medical Center also has a catheterization lab but is restricted to diagnostic and emergent procedures only. The more complex cases or those with complications must be sent to Anchorage. Even with these locations there is still an unmet need as demonstrated by the waiting list for some procedures up to three to four weeks.

Demand for Service

With the Alaska population growing and aging, there is increased demand for cardiac, oncology, and surgical services. The population age cohort 45-64 accounts for a large percentage of hospitalizations. This is one of the fastest growing age cohorts in Alaska. In addition, residents age 65 and older are high users of health care services and that group is growing as well. Although most of these services are currently provided, this growth in demand will tax the current supply of diagnostic machines, ORs, procedure rooms, treatment equipment and

physicians currently available at PAMC, most of Anchorage, and Alaska. This is a nation-wide trend due to the aging of the baby boomer generation.

Even with four catheterization labs, the demand is so high, PAMC currently has a three to four week waiting list for ablations. Adding one new catheterization lab will help ease the waiting list. Adding two labs will help to reduce or eliminate the wait times over the next few years. The continued growth in the population will keep demand high.

Higher Quality and Efficiency

Two additional labs will provide sufficient capacity. These labs will allow for improved scheduling of patients, reduce waiting lists for elective procedures, and reduced overtime for staff.

3. Describe any internal deficiencies of the facility that will be corrected, and document which of these deficiencies have been noted by regulatory authorities. Note any deficiencies that will not be corrected by this project, what efforts have been taken to correct the deficiencies, and how this project will affect the deficiencies. Attach any pertinent inspection records and other relevant reports as an appendix to the application.

There are no regulatory deficiencies in the lab area. The operational problems are due to capacity issues and include:

- Waiting list – There is a three month wait for ablations;
- Limited capacity - Although there are about 20 physicians able to do catheterizations, only four can perform a procedure at any given time at PAMC; only six in all of Anchorage;
- Length of procedures is getting longer - As these procedures become more complex, the length of time to perform them increases. Some procedures can take five hours and some even eight hours. Throughput is greatly affected as more and more procedures are complex in nature.
- Overtime - High use of overtime to care for routine patients and emergent patients. This is hard on staff in very stressful roles

4. Identify the target population to be served by this project. The "target population" is the population that is or may reasonably be expected to be served by a specific service at a particular site. Explain whether this is a local program, or a program that serves a population outside of the proposed service area. Use the most recent Alaska Department of Labor and Workforce Development statistics for population data and projections. Explain and document any variances from those projections. The population may be defined in one or more ways:

The target population for this project is the residents of the state of Alaska. This is tertiary service and is only offered in Anchorage. Although most patients are over age 44, pediatric and young adults also utilize the catheterization labs. The Alaska Department of Labor states that the 2004 population of Alaska is 655,435. Their projections show the State's population growing 5.5% by 2009 and 12% by 2013.

a. Document the service area by means of a patient origin analysis.

At Providence Alaska Medical Center, an average of 24% of inpatients and 14% of outpatients live outside of the Anchorage area. Providence's patient demographics by race and age closely follow Anchorage's demographics. Hospital utilization by females and by seniors is greater than the overall population distribution.

Utilization of the Heart Center, however, is significantly different than the overall hospital experience. Patients tend to be male and older than the average hospital patient. Because the services within the Heart Center are tertiary, there is a higher percentage of patients from outside of Anchorage, 44% vs. 15% of the hospital as a whole.

Table I
Providence Alaska Medical Center
Total Patients vs. Heart Center Patients
Patient Origin, 2005

Service Area	Total PAMC	Heart Center
Anchorage	85%	56%
Gulf Coast & Mat-Su Regions	10%	26%
Other Alaska	5%	15%
Outside Alaska	<1%	3%
Total	100%	100%

Table J
Providence Alaska Medical Center
Total Patients vs. Heart Center Patients
Race by Percentage, 2005

Race	Total PAMC	Heart Center
Caucasian	78%	84%
Native	4%	3%
Black	6%	4%
Pacific/Asian Islander	7%	6%
Hispanic	4%	2%
Unknown	1%	1%
Total	100%	100%

Table K
Providence Alaska Medical Center
Total Patients vs. Heart Center Patients
Gender by Percentage, 2005

Gender	PAMC	Heart Center
Female	63%	40%
Male	37%	60%
Total	100%	100%

Table L
Providence Alaska Medical Center
Total Patients vs. Heart Center Patients
Age by Percentage, 2005

Age	PAMC	Heart Center
0-14	11%	1%
15-44	33%	10%
45-64	35%	45%
65+	21%	44%
Total	100%	100%

- b. **Justify the customary geographical area served by the facility using trade and travel pattern information. Indicate the number and location of individuals using services who live out of the primary service area.**

Table M
Providence Alaska Medical Center
Heart Center Patients By Area of Residence, 2005
Compared to Population Distribution, 2005

Area	Heart Center Patients	Population Distribution
Anchorage	56%	42%
Mat-Su	15%	11%
Gulf Coast Region	12%	11%
Interior Region	8%	15%
Northern Region	2%	4%
Southeast Region	2%	11%
Southwest Region	2%	6%
Outside Alaska	3%	na
Total (n=3365)	100%	100%

When comparing the patient utilization by area with the State's population distribution by area, there is higher utilization by patients who live in Anchorage or are on the road system – Anchorage, Mat-Su and the Gulf Coast region. Those that must fly into Anchorage have a lower utilization than the population distribution. However, the utilization of the Heart Center is in general closer to the State's population distribution as it is a tertiary service, i.e. Anchorage utilization is 56% compared to Anchorage population of 42%. Total PAMC utilization is 85% Anchorage versus the Heart Center at 56% Anchorage.

- c. **Use Alaska Department of Labor and Workforce Development information, including current census data on cities, municipalities, census areas, or census sub-areas, to describe trends, age/sex breakdowns, and other characteristics pertinent to the determination of need.**

Table N
Alaska Department of Labor, Population by Borough and Region, 2005

Area Name Estimate	2005 Estimate	% Of Total
<u>Alaska</u>	<u>663,661</u>	<u>100%</u>
Anchorage Mat-Su Region	352,282	53%
<i>Anchorage Municipality</i>	<i>278,241</i>	<i>42%</i>
<i>Matanuska-Susitna Borough</i>	<i>74,041</i>	<i>11%</i>
Gulf Coast Region	74,904	11%
Interior Region	102,005	15%
Northern Region	23,669	4%
Southeast Region	70,822	11%
Southwest Region	39,979	6%

Table N shows the population distribution of residents of Alaska by areas. Table M, in answer to question b. above shows the patient utilization by the same areas. There is higher

use by those who live in Anchorage and those within a few hours drive of Anchorage. However, as a catheterization laboratory is a tertiary service and only available in Anchorage, there is use by residents who must fly in for the service. Like many tertiary services, a portion of the population seeks care in other states. There is no known database that tracks the number of catheterization procedures done on Alaskans in other states.

- d. **The population to be served can be defined according to the unique needs of patients requiring specialized or tertiary care (e.g. heart, cancer, kidney, alcoholism, etc.) or the needs of under-served groups.**

Patients using the catheterization labs vary greatly in their diagnosis, as the catheterization lab can provide images for the heart and all parts of the body. There is a high usage by patients with heart disease, diabetes, and cancer.

5. **Describe the projected utilization of the proposed services and the method by which this projection was derived. Do not annualize utilization data. It must include the last complete year of operation (indicate if it is a calendar year or fiscal year) and as many prior years as is feasible to show trends. If graphs are used to depict this information, and they do not include the actual utilization numbers, numerical charts must be included.**

Table O
Providence Alaska Medical Center
Catheterization Lab Volumes
2001 – 2005

	2001	2002	2003	2004	2005	% Increase 2001-2005
Cardiac Catheterizations	1998	2027	1820	1659	2299	15%
Electrophysiology	410	480	514	558	623	52%
Interventional Radiology	1109	1086	1205	1184	1281	15%
Total	3517	3593	3539	3401	4203	20%

- a. **Include evidence of the number of persons from the target population who are currently using these services and who are expected to continue to use the service, including individuals served out of the service area or out of state;**

Alaska has an inpatient database that tracks patients by DRG. Catheterization lab volumes must be tracked by procedure code and track outpatients as well as inpatients. The Alaska database does not track by procedure code, nor include outpatients. A database on Alaskans going to facilities outside of Alaska is also not available. For patients traveling outside of Alaska, the Washington State database, CHARS, is the usual source for data. However, it too is a DRG, inpatient only, database and does not track at the procedure level. Most likely patients who receive this service Outside do so because they are out-of-state when an accident or medical condition happens or they went to see a medical specialist in another state who then ordered the test to be done there. There is no reason a person would have to leave the State just for this service.

- b. **Include evidence of the number of persons who will begin to use any new services that are not now available, accessible, or acceptable to the target population.**

NA

- c. Provide annual utilization data and demand trends for the five most recent years and monthly utilization data for the most recent incomplete year prior to the application for each existing facility offering a similar service in the service area.

Table P
Providence Alaska Medical Center
Catheterization Lab Volumes, 2001 – 2005

	2001	2002	2003	2004	2005	% Increase 2001-2005
Patients	3517	3593	3539	3401	4203	
% Growth		2%	-2%	-4%	24%	20%
Procedures	11,966	13,285	13,541	15,943	18,562	
% Growth		11%	2%	18%	16%	55%

Note the minor reductions in 2003 and 2004 were related to a lab being down for several months during refurbishing.

Table Q
Alaska Regional Hospital
Catheterization Lab Volumes, 2001 – 2005

	2001	2002	2003	2004	2005	% Increase 2001-2005
Patients	na	na	na	1078	1069	
% Growth					<-1%	na
Procedures	na	na	na	5092	5957	
% Growth					17%	na

Table R
Providence Alaska Medical Center and Alaska Regional Hospital
Combined Catheterization Lab Volumes, 2001 – 2005

	2001	2002	2003	2004	2005	% Increase 2001-2005
Patients	na	na	na	4479	5272	
% Growth					18%	na
Procedures	na	na	na	21,035	24,519	
% growth					17%	na

As can be seen in Table R above, this is a growing technology. Having large growth of 17% to 18% in one year alone dramatically affects the ability to meet the community demand. This growth is beyond growth in population and aging of population. This growth is due to increases in type of procedures and the number of physicians able to perform the procedures.

Provide projections for utilization for three years (or the appropriate planning horizon set out in the review standards related to this project) after construction, and show methodology used to determine use, including the math.

Table S
Providence Alaska Medical Center
Projected Catheterization Lab Volume, 2007-2009

	2007	2008	2009
Volume	4871	5304	5774
% Growth	6%	9%	9%

* In 2007 fifth lab to come on line in June; 2008 sixth lab to come on in January 2008

The first proposed catheterization lab would come on line in June 2007 for seven months of volume. This will result in an volume increase of about 6% over 2006 volumes. The second proposed catheterization lab would become operational in January 2008, allowing both new catheterization labs full years of operation and a 9% volume increase over the previous year. Volumes for 2009 are expected to grow at that same level of 9% over 2008 volumes. This growth is supported by the population growth trends for Alaska, the aging of the population, higher use rate due to new procedures, and large and growing number of physicians credentialed for catheterization procedures.

Volume projections for ARH are unknown.

- d. If the project is an acquisition of a new piece of major equipment or a new service, provide utilization data for similar services, existing equipment, or older technology. Indicate whether similar existing equipment will continue to be used and the project's effect on utilization of similar services. If this service or equipment was not in place in the service area, compare the expected utilization with other similar communities in Alaska or in other states.**
All current labs will continue to be used. The proposed labs will expand capacity. The new labs will not reduce the utilization of the existing catheterization labs but should help reduce overtime and waiting lists.
- e. If an increase in utilization is projected, list the factors that will affect the increase. Provide annual utilization projections for three years in the future for each specific service in the proposal. Include each of the following data when applicable:**
The factors affecting utilization include:
- Aging population resulting in increased community need;
 - Additional physicians trained in cardiac catheterizations, electrophysiology and interventional radiology creating higher demand;
 - New technologies constantly being introduced increasing demand;
 - More complex procedures being performed increasing the time it takes to perform a case;
 - More complex procedures take several hours to complete impacting capacity; and
 - Increased access to services allows for more patients and reduces waiting lists.

Table T
 Providence Alaska Medical Center
 Projected Catheterization Lab Volumes and Lab Capacity, 2007 – 2009

	2007	2008	2009
Patients	4871	5304	5774
Percentage Growth	6%	9%	9%
Number of IR Labs	5	6	6
Capacity based on 1000 procedures	97%	88%	96%
Number of labs needed based on 750 procedures per lab at PAMC alone	6.49	7.07	7.70

- f. **If any services will be reduced, indicate how the proposed reduction will affect the service area needs and patient access.**

No other services will be affected by this service.

- g. **Provide any other information that may be pertinent to establishing the need for this project.**

The number of physicians trained in this field has greatly increased and has created a high demand on the current labs.

Table U
 Providence Alaska Medical Center
 Number of Physicians with Catheterization Lab Privileges

Year	Number of Physicians	% Increase
2001	15	na
2002	15	0%
2003	16	7%
2004	17	6%
2005	20	18%

- h. **Attach letters of support from local and regional agencies, other health care facilities, individuals, governmental bodies, etc.**

Letters of support will be sent directly to the CON Coordinator.

6. **Include your calculations of numerical need for each proposed activity for your service area. If the proposed project is expected to have a larger capacity than that projected by (and available from) the department, explain the rationale and provide documentation to support the larger capacity.**

The projected volume for the catheterization labs at PAMC is higher than the State methodology indicates. The States methodology projects volumes to decrease 2.5% between 2005 and 2009. The three year historic use rate used in the State's methodology is lower than actual use rate in 2005. It then uses the same low use rate for projecting 2009 volume. The historic utilization data shows that volumes and use rates have been increasing an average of 5% per year over the last five years. PAMC's volume projections are consistent with historic growth rates and are

supported by population growth, the aging of population, which has a higher utilization rate of health care services, and increasing physician demand.

The State's methodology predicts a decline in volume that is inconsistent with what is happening in the marketplace. Earlier in this document other scenarios were presented that showed projected volumes using a compound growth rate of 7.7% and 8.7%. (Tables C-F). The recommended scenario can be seen in Table E which uses volumes from both PAMC and Alaska Regional and a compound growth rate of 7.7%. This scenario uses a conservative growth rate but still reflects the growth that is happening in the marketplace.

C. AVAILABILITY OF LESS COSTLY OR MORE EFFECTIVE ALTERNATIVES

1. Describe the different alternatives considered in developing this project. Explain why the particular alternative for providing the services proposed by this application was selected. Include as an alternative a discussion of the effect of doing nothing.

Alternatives considered for the Catheterization Labs:

- A. Do nothing – Patients will have to wait weeks, or months for a procedure, or travel outside for care. The demand is too great to do nothing.
- B. Change use of existing catheterization labs – All four labs are fully functioning and near capacity. There are no labs that have enough time for additional procedures.
- C. Utilize another lab in the community - Alaska Regional Hospital provides catheterization services as well. Most of the cardiologists have privileges at both hospitals. The four radiologists on staff at PAMC have an exclusive contract with PAMC and do not have privileges at ARH. Procedures requested of them must be performed at PAMC. ARH's labs are also approaching target capacity and does not have enough capacity to address the growing community need.
- D. Add one new lab - Adding one new lab will provide additional capacity and will reduce overtime. This lab enables the Heart Center to better handle current volumes, however, it will not be enough to handle the expected growth in volumes due to population growth and increased technology.
- E. Add two new labs – Two new labs will allow the Heart Center to meet current demands and have adequate capacity to meet the growing volumes without creating large amounts of overtime. Local physician groups are currently recruiting additional physicians and the extra capacity is needed to meet the demands of physicians.

2. Describe any special needs and circumstances. Special needs may include special training, research, Health Maintenance Organizations (HMOs), managed care, access issues, or other needs.

Not applicable

D. THE RELATIONSHIP OF THE PROPOSED PROJECT TO EXISTING HEALTH CARE SYSTEM AND TO ANCILLARY OR SUPPORT SERVICES

1. Identify any existing comparable services within the service area and describe any significant differences in population served or service delivery. If there are no existing comparable services in the area, describe the unmet need and how the target population currently accesses the services. Describe significant factors affecting utilization, including cost, accessibility, and acceptability.

Alaska Regional Hospital has two catheterization labs and can perform cardiac catheterizations, electrophysiology, and interventional radiology procedures. Many of the same physicians have catheterization lab privileges at both hospitals. Alaska Regional has their own interventional radiologists who perform procedures at ARH. Their radiologists do not have privileges at PAMC.

Table V
Alaska Regional Hospital
Catheterization Lab Volumes, 2004-2005

	2004	2005
Patients	1078	1069
% Growth		<-1%
Procedures	5092	5957
% Growth		17%
Labs	2	2

Mat-Su Regional Medical Center has a catheterization lab but is not authorized to perform the more complex procedures as they do not provide cardiac surgical services. These more complex procedures are performed at PAMC and ARH.

2. Describe the probable effect on other community resources, including any anticipated impact on existing facilities offering the same/similar services or alternatives locally or statewide if applicable. Describe how each proposed new or expanded service will:

- a. **Complement existing service** – The proposed lab will increase the availability of services at PAMC. ARH does have existing similar services. Volumes can shift between hospitals based on physician preference. The majority of physicians using these labs are cardiologists who tend to have privileges at both hospitals and can choose in which hospital to perform the procedures. In addition, radiologists also perform interventional radiology procedures using these labs. The radiologists are under contract with the hospitals and must perform their procedures at their contracted hospital. Both hospitals catheterization labs are near or beyond target capacity and can not handle continued increases in demand.

3. Identify existing working relationships the applicant has with hospitals, nursing homes, and other resources serving the target population in the service area. Include a discussion

of cooperative planning activities, shared services (i.e. agreements assigning services such as emergency or obstetrics), and patient transfer agreements. If other organizations provide ancillary or support services to your facility, describe the relationship. Attach copies of relevant agreements in an appendix in the application. If a service requires support from another agency but does not have an agreement, explain why.

This service is a diagnostic tool. Many patients are seen on an outpatient basis. There is no need for patient transfer agreements.

E. FINANCIAL FEASIBILITY

1. Demonstrate how the project will ensure financial feasibility, including long-term viability, and what the financial effect will be on consumers and the state, region, or community served.

The addition of two catheterization labs will provide adequate capacity to serve patients needing cardiac catheterizations, electrophysiology and interventional procedures. This expansion of service will reduce the amount of overtime and the reduce the waiting list for some procedures. The expansion will not increase charges to patients. No financial effect has been identified that would burden patients, the state or the community.

2. Discuss how the project construction and operation is expected to be financed. Demonstrate access to sufficient financial resources and the financial stability to build and operate this project.

Providence Alaska Medical Center will finance the two additional catheterization labs with internal capital funds. No borrowing of funds will be required.

3. Provide a description and estimate of:

a. the probable impact of the proposal on the annual increase on the overall costs of the health services to the target population to be served;

There is no anticipated increase on the pricing of services to our patients, community, or the state as a result of this project.

b. If applying to build a residential psychiatric treatment centers, nursing homes, or additional nursing home beds the annual increase to Medicaid required to support the new project, and the projected cost of and charges for providing the health care services in the first year of operation (per diem rate, scan, surgery etc);

NA

c. the immediate and long-term financial feasibility of continuing operations of the proposal.

This project will not have any negative impact on the overall financial condition of PAMC nor its ability to continue operations.

F. ACCESS TO SERVICE BY THE GENERAL POPULATION AND UNDER-SERVED GROUPS

1. Provide information on service needs and access of under-served groups of people such as low-income persons, racial and ethnic minorities, women, and persons with a disability. Discuss any plans to overcome language and cultural barriers of groups to be served.

Providence Alaska Medical Center maintains an open door philosophy consistent with the values of the Sisters of Providence and their mission to provide quality health care to all individuals regardless of their race, creed or ability to pay. Over the last three years, Providence has provided more than \$20 million in charity care a year. Projected budget for charity care is expected to increase over 40% over the next three years. See Table W below.

PAMC utilizes interpreters via a telephone service which is available 24 hours a day. The interpreter is connected via speaker phone so the patient, family and staff can hear.

2. Indicate the annual amount of charity care provided in each of the last five years with projections for the next three years. Include columns for revenue deductions, contractual allowances, and charity care.

Table W
Providence Alaska Medical Center
Total Deductions from Revenue (in thousands)
Actual 2001-2005, Projected 2006-2008

	Year	Charity Care	Contractual Allowances	Other	Total Deductions from Revenue
Actual	2001	\$18,299	\$47,225	\$136,083	\$201,607
	2002	\$20,411	\$54,206	\$157,763	\$232,380
	2003	\$21,308	\$61,516	\$198,448	\$281,272
	2004	\$23,214	\$76,115	\$242,612	\$341,941
	2005	\$27,874	\$85,660	\$264,292	\$377,826
Projected					
	2006				\$423,856
	2007				\$481,374
	2008				\$521,068

3. Address the following access issues:

a. transportation and travel time to the facility;

PAMC is located in Anchorage, Alaska's largest city with 42% of the State's population. Being in the center of Anchorage, Providence is easily within a half hour's drive for most residents and from the International Airport. PAMC is served by the city transit system. Providence provides care 24 hours a day/ seven days a week.

b. special architectural provisions for the aged and persons with a disability;

PAMC complies with the Rules and Regulations of the Federal Register Nondiscrimination on the basis of Disability by Public Accommodations and in Commercial Facilities; the Joint Commission on Accreditation of Healthcare Organizations (JCAHO); and Alaska State Department of Health and Social Services, which oversees hospital licensing.

c. hours of operation; and

Providence provides care 24 hours a day/ seven days a week. The catheterization labs schedule patients Monday-Friday, 8am- 4 pm. The labs are available after-hours for urgent and emergent patients via treatment teams on call 24 hours a day /seven days a week.

d. the institution's policies for nondiscrimination in patient services.

Providence Alaska Medical Center maintains an open door philosophy consistent with the values of the Sisters of Providence and their mission to provide quality health care to all individuals regardless of their race, creed or ability to pay.

Section V. Consideration of Quality, Effectiveness, Efficiency, and Benefits of the Applicant's Services

Please discuss the following in narrative form:

1. ACCREDITATION AND LICENSURE: The current status, source, date, length, etc., of the applicant's license and certification. Include information on Medicaid and Medicare Certification.

PAMC is licensed as an acute care hospital with 326 beds by the State of Alaska. It is certified by Medicare and Medicaid. PAMC's Medicare ID number is 020001. PAMC's Medicaid ID numbers are HP11IP and HP11OP. A copy of license is in the Appendices.

2. QUALITY CONTROL: How the applicant plans to ensure high quality service.

The quality control program is outlined below:

- a. Equipment – all equipment meets quality and safety standards required of all manufacturers by the federal government. Preventative maintenance is preformed on equipment, and consists of a thorough inspection for any defects that may affect patient care or safety.
- b. Physicians – Physicians education, training and skills are evaluated through a credentialing process, and only qualified physicians are recommended for privileges. Members of the medical staff, through training and continuing education, stay current with new developments in their respective specialties.
- c. Clinical and Non-Clinical Personnel – All personnel must meet professionally accepted job requirements.
- d. Continuing Education – The hospital provides continuing education training and ensures that all personnel receive training provided by equipment vendors, professional societies and attend selected special educational meetings both in and out of state.
- e. The objectives of the Quality Improvement Program include:
 - Provide optimal patient care within available resources
 - Manage resources in the most appropriate manner;
 - Minimize risk and injury;
 - Identify and act upon opportunities to improve patient care; and
 - Trend, benchmark and maximize patient outcomes with advanced databases.

3. PERSONNEL: Plans for optimum utilization and appropriate ratios of professional, sub-professional and ancillary personnel.

All of the staff that work in the heart center labs are cross-trained to work in all the labs, on all patient types and all roles within the labs. A fifth and sixth team will be added for the proposed labs and will be fully cross-trained as well. Staffing ratio for a catheterization labs is one patient to three staff and one physician. The ratio is recommended by the Society of Interventional Radiology and the American College of Cardiology. An article outlining laboratory operations is located in the appendices.

4. APPROPRIATE UTILIZATION: Development of programs such as ambulatory care, assisted living, home health services, and preventive health care that will eliminate or reduce inappropriate use of inpatient services

The proposed catheterization labs are an outpatient service, although procedures can also be done on inpatients. It is a diagnostic tool that is used to identify blockages and other conditions. Procedures are minimally invasive. New techniques allow services to be done in a catheterization lab that formally required surgery, and can even eliminate a hospitalization.

5. NEW TECHNOLOGY AND TREATMENT MODES: Plans to use modern diagnostic and treatment devices to enhance the accuracy and reliability of diagnostic and treatment procedures.

Catheterization is an ever evolving field of medicine that helps to diagnose conditions and often provide treatment without surgery. The new labs will have outcome tracking software installed which will allow comparison to national benchmarks.

6. LABOR SAVING DEVICES AND EFFICIENCY: The employment of labor-saving equipment and programs to provide operating economies.

Having two additional catheterization labs will increase capacity and access to the equipment. This should help reduce waiting lists for procedures and reduce the amount of overtime spent to keep up with the multiple physician demands. All staff are trained to work in all labs and perform all roles. This continued cross-training of staff increases efficiency, elevates skill levels and increases quality for all patients.

7. PROGRAM EVALUATION: Future plans for evaluation of the proposed activity to ensure that it fulfills present expectations and benefits.

The Heart Center reviews its budget, volumes, staffing, productivity, quality indicators monthly as well through an annual review process. Both the department manager and medical director are responsible for developing plans for corrective action when indicators are not met.

8. ORGANIZATIONAL STRUCTURE: Include an organizational chart, descriptions of major position requirements and board representation; show representation from community economic and ethnic groups.

The catheterization labs are part of the Heart Center, which is managed by Director of the Heart Center. The Director of the Heart Center reports to the Administrator of Providence Alaska Medical Center. PAMC organizational charts are located in the Appendices.

Lists of the Providence Health System Board of Directors and Officers and the Providence Alaska Region Board of Directors are located in Section I.

9. STAFF SKILLS: Provide descriptions of major position requirements, appropriate staff-to-patient ratios to maintain quality, and the minimal level of utilization that must be maintained to ensure that staff skills are maintained. Provide a source for the staffing standards.

Position descriptions included in the appendices are:

- Manager, Heart Center
- RN, Cardiac Catheterization
- Technologist, Cardiovascular

The staffing ratio recommended by the Society of Interventional Radiology and the American College of Cardiology is followed in the Heart Center. The staffing ratio for a catheterization lab is one patient to three staff and one physician.

10. ECONOMIES OF SCALE: The minimum and maximum size of facility or unit required to ensure optimum efficiency. If the planned project is significantly smaller or larger, explain the effect and why the size was chosen.

The current catheterization labs are operating at 105% capacity. With the addition of the two labs and no volume increase, the labs would be operating at 70% capacity. With an increase of volume of 7%, the six labs would be each operating at 75%, the target capacity. This added capacity will reduce the need for overtime and reduce the use of waiting lists for elective procedures.

Section VI. Narrative Description of How Project Meets Applicable Review Standards

Describe in this section of the application how the proposed project meets each review standard applicable to all activities, and each specific review standard applicable to the proposed activity. *Some of this information will duplicate information required elsewhere in the application packet; that duplication is intentional.*

The State Review Standards for Cardiac Catheterizations is used in this application.

Review Standards – Cardiac Catheterization

1. *No new labs with will be approved unless existing services are operating at an average occupancy of at least 75% of capacity or an average of at least 750 procedures per year.*

PAMC's four catheterization labs are operating at 105% capacity with 4203 patients in 2005 or an average of 1050 patients per lab.

ARH's two catheterization labs are operating at 53% capacity with 1069 procedures in 2005 or an average of 534 patients per lab.

Together the six catheterization labs are operating at 88% with 878 patients per lab in 2005

2. *Pediatric Labs – NA*
3. *Angioplasty requirements – NA*
4. *Elective coronary interventions and not located within a hospital providing open heart surgery – NA*
5. *New service – NA*
6. *Need for pacemakers – NA*

Methodology- Cardiac Catheterization

Step 1. Determine historic use rate

<u>PAMC & ARH Caseload</u>			<u>AK Population</u>		<u>Use Rate</u>
2003	na	/	648,280	=	na - ARH volume not available
2004	4479	/	655,435	=	6.81
2005	5272	/	656,863	=	7.75
2 Year Avg	4876	/	656,149	=	7.43 patients per 1000 population

Step 2. Calculate 3 year operational volume

$$\begin{array}{rclcl} 2009 \text{ Projected PAMC \& ARH caseload} & = & 2009 \text{ AK Population} & \times & 2 \text{ Yr Avg Use Rate} \\ \mathbf{5142} & = & 692,001 & \times & \mathbf{7.43} \end{array}$$

Step 3. Determine number of labs required

$$\begin{array}{rclcl} \text{Labs required} & = & (\text{caseload} / \text{capacity}) / \text{target occupancy} \\ ? & = & (5142/1000) / .75 \\ & = & \mathbf{6.9 \text{ labs}} \end{array}$$

Step 4. Determine number of additional labs needed

$$\begin{array}{rclcl} \text{Labs required} & - & \text{Labs existing} & = & \text{Labs needed} \\ \mathbf{6.9} & - & \mathbf{6} & = & \mathbf{0.9 \text{ labs needed}} \end{array}$$

This formula results in 2009 volumes that are lower than the 2005 volumes.

This formula does not take into account the higher use rate of 2005, the number of physicians utilizing the catheterization labs in 2005, the increased complexity of procedures in length of time needed to complete a case, and the growing, aging population. Nor does the formula reflect the expected growth in this field of medicine for the years 2006-2009. The addition of one lab will not be sufficient to meet demand, reduce the waiting lists and minimize overtime needed to complete emergent procedures.

Growth Trend

We recommend using a scenario which uses the compound growth rate seen at PAMC between 2003-2005 of 7.7%, (See step 1 below), and apply it to the total patient volume at PAMC and ARH for 2006 – 2009 (Step 2 below). This scenario uses both hospital's actual experience and growth rates in the market from a three year period.

Step 1:			
PAMC Compound Growth Rate from 2003-2005			
<u>Year</u>	<u>AK Population</u>	<u>PAMC Volume</u>	<u>Use Rate</u>
2003	648,510	3539	5.46
2004	657,755	3401	5.17
2005	663,661	4203	6.33
Compound growth=			
$5.46 * (1 + \text{rate})^{\text{periods}} + 6.33 = 0$			
$5.46 * (1 + \text{rate})^2 + 6.33 = 0$			
rate = 7.7%			

Step 2:

Apply Compound Growth Rate to Combined PAMC and ARH Volumes 2004 and 2005

Year	AK Population	Combined PAMC + ARH Volume	Use Rate		Labs needed: Procedures divided by 750
2004	657,755	4479	6.81		5.97
2005	663,661	5272	7.94		7.03
2006	669,977	5733	8.56	7.94 * 1.077	
2007	677,362	6245	9.22	8.56 * 1.077	
2008	684,714	6800	9.93	9.22 * 1.077	
2009	692,001	7403	10.70	9.93 * 1.077	9.87

Step 3. Calculate 3 year operational volume

$$\begin{array}{rclcl}
 2009 \text{ Projected caseload} & = & 2009 \text{ AK Population} & \times & \text{Projected use rate} \\
 \mathbf{7403} & = & 692,001/1000 & \times & 10.70
 \end{array}$$

Step 4. Determine number of labs required

$$\begin{array}{rclcl}
 \text{Labs required} & = & (\text{caseload} / \text{capacity}) & / & \text{target occupancy} \\
 ? & = & (7403/1000) & / & .75 \\
 & = & \mathbf{9.87 \text{ labs}}
 \end{array}$$

Step 5. Determine number of additional labs needed

$$\begin{array}{rclcl}
 \text{Labs required} & - & \text{Labs existing} & = & \text{Labs needed} \\
 \mathbf{9.87} & - & 6 & = & \mathbf{3.87 \text{ labs needed}}
 \end{array}$$

Although this projected usage is higher compared to the State's methodology, it more accurately reflects the growth this service has been experiencing over the last two years and what is expected to continue over the next several years.

Section VII. Construction Data

A. Please check appropriate boxes:

- | | | | |
|----------------------|-------------------------------|------------------------------------|--|
| 1. Construction type | <input type="checkbox"/> New | <input type="checkbox"/> Expansion | <input checked="" type="checkbox"/> Renovation |
| 2. Basement | <input type="checkbox"/> Full | <input type="checkbox"/> Partial | <input checked="" type="checkbox"/> None |

B. Project Development Schedule

Date

- | | |
|--|---|
| 1. Estimated completion of final drawings and specifications | February 2007 |
| 2. Estimated construction begun by | April 2007 |
| 3. Estimated construction complete by | June 2007 |
| 4. Estimated opening of proposed services | June 2007 for cath lab #5
January 2008 for cath lab #6 |

C. Facility site data: Provide the following as attachments (referenced by the subsection and item number):

1. A legal description and area of the proposed site. Is the site now owned by the facility?
If not, how secure are the arrangements to acquire the site?
Legal description of Providence Alaska Medical Center is on file with the department.
2. Diagrammatic plan showing:
 - a. dimensions and location of structures, easements, rights-of-way or encroachments;
 - b. location of all utility services available to the site; and
 - d. Location of service roads, parking facilities, and walkways within site boundaries.All items listed above are on file with the department.
3. Document clearances regarding zone restrictions, fire protection, sewage, and other waste disposal arrangements (under special circumstances, it is acceptable to present evidence of conditional approvals from local government and regulatory agencies).
All items listed above are on file with the department.
4. An architectural master plan including long-range concept and development of total facility.
The PAMC master site plan is included in the Appendices.
5. Schematic floor plan drawings (or conceptual drawings) of proposed activity, including functional use of various rooms.
Drawings of the existing area, the proposed area and the proposed layout of the catheterization labs are located in the Appendices.

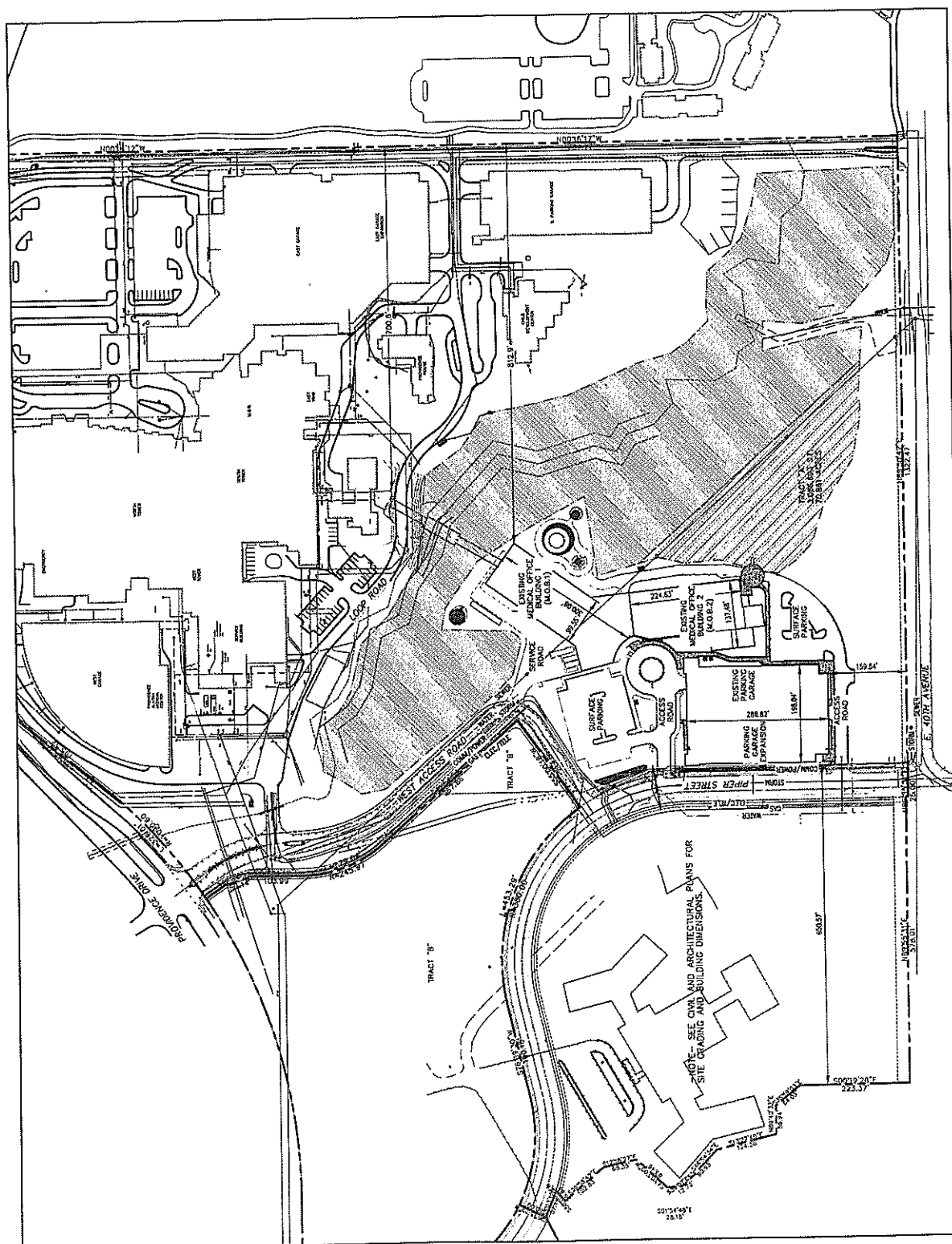
D. Describe the plan for completing construction and the effect (disruption) construction activities will have on existing services.

The catheterization labs will be constructed from a group of spaces within the Heart Center. The current occupants, who include respiratory therapy, cardiac rehab and heart center support space, are being relocated to a different space. Minor remodeling will be needed. As the labs are additional pieces of equipment, there will be no disruption in service to the existing services. Negative air work areas will be created by using fire resistant plastic barriers and negative air units. Construction will consist of steel studs, lead-lined sheet rock and installation of new unistrut ceiling system. There will be a need for a few core drills through the concrete floor. These will be accomplished during early morning hours with no disruption to patient care. Completion of the first lab is expected in June 2007. Completion of the second lab is expected by January 2008.

E. Describe replacement or upgrading of utilities including the electrical, heating, ventilation and air conditioning systems.

An existing air handler is being upgraded; this will accommodate the added air requirements for the catheterization labs. The electrical infrastructure will be enhanced by adding a new main panel to accommodate the demands of the new catheterization labs emergency power needs.

Figure I
Providence Alaska Medical Center
Master Site and Facility Plan



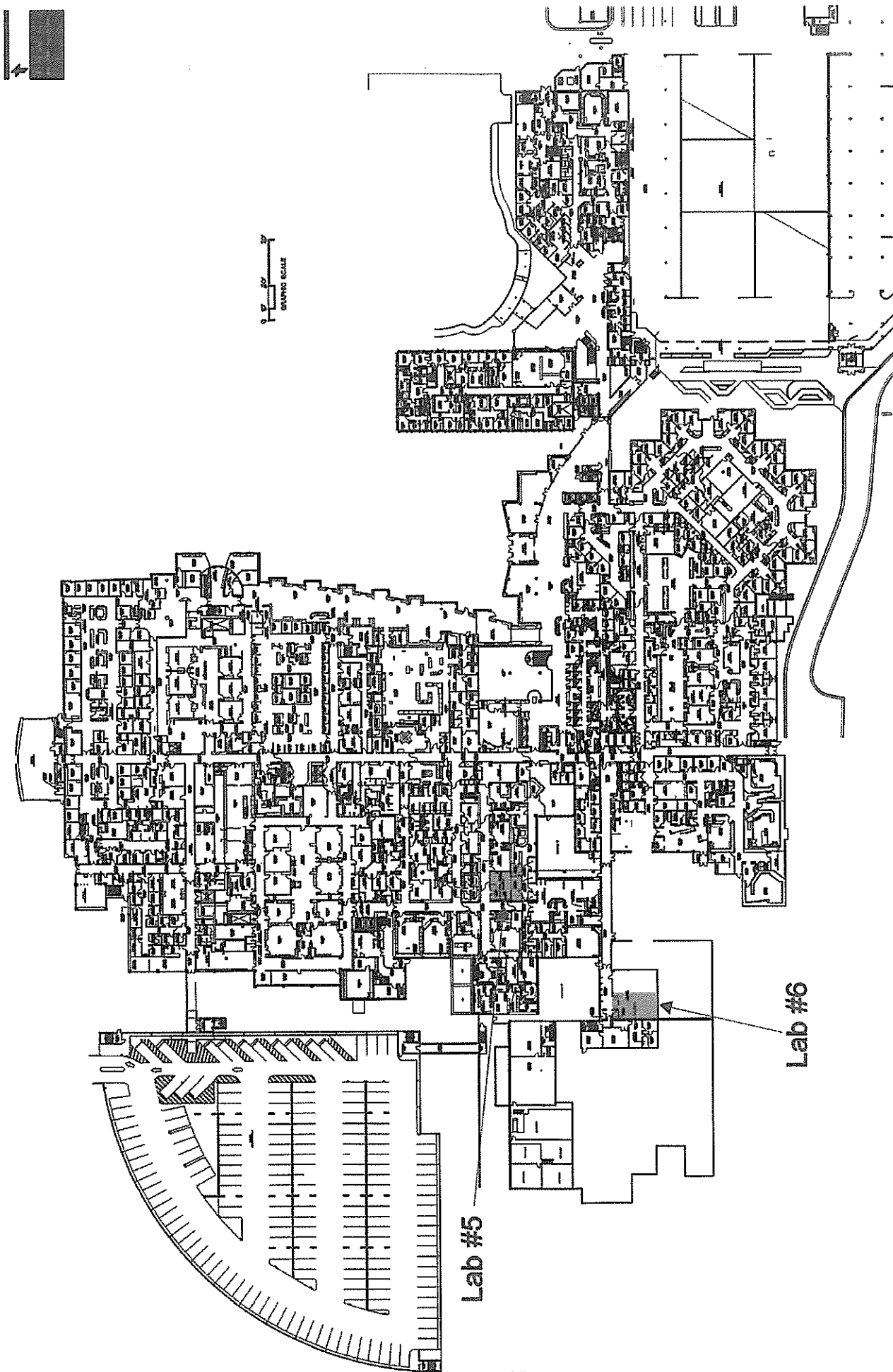




Figure II
Location of Cath Labs #5 and #6

 PROVIDENCE HEALTH SYSTEM 1000 EAST 10TH AVENUE ANCHORAGE, ALASKA 99501-2000 PHONE: 907.566.1000 FAX: 907.566.1001	 RIM ARCHITECTS 1000 EAST 10TH AVENUE ANCHORAGE, ALASKA 99501-2000 PHONE: 907.566.1000 FAX: 907.566.1001	Designer: [Blank] Designer Title: [Blank] Architect in Charge: [Blank]	SPECIAL PROCEDURE ROOM #5 PROVIDENCE ALASKA MEDICAL CENTER	SERIAL NUMBER: 00000-00	Date: 12/18/06	Revisions: No. Description Date
					Sheet Calculated: 0000 FLOOR PLAN	Sheet Number: D1

- KEY NOTES:
- 1 DEMO WALL AND FRAMING
 - 2 DEMO EXISTING DOOR AND FRAME
 - 3 DEMO EXISTING FIXTURES
 - 4 DEMO EXISTING DOOR AND FRAME FOR NEW ENLARGED DOOR OPENING

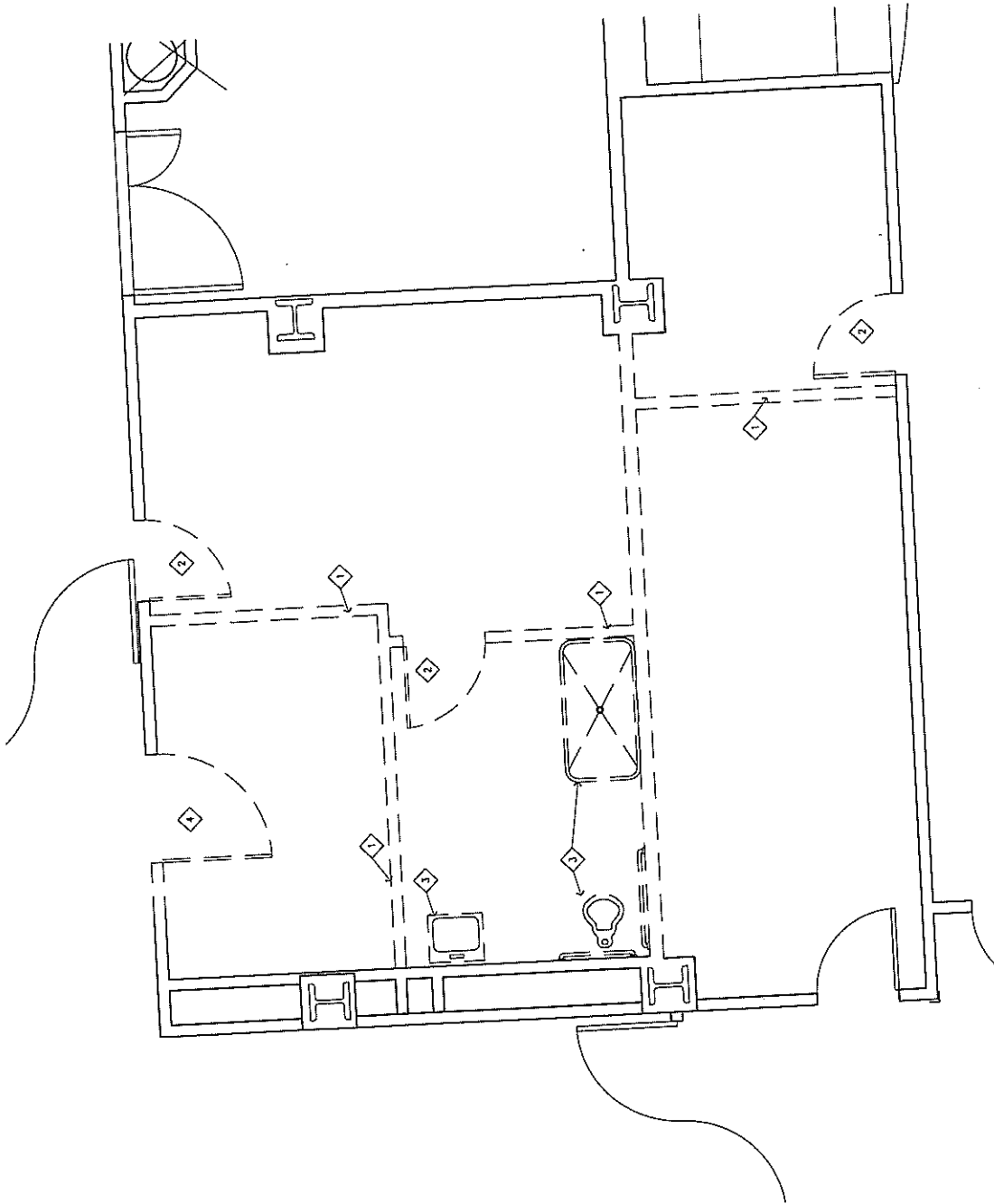


Figure III
Demolition Plan for Existing Space for Cath Lab #5

PROVIDENCE HEALTH SYSTEM PROJECT NUMBER: 2008-0-		SERIAL NUMBER: 0000-00	
SPECIAL PROCEDURE ROOM #5 PROVIDENCE ALASKA MEDICAL CENTER		Date: 12/18/06	
Approved for Construction Department Director		Approved for Design Department Director	
PROVIDENCE HEALTH SYSTEM PROVIDENCE ALASKA 1000 W. 10TH AVENUE ANCHORAGE, ALASKA 99501-2000		RIM ARCHITECTS	
Sheet Contents FLOOR PLAN		Sheet Number A1	

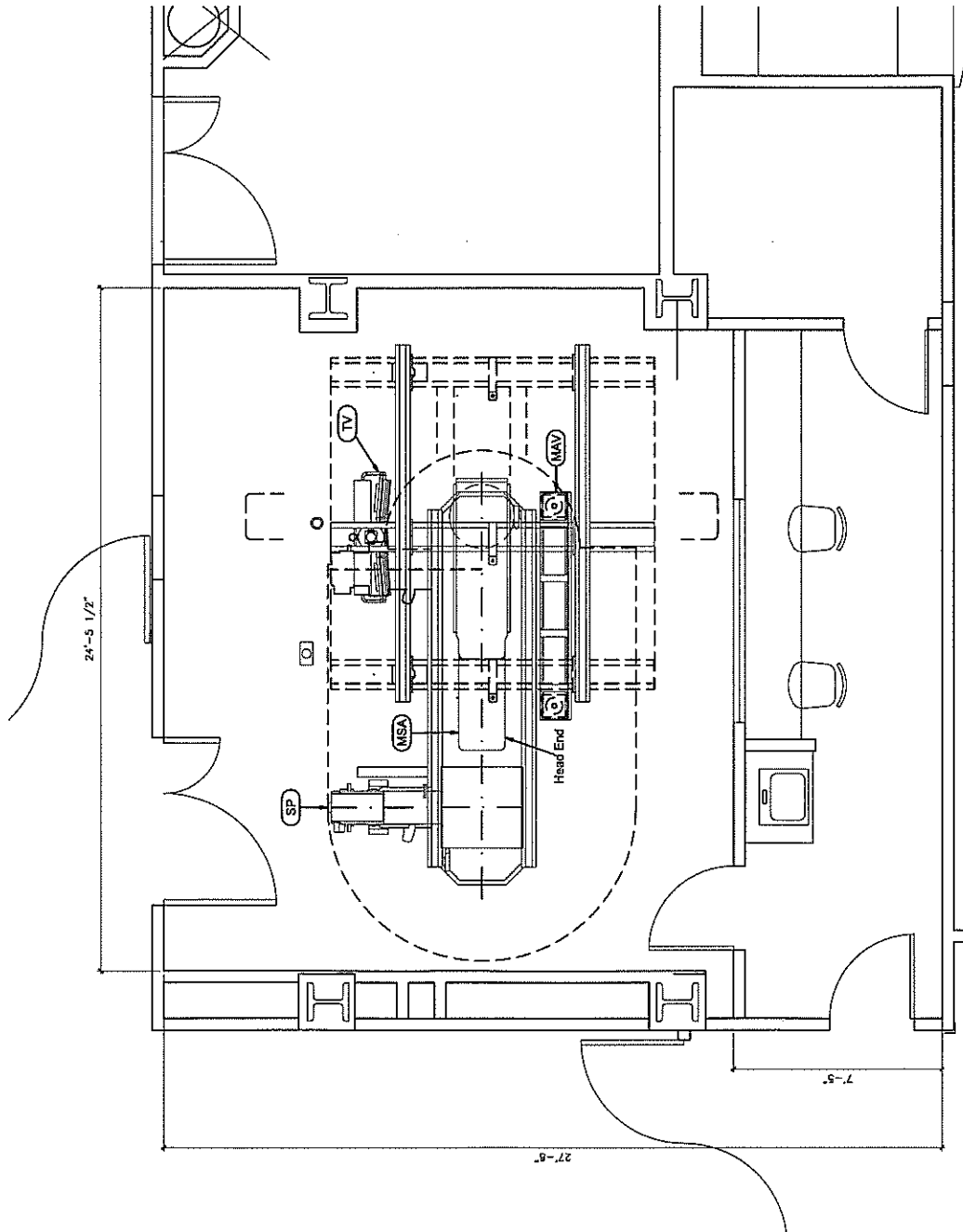

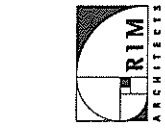


Figure IV
Floor Plan for Cath Lab #5

				SPECIAL PROCEDURE ROOM #6 PROVIDENCE ALASKA MEDICAL CENTER		ADAPTABLE IN CHARGE DESIGN TEAM DESIGNER PROJECT FOLDER		SERIAL NUMBER: 00000-00	
PROVIDENCE HEALTH SYSTEM PROJECT NUMBER: 2009-0-		DATE: 12/18/06		REVISIONS No. Description Date		SHEET CONTENTS DEMO FLOOR PLAN		SHEET NUMBER D1	

KEY NOTES:
 1 DEMO EXISTING DOOR AND WALL FOR NEW ENLARGED DOOR OPENING.

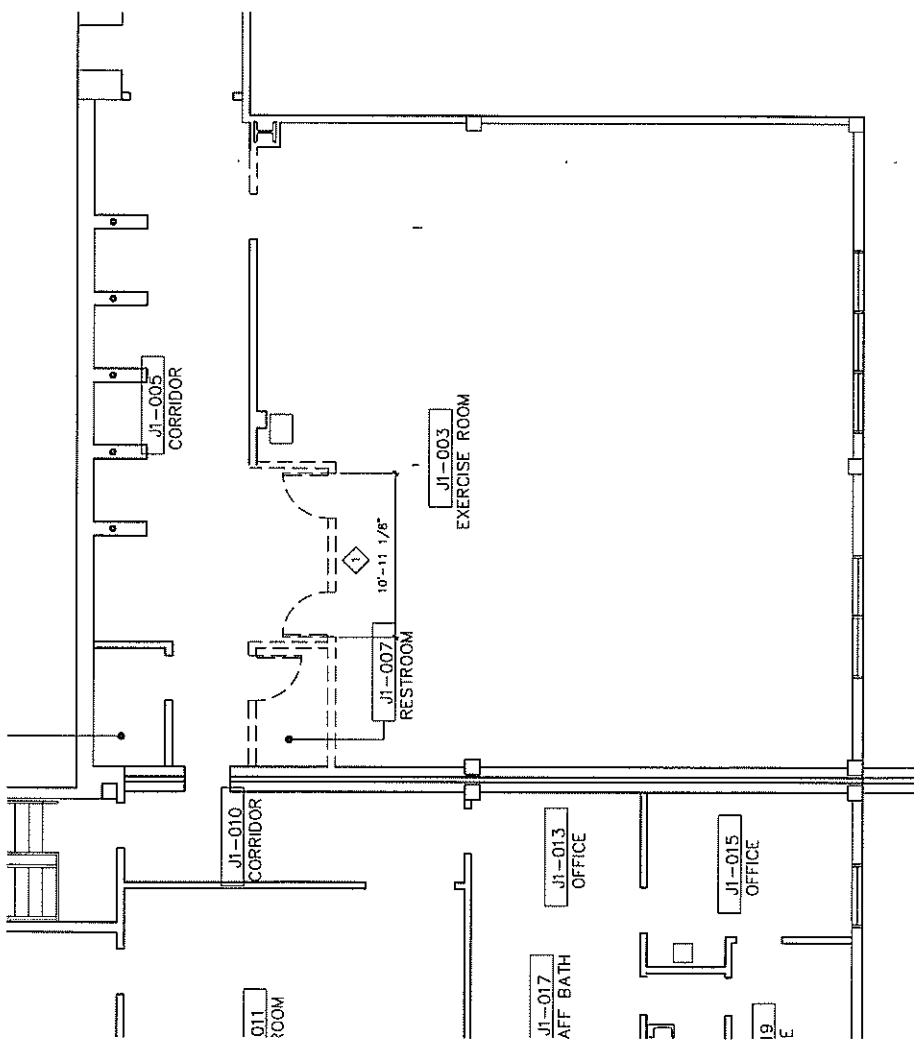


Figure V
 Demolition Plan for Existing Space for Cath Lab #6



Proposal

DATE: 12/15/2006

PO Box 221911
Anchorage, Ak 99522-1911
(907) 563-9900 / (907) 563-9905 fax

TO:	Providence Alaska Medical Center	Job Name:	IR Lab 5
	3200 Providence Drive	Attention:	John Bush
	Anchorage, Ak	MCN Job #	

We are pleased to offer this proposal based on our understanding of the work to be done.

Projects include ; IR LAB 5, IR LAB 6, Respiratory Care, and Cardiology Support.

IR Lab 5	\$ 649,804.00
IR Lab 6	\$ 706,023.00
Respiratory Care	\$ 275,648.00
Cardiology Support	\$ 305,501.00

MCN Construction excludes all work below;

- * Lead sheeting (shielding) for floors of IR lab 5 and lab 6.
- * Any abatement and or monitoring of hazardous materials including; asbestos and or vermiculite.
- * Monkote fireproofing of IR lab 6 / 7 and Corridor hallway
- * Card readers for security doors

Sincerely


Chuck Nystuen
MCN Construction, Inc.
Project Manager

Section VIIIB. Financial Data – Construction Only

1. Construction Method (Please check)

- a. ☐ Conventional bid ☐ Contract management ☐ Design and build
b. ☒ Phased ☐ Single project ☐ Fast Track

2. Construction Cost (New Activity)

(Omit cents)

- | | |
|---|--------------------|
| a. Site acquisition (Section VIIIA.2.f) | \$ 0 |
| b. Estimated general construction** | \$1,936,976 |
| c. Fixed equipment, not included in a** | \$2,270,644 |
| d. Total construction costs (sum of items a, b, and c)** | \$4,207,620 |
| e. Major movable equipment** | \$ 456,850 |
| f. Other cost:** | |
| (1) Administration expense | \$ 111,000 |
| (2) Site survey, soils investigation, and materials testing | \$ 0 |
| (3) Architects and engineering fees | \$ 195,494 |
| (4) Other consultation fees (preparation of application included) | \$ 30,650 |
| (5) Legal fees | \$ 0 |
| (6) Land development and landscaping | \$ 0 |
| (7) Building permits and utility assessments (including water, sewer, electrical, phones, etc.) | \$ included in b. |
| (8) Additional inspection fees (clerk of the works) | \$ included in b. |
| (9) Insurance (required during construction period) | \$ included in b. |
| g. Total project cost (sum of items d, e, f) | \$5,001,614 |
| h. Amount to be financed | \$ 0 |
| i. Difference between 2.g and 2.h (list, as Schedule 1, available resources to be used, e.g., available cash, investments, grants funds, community contributions, etc.) | \$5,001,614 |
| j. Anticipated long-term interest rate | na% |
| k. Anticipated interim (construction) interest rate | na% |
| l. Anticipated long-term interest amount | \$ 0 |
| m. Anticipated interim interest amount | \$ 0 |
| n. Total items g, l, and m | \$5,001,614 |
| o. Estimated annual debt service requirement | \$ 0 |
| p. Construction cost per sq. ft. | \$2613 |
| q. Construction cost per bed | \$ na |
| r. Project cost per sq. ft. | \$3107 |
| s. Project cost per bed (if applicable) | \$ na |

*Site acquisition should be stated as "book" value, i.e., actual purchase price (or estimate of value if donated) plus costs of development. If desired, the applicant may elect to state as "fair market value" (in which case, so indicate). See Section VIIIA for how to determine fair market value.

** Items must be certified estimates from an architect or other professional. Major medical equipment may be documented by bid quotes from suppliers.

Section IX. Financial Data – All Proposed Activities

Provide an accompanying narrative explanation for each of the schedules below if there are any significant trends or significant changes in any item or group of items from year to year.

Note: Indicate whether you are using a calendar year or other fiscal year period.

A. Attach Schedule I - Facility Income Statement

1. For the most recent five prior full fiscal or calendar years
2. Projections during construction or implementation period (if applicable)
3. Projection for three years following completion of construction, or implementation of the proposed activity.

B. Attach Schedule II - Facility Balance Sheet

1. For the most recent five prior fiscal or calendar years.
2. Current fiscal or calendar year to date

C. Attach Schedule III - Average Patient Cost Per Day (Per Diem Rate if applicable) and Revenue Amounts

Provide revenue and expense data FOR EACH SERVICE THAT IS IDENTIFIED AS CHANGING.

1. For the most recent five prior full fiscal or calendar years (information may be obtained on total patient load, directly from your respective years' Medicare Cost Reports)
2. Current fiscal or calendar year to date
3. Projection for five years following completion of construction or implementation.

D. Attach Schedule IV – Operating Budget

Current and projected line item capital and operating budgets for the proposed activity. Describe what alternative plans have been made if deficits occur.

E. Attach Schedule V – A. Debt Service Summary, and B. New Project Debt Service Summary

A debt service cash flow schedule over the life of the debt, if applicable, for all long-term debt of the facility. Identify each debt, including the proposed activity, and break out interest, principal, and other costs.

F. Attach Schedule VI - Reimbursement Sources

Showing reimbursement sources for the facility for the previous five full years and projected for three years after implementation.

G. Attach Schedule VII – Depreciation Schedule

Showing a depreciation schedule for all items acquired through the proposed project. Note that the straight-line method must be used. Indicate on the depreciation schedule or separately which major movable equipment is being purchased for the project (see Section VIIIB, Item 2e). Also, on a separate page, include a list of all equipment to be purchased through this project and the costs.

Section IX

Schedule I.A

INCREMENTAL PROJECTED INCOME STATEMENT (Project Only)

GROSS PATIENT REVENUE:	FY 2007	FY 2008	FY 2009
INPATIENT	\$ 1,275,053	\$ 8,971,534	\$ 15,014,649
OUTPATIENT	\$ 488,116	\$ 2,511,037	\$ 4,099,393
LONG-TERM CARE			
SWING BEDS			
OTHER			
TOTAL PATIENT REVENUE	\$ 1,763,169	\$ 11,482,571	\$ 19,114,041
LESS DEDUCTIONS			
CHARITY CARE	\$ 43,380	\$ 292,220	\$ 487,604
CONTRACTUAL ALLOWANCES	\$ 888,725	\$ 5,788,849	\$ 9,636,324
TOTAL DEDUCTIONS	\$ 932,105	\$ 6,081,069	\$ 10,123,928
NET OPERATING REVENUES	\$ 831,064	\$ 5,401,502	\$ 8,990,114
ALL OTHER REVENUES			\$ -
EXPENSES:			
SALARIES	\$ 141,960	\$ 486,720	\$ 486,720
BENEFITS	\$ 42,588	\$ 146,016	\$ 146,016
SUPPLIES	\$ 320,635	\$ 2,154,277	\$ 3,594,013
UTILITIES			
PURCHASED SERVICE			
PROFESSIONAL FEES			
LEASE			
BAD DEBT	\$ 42,770	\$ 287,452	\$ 479,572
OTHER EXPENSES	\$ 75,132	\$ 482,246	\$ 801,904
DEPRECIATION	\$ 160,726	\$ 647,477	\$ 647,477
INTEREST			
TOTAL EXPENSES	\$ 783,811	\$ 4,204,188	\$ 6,155,702
NET INCOME	\$ 47,252	\$ 1,197,313	\$ 2,834,411

Schedule I.B

INCOME STATEMENTS PAMC (Facility)

GROSS PATIENT REVENUE:	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
INPATIENT	\$ 345,670	\$ 381,816	\$ 425,019	\$ 485,929	\$ 540,259
OUTPATIENT	\$ 140,302	\$ 173,084	\$ 204,052	\$ 220,132	\$ 231,949
LONG-TERM CARE					
SWING BEDS					
OTHER	\$ 7,779	\$ 8,290	\$ 8,938	\$ 9,291	\$ 9,806
TOTAL PATIENT REVENUE	\$ 493,751	\$ 563,190	\$ 638,009	\$ 715,352	\$ 782,014
LESS DEDUCTIONS					
CHARITY CARE	\$ 18,299	\$ 20,411	\$ 21,308	\$ 32,087	\$ 36,507
CONTRACTUAL ALLOWANCES	\$ 183,309	\$ 211,969	\$ 259,964	\$ 309,854	\$ 341,320
BAD DEBT	\$ 15,717	\$ 36,991	\$ 36,991	\$ 43,712	\$ 36,818
TOTAL DEDUCTIONS	\$ 217,325	\$ 269,371	\$ 318,263	\$ 385,653	\$ 414,645
NET OPERATING REVENUES	\$ 276,426	\$ 293,819	\$ 319,746	\$ 329,699	\$ 367,369
ALL OTHER REVENUES	\$ 16,918	\$ 17,658	\$ 21,391	\$ 25,642	\$ 18,668
EXPENSES:					
SALARIES	\$ 116,189	\$ 128,267	\$ 128,461	\$ 130,262	\$ 141,697
BENEFITS	\$ 26,020	\$ 29,794	\$ 34,571	\$ 34,763	\$ 37,059
SUPPLIES	\$ 50,609	\$ 57,192	\$ 62,684	\$ 62,370	\$ 70,941
PURCHASED SERVICE	\$ 35,328	\$ 38,558	\$ 52,212	\$ 56,879	\$ 63,349
PROFESSIONAL FEES	\$ 4,311	\$ 5,101	\$ 7,157	\$ 11,161	\$ 7,230
OTHER EXPENSES	\$ 9,097	\$ 14,530	\$ 15,548	\$ 14,943	\$ 18,689
DEPRECIATION	\$ 19,580	\$ 23,365	\$ 23,900	\$ 24,815	\$ 24,216
INTEREST	\$ 1,921	\$ 1,441	\$ 1,130	\$ 668	\$ 1,231
TOTAL EXPENSES	\$ 263,055	\$ 298,248	\$ 325,663	\$ 335,861	\$ 364,412
NET OPERATING INCOME	\$ 30,289	\$ 16,962	\$ 15,474	\$ 19,480	\$ 21,625

SECTION IX Schedule II

Schedule II. Facility Balance Sheet (in Thousands)

PAMC BALANCE SHEET	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
CURRENT ASSETS					
CASH & EQUIVALENTS	\$ 25,166	\$ 19,247	\$ 8,551	\$ 10,789	\$ 12,376
ACCOUNTS RECEIVABLE	\$ 64,234	\$ 76,169	\$ 92,741	\$ 65,287	\$ 63,352
SUPPLIES INVENTORY	\$ 5,960	\$ 8,021	\$ 8,973	\$ 10,292	\$ 11,564
OTHER CURRENT ASSETS	\$ 1,124	\$ 1,776	\$ 2,868	\$ 8,391	\$ 16,263
TOTAL CURRENT ASSETS	\$ 96,484	\$ 105,213	\$ 113,133	\$ 94,759	\$ 103,555
PROPERTY AND EQUIPMENT					
LAND	\$ 15,487	\$ 17,911	\$ 17,760	\$ 17,965	\$ 32,901
BUILDING/FIXED EQUIP	\$ 236,869	\$ 250,071	\$ 253,844	\$ 261,256	\$ 283,938
MAJOR MOVABLE EQUIP	\$ 155,821	\$ 165,805	\$ 186,175	\$ 204,357	\$ 255,520
ACCUMULATED DEPRECIATION	\$ 202,941	\$ 225,850	\$ 248,250	\$ 272,763	\$ 301,448
NET PROPERTY AND EQUIPMENT	\$ 205,236	\$ 207,937	\$ 209,529	\$ 210,815	\$ 270,911
OTHER ASSETS	\$ 101,205	\$ 108,035	\$ 188,576	\$ 188,672	\$ 226,190
TOTAL ASSETS	\$ 402,925	\$ 421,185	\$ 511,238	\$ 494,246	\$ 600,656
LIABILITIES/FUND BALANCE					
CURRENT LIABILITIES					
ACCOUNTS PAYABLE	\$ 12,787	\$ 12,744	\$ 15,571	\$ 13,436	\$ 27,833
ACCRUED EXPENSES	\$ 17,861	\$ 9,313	\$ 8,279	\$ 8,350	\$ 11,404
ACCRUED COMPENSATION/OTHER	\$ 16,008	\$ 18,623	\$ 19,880	\$ 16,782	\$ 20,372
TOTAL CURRENT LIABILITIES	\$ 46,656	\$ 40,680	\$ 43,730	\$ 38,568	\$ 59,609
LONG TERM LIABILITIES					
LONG TERM DEBT	\$ 18,175	\$ 12,624	\$ 61,721	\$ 55,770	\$ 113,517
OTHER	\$ 5,710	\$ 5,210	\$ 22,485	\$ 25,133	\$ 40,430
TOTAL LONG TERM LIABILITIES	\$ 23,885	\$ 17,834	\$ 84,206	\$ 80,903	\$ 153,947
FUND BALANCE	\$ 332,384	\$ 362,671	\$ 383,302	\$ 374,775	\$ 387,100
TOTAL LIABILITIES & FUND BALANCE	\$ 402,925	\$ 421,185	\$ 511,238	\$ 494,246	\$ 600,656

Schedule II. Facility Balance Sheet (in Thousands)

PAMC BALANCE SHEET	As of Oct 2006
CURRENT ASSETS	
CASH & EQUIVALENTS	\$ 19,749
ACCOUNTS RECEIVABLE	\$ 59,290
SUPPLIES INVENTORY	\$ 13,263
OTHER CURRENT ASSETS	\$ 5,768
TOTAL CURRENT ASSETS	\$ 98,070
PROPERTY AND EQUIPMENT	\$ 670,255
LAND	
BUILDING/FIXED EQUIP	
MAJOR MOVABLE EQUIP	
ACCUMULATED DEPRECIATION	\$ (318,953)
NET PROPERTY AND EQUIPMENT	\$ 351,302
OTHER ASSETS	\$ 202,418
TOTAL ASSETS	\$ 651,790
LIABILITIES/FUND BALANCE	
CURRENT LIABILITIES	
ACCOUNTS PAYABLE	\$ 25,183
ACCRUED EXPENSES	\$ 9,045
ACCRUED COMPENSATION/OTHER	\$ 22,923
TOTAL CURRENT LIABILITIES	\$ 57,151
LONG TERM LIABILITIES	
LONG TERM DEBT	\$ 137,015
OTHER	\$ 43,700
TOTAL LONG TERM LIABILITIES	\$ 180,715
FUND BALANCE	\$ 413,924
TOTAL LIABILITIES & FUND BALANCE	\$ 651,790

SECTION IX. Schedule III

Schedule III. Average Patient Cost Per Day (per Diem Rate if applicable) and Revenue Amounts										
	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
(Gross) REVENUES	\$ 493,751	\$ 563,190	\$ 638,009	\$ 715,352	\$ 782,014					
EXPENSES	\$ 263,055	\$ 298,248	\$ 325,663	\$ 335,861	\$ 364,412					
PATIENT DAYS	\$ 87,857	\$ 86,452	\$ 84,954	\$ 87,497	\$ 88,521					
REVENUE PER PATIENT DAY	\$ 6	\$ 7	\$ 8	\$ 8	\$ 9					
OPERATING & CAPITAL BUDGET SUMMARY										
GROSS REVENUES	\$ 493,751	\$ 563,190	\$ 638,009	\$ 715,352	\$ 782,014					
DEDUCTIONS FROM REVENUE	\$ 217,325	\$ 269,371	\$ 318,263	\$ 385,653	\$ 414,645					
NET REVENUE	\$ 276,426	\$ 293,819	\$ 319,746	\$ 329,699	\$ 367,369					
DIRECT EXPENSE	\$ 248,915	\$ 288,283	\$ 309,725	\$ 315,357	\$ 364,412					
INDIRECT EXPENSE	\$ 242,929	\$ 281,149	\$ 302,392	\$ 307,513						
NET INCOME PROJECTED										
RATE COMPUTATION	Providence Alaska Medical Center is an									
ANNUAL MEDICAID RATE	Acute care facility, not long term care.									
BASE YEAR COST										
LESS ANCILLARY										
PLUS ADMIN. OVERHEAD										
COST BASIS FOR RATE										
BASE YEAR PATIENT DAYS										
COST PER PATIENT DAY										

2001-2004 Direct and Indirect Expense from PAMC Medicare Cost Report

2005 Direct cost from Hyperion report

SECTION IX. Schedule IV

Schedule IV. Operating Budget					
Provide Last Five Years Actual and					
Projections for Three Years Beyond Project Completion					
Description:	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Number of Beds					
Days in a Year					
Available Bed Days					
Resident Bed Days					
Percent Growth					
Occupancy					
Average Length of Stay					
Patient Bed Days					
Number of Residents					
Daily Room and Board Rate*					
Nursing Revenue					
Nursing Services					
Payer mix					
Medicaid					
Medicare					
Other					
Ancillary Revenue					
Total Revenue					
Rate Computation					
Annual Medicaid Rate					
Base Year Cost					
Less Ancillary					
Plus Admin Overhead					
Cost Basis for Rate					
Base Year Patient Days					
Cost per Patient Day					

Providence Alaska Medical Center is
Acute care facility, not long term care.

SECTION IX V-A

Schedule V-A. Debt Service Summary

Provide Current Debt Data and Projections For the Next Three Years

Existing Debt:	[In Thousands]	FY 2006	FY 2007	FY 2008	FY 2009
	Principal	\$1,930	\$2,050	\$11,443	\$13,671
	Interest	\$5,203	\$8,897	\$8,830	\$8,540

SECTION IX Schedule V B.

Schedule V-B. New Project Debt Service Summary					
Attach a debt service cash flow schedule over the life of the debt for the new project					
Break out principal, interest and Other					
year	Item	Principal	Interest	Other	Total
2006		\$ -	\$ -	\$ -	
2007	PAYMENT	No new debt issued for this project.			
2008	PAYMENT				
2009	PAYMENT				

Schedule VI. Reimbursement Sources

Show reimbursement sources for the previous five years and projections for three years after the new project opens

Fiscal Year 2001				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		19.04%		18.12%
Medicare		26.12%		19.24%
Commercial		42.59%		55.76%
Self Pay		5.26%		2.63%
Other Government		6.99%		5.18%
Other		0.00%		-0.93%
Total		100.00%		100.00%

Fiscal Year 2002				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		18.10%		17.52%
Medicare		26.20%		17.57%
Commercial		43.01%		56.79%
Self Pay		6.11%		4.23%
Other Government		6.59%		5.10%
Other		0.00%		-1.21%
Total		100.01%		100.00%

Fiscal Year 2003				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		17.27%		13.95%
Medicare		27.82%		18.56%
Commercial		41.13%		55.97%
Self Pay		8.14%		8.58%
Other Government		5.64%		4.27%
Other		0.00%		-1.33%
Total		100.00%		100.00%

Schedule VI

Fiscal Year 2004				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		17.54%		14.24%
Medicare		29.46%		19.87%
Commercial		39.66%		54.97%
Self Pay		7.27%		7.72%
Other Government		6.06%		4.71%
Other		0.00%		-1.51%
Total		99.99%		100.00%

Fiscal Year 2005				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		17.28%		14.14%
Medicare		28.20%		18.93%
Commercial		40.85%		56.92%
Self Pay		7.60%		7.80%
Other Government		6.07%		4.48%
Other				-2.27%
Total		100.00%		100.00%

Schedule VI. Reimbursement Sources

Fiscal Year 2006				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		17.48%		14.28%
Medicare		27.58%		18.24%
Commercial		41.33%		58.15%
Self Pay		7.19%		8.17%
Other Government		6.42%		4.08%
Other				-2.92%
Total		100.00%		100.00%

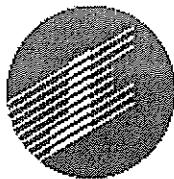
Fiscal Year 2007				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		17.48%		14.28%
Medicare		27.58%		18.24%
Commercial		41.33%		58.15%
Self Pay		7.19%		8.17%
Other Government		6.42%		4.08%
Other				-2.92%
Total		100.00%		100.00%

Fiscal Year 2008				
Reimbursement Source	Number of Patients	Gross Patient Charges	Deductions	Net Patient Revenues
Medicaid		17.48%		14.28%
Medicare		27.58%		18.24%
Commercial		41.33%		58.15%
Self Pay		7.19%		8.17%
Other Government		6.42%		4.08%
Other				-2.92%
Total		100.00%		100.00%

Due to the nature of charity and bad debts expense this schedule is not projectable with certain accuracy. The payor mix is not expected to change from the current mix.

SECTION IX Schedule VII

Schedule VII. Depreciation Schedule			
Schedule includes Fixed, Major Moveable shown in Schedule VII B. and Additional Major Moveable Equipment. Straight-Line Method			
Equipment to be Purchased			
Equipment Description	Unit Cost x Volume	AHA Life	Depreciation Per Year
Fixed Equipment as Reported in Section VIII B			
Hemodynamics (w/remote Operator Terminal) x 2	196,070	5	\$ 39,214
C-arm Digital Imaging System x 2	2,074,574	5	\$ 414,915
Subtotal Fixed Equipment	\$ 2,270,644		
Major Moveable Equipment as Reported in Section VIIB			
Mayo Stand x 2	354	15	\$ 24
IV Pole x 4	920	15	\$ 61
Surgical Table (Scrub Table) x 2	1,110	15	\$ 74
Desk Chairs x 6	2,400	15	\$ 160
Codecart x 2	4,590	10	\$ 459
Pressure Injector x 2	60,000	10	\$ 6,000
Undercounter Lab Refrigerator x 2	3,116	10	\$ 312
PC x 2	1,200	5	\$ 240
Defibrillator x 2	36,000	5	\$ 7,200
Pyxis Med Storage Unit x 2	77,160	5	\$ 15,432
Ultrasound x 2	100,000	5	\$ 20,000
Intravascular Ultrasound x 2	170,000	5	\$ 34,000
Subtotal Maj Moveable Equip	\$ 456,850		
TOTAL ALL DEPRECIABLE EQUIPMENT	\$ 2,727,494		



Joint Commission
on Accreditation of Healthcare Organizations
Setting the Standard for Quality in Health Care

February 8, 2006

George Kuykendall
Administrator
Providence Alaska Medical Center
3200 Providence Drive
Anchorage, AK 99519-6604

Joint Commission ID #: 10208
Accreditation Activity: Evidence of Standards
Compliance
Accreditation Activity Completed: 2/8/2006

Dear Mr. Kuykendall:

The Joint Commission would like to thank your organization for participating in the Joint Commission's accreditation process. This process is designed to help your organization continuously provide safe, high-quality care, treatment, and services by identifying opportunities for improvement in your processes and helping you follow through on and implement these improvements. We encourage you to use the accreditation process as a continuous standards compliance and operational improvement tool.

The Joint Commission is granting your organization an accreditation decision of Accredited for all services surveyed under the applicable manual(s) noted below:

- Comprehensive Accreditation Manual for Home Care
- Comprehensive Accreditation Manual for Hospitals

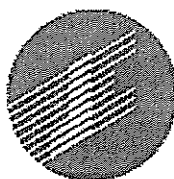
This accreditation cycle is effective beginning October 22, 2005. The Joint Commission reserves the right to shorten or lengthen the duration of the cycle; however, the certificate and cycle are customarily valid for up to 39 months. Please visit Quality Check® on the Joint Commission web site for updated information related to your accreditation decision.

We encourage you to share this accreditation decision with your organization's appropriate staff, leadership, and governing body. You may also want to inform the Centers for Medicare and Medicaid Services (CMS), state or regional regulatory services, and the public you serve of your organization's accreditation decision.

Please be assured that the Joint Commission will keep the report confidential, except as required by law. To ensure that the Joint Commission's information about your organization is always accurate and current, our policy requires that you inform us of any changes in the name or ownership of your organization or the health care services you provide.

Sincerely,

Russell P. Massaro, MD, FACPE
Executive Vice President
Division of Accreditation and Certification Operations



Joint Commission
on Accreditation of Healthcare Organizations
Setting the Standard for Quality in Health Care

Providence Alaska Medical Center
3200 Providence Drive
Anchorage, AK 99519-6604

Organization Identification Number: 10208

Evidence of Standards Compliance Received: 2/8/2006

PROGRAM(S)

Hospital Accreditation Program
Home Care Program

Executive Summary

There is no follow-up due to the Joint Commission as a result of the accreditation activity conducted on the above date.

The results of this accreditation activity do not affect any other Requirement(s) for Improvement that may exist on your current accreditation decision.

COPY

STATE OF ALASKA
DEPARTMENT OF HEALTH AND SOCIAL SERVICES

Frank H. Murkowski, Governor

This is to Certify that a license is hereby granted by the Department of Health and Social Services to

Providence Alaska Medical Center

To conduct and maintain a 326 Bed Acute Care Hospital including 27 Psychiatric Beds
and 10 Rehabilitation Beds

In the premises located at 3200 Providence Drive, Anchorage, Alaska

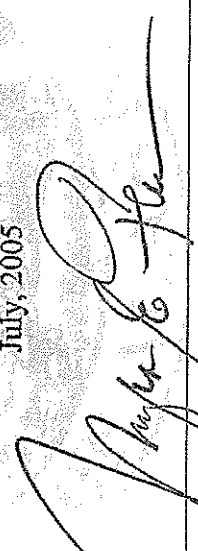
This License is effective July 1, 2005 through June 30, 2006
of TITLE 18, ALASKA STATUTES. This License shall not be assignable or transferable and shall be subject to revocation at any
time by the Department of Health and Social Services for failure to comply with the laws of Alaska or rules and regulations as
provided under the Alaska Administrative Code.

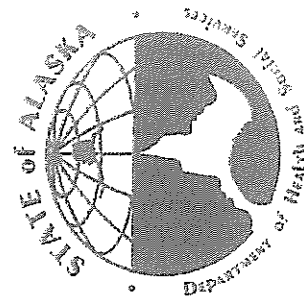
and is subject to the provisions

In Witness Whereof I have hereunto set my hand and seal of the Department of Health and Social Services this

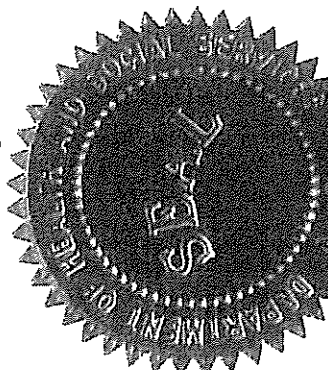
First day of

July, 2005

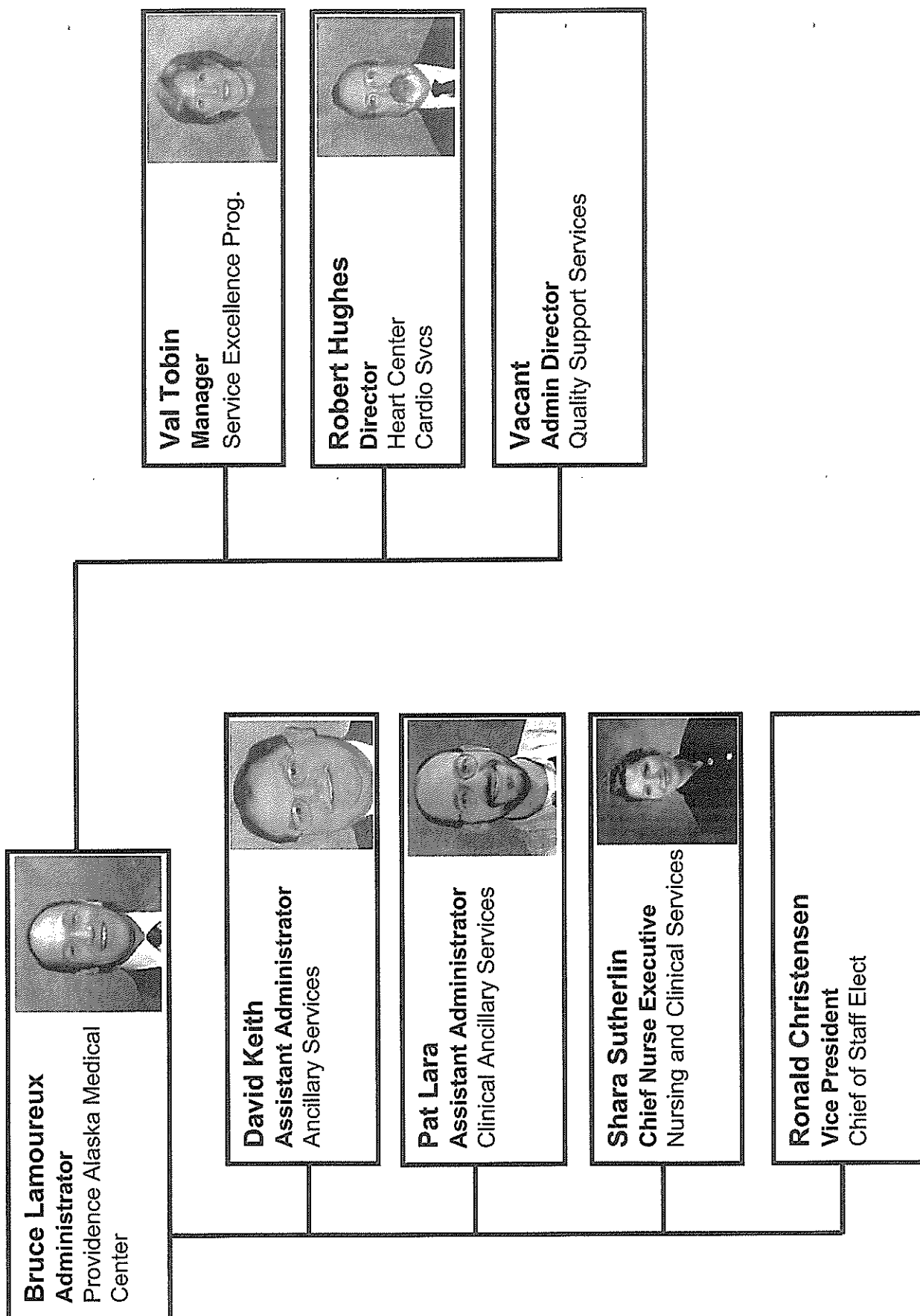
By 
DEPARTMENT OF HEALTH AND SOCIAL SERVICES



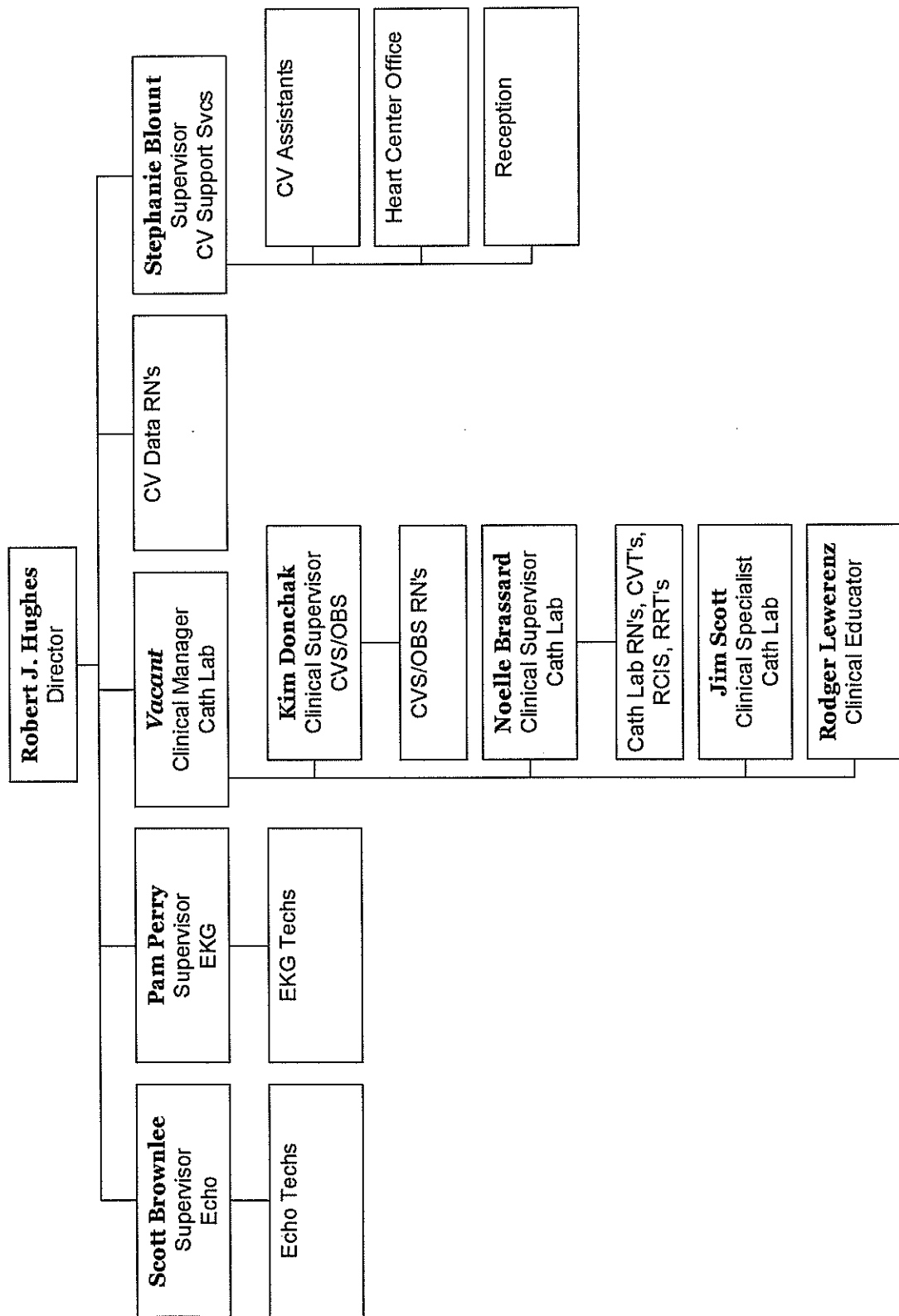
This License Must Be Posted In A Conspicuous Place On The Premises



Providence Health System in Alaska



PAMC Heart Center Org Chart



ROBERT J. HUGHES

710 Barberry Dr.
Cinnaminson, NJ 08077
(856) 829-7950

QUALIFICATIONS:

Thirty years of experience in the Medical field, of which twenty-three years are in Cardio-pulmonary management and six years experience in private business.

- Budget development and implementation, both capital and operational
- Divisional personnel responsibility including recruitment, hiring, training, supervising, and discipline
- Planning and implementing market strategies
- International medical relations and business
- Program development and implementation
- Evaluation and recommendation of products and services
- Experience working on national, state and local boards
- Experience planning and participating in various flight programs
- Experience with construction, general contracting and blueprint review
- Extensive experience with multiple cost centers and decentralized units
- CQI Facilitator

EMPLOYMENT HISTORY:

2001 – Present Cooper Health Systems, Camden New Jersey

Assistant Vice President Cardiovascular Disease and Critical Care Services

Responsible for entire Cardiovascular and Critical Care product lines including hospital services, related nursing areas, physician practices and multiple outlying clinics.

1995 - 2001 Rush-Presbyterian-St. Luke's Medical Center, Chicago, Illinois

Rush-Presbyterian-St. Luke's Medical Center is a 932 bed facility with \$1.3 billion in billed revenue. The Rush-Presbyterian-St. Luke's Cardiology Program was recently named by U.S. News and World Report as the # 1 Cardiology program in Chicago for the third year in a row.

Administrator, Division of Cardiovascular Disease and Critical Care Medicine

Ultimate responsibility for 250 employees covering all aspects of Cardiac Care.

Responsible for operating budget of over \$29,000,000.

Responsible for billed revenues of over \$64,000,000.

Administrator, Rush Heart Institute

Responsible for the marketing and growth of the Cardiac Program.

Increased exposure and name recognition of Rush Heart Institute.

Facilitated the cooperation of Cardiologists and Cardiac Surgeons.

Supervised and approved marketing programs and publications.

Maintained surgical volume despite significant changes in the surgical staff, including the Chairman of CV Surgery.

Assistant Professor, College of Health Sciences

Active member on the faculty of the Health Systems Management Program

Member of Curriculum, Marketing and Advisory Committees.

Lectured in courses and lead International Health course.

Chief Operating Officer, Rush International Health Services; 1996 – 1998

Responsible for launching the International Program at Rush.

Facilitated contract with government of Yemen.

Facilitated agreements for medical service with United Arab Emirates

ROBERT J. HUGHES

Page Two

- 1992 - 1995** Jefferson Regional Medical Center, Pine Bluff, Arkansas
Director of Therapies and Special Projects Coordinator
- Pine Bluff Technical College, Pine Bluff, Arkansas; 1993
Adjunct Instructor, Medical Terminology and Anatomy and Physiology
- 1989 - 1992** Deaconess Medical Center, Billings, Montana
Respiratory Therapist III
- 1983 - 1989** Quik Mart Stores, Yellowstone Ice & Water Co., Billings, Montana
Partner and Vice President of Operations
- 1974 - 1983** Deaconess Medical Center, Billings, Montana
Director of Cardiopulmonary Department
- 1971 - 1974** Los Angeles Orthopedic Medical Center, Los Angeles, California
Supervisor, Respiratory Care.
Licensed Vocational Nurse

MILITARY SERVICE:

- 1966 - 1970** United States Navy, Hospital Corpsman
Last Duty: U. S. Naval Medical Center, Long Beach, California
Completed USN Physical Therapy Technician School, Bethesda, MD.
Honorable discharge as E-5
Served in U. S. Naval Reserve 1972-1981

EDUCATION:

Master of Arts, Health Services Management
Webster University, St. Louis, Missouri: Little Rock, Arkansas Campus

Advanced Respiratory Therapy, Registry Eligible
Mount San Antonio Junior College, Walnut, California

Bachelor of Science, Health Science - Community Health Education
California State University, Northridge, California

Licensed Vocational Nurse, California

Continuing Education:

CQI-TQM, ACLS, CPR
Eastern Montana College, Business
Cornell University, Convenience Store Merchandising
Colorado School of Mines, Underground Storage Tanks
Numerous courses and seminars on Management, Business, Maintenance and education.

INTERESTS:

Habitat for Humanities, Clinical Pastoral Education, Hunting, Woodworking

PROVIDENCE HEALTH SYSTEM IN ALASKA JOB DESCRIPTION

JOB CODE: 11506-198

JOB TITLE: **DIRECTOR HEART CENTER & CARDIOVASCULAR SERVICES**

PROCESS LEVEL: PROVIDENCE MEDICAL CENTER

REPORTS TO: CHIEF NURSE EXECUTIVE and CHIEF OPERATIONS OFFICER

SUPERVISES: ASSIGNED AREAS AND STAFF

DESCRIPTION STATUS: New 04/05

SUPERSEDES:

POSITION SUMMARY

The Director is accountable for the operations, strategic planning, and service line management abilities necessary to lead a specialized cardiovascular team of nurses, technologists, and support staff dedicated to its state-wide reputation of providing outstanding Cardiovascular tertiary care with physician specialists that contributes to PAMC's mission, care excellence, patient safety, and community commitment. Working within the strategic direction of the health system and with the collaboration of Alaska Heart Institute's leadership and Cardiologists, the Director provides managerial oversight and direction for all assigned functions. The Director contributes to the effective and efficient operations in support of high quality, cost-effective patient care in line with PHSA's mission and is responsible for implementing and administering the organization's philosophy, goals and policies. The Director must have outstanding and creative collaborative, supervisory and administrative skills that will develop vision and priorities, direct and delegate the management of patient care services, while assuring compliance with the Federal, State, JCAHO standards, cardiovascular national organizations and associated databases, and local laws.

ESSENTIAL JOB FUNCTIONS:

(Responsibilities, Accountabilities, and Competencies; May not include all duties of this job)

A. JOB DUTIES: (For performance review, assess competence for each essential function using "C" for competent and "NI" for needs improvement)

1. Create an environment of collegial and collaborative relationships amongst physicians, staff, the Alaska Heart Institute, and medical center colleagues. Recognize excellence individually and publicly.
2. Direct and administer assigned functions to ensure high quality, cost-effective patient services which meet and/or surpass customer and accreditation standards.

3. Evaluate organization structure, reporting relationships and position incumbents to ensure that high standards of performances are obtained and developed as needed. Assure optimal organizational performance by meeting goals and projections; providing timely and accurate data as requested, and maintaining compliance with all Federal, State and local laws.
4. Develop annual operating plans to meet the strategic service line's specialty goals and support functions. Monitor actual performances and take corrective actions. Develop, implement and maintain the annual operating budget, ensuring that operations are managed within the established guidelines. Establish financial and programmatic goals and conduct an annual audit and evaluation of goals achieved.
5. Collaborate and communicate regularly with the Cardiovascular physicians and their respective teams involved in the diagnostic, interventional, surgical, and administrative aspects of the Heart & Cardiovascular Program. Assure visibility and accessibility to the physician and administrative leadership and staff. Round routinely for customer service, patient safety, and care outcomes. Review and share customer survey results and concerns with team, and respond appropriately. Develop improvements to these experiences and events.
6. Direct, coordinate and/or participate in various hospital committees as needed in order to promote the strategic and operational goals of the Heart & CV Services Program and health system.
7. Select, train, develop and evaluate team members and initiate personnel actions in accordance with Human Resource policies and organizational philosophy. Monitor the progress of employee performance, review skills and practices, promote education, evaluate and implement appropriate training programs. Ensure timely staff performance evaluations, establish goals and criteria of performance with staff, and implement appropriate actions for achievement.
8. Collaborate with colleagues from other divisions within and without the organization for the purpose of furthering the goals and objectives of the Heart and Cardiovascular Center and Program.
9. Support and participate in quality improvement, health and safety control programs as established by organization policy and procedures.
10. Monitor monthly performance of the Center and service line in relation to the inventory, new devices, supplies, vendors, and budget. Intervene as needed. Prepare and submit reports on operations as required.
11. Schedule regular meetings with direct report staff to provide supervision, assure communication and to monitor facility operations. Conduct and document annual performance evaluations on each direct report staff.
12. Oversee the coordination and success of PAMC's annual CV Conference, public educational forums, fund-raisers, and quarterly SPHS Collaboratives.

13. Maintain and guide the implementation of organization policies and procedures in compliance with State, Federal and other regulatory guidelines. Assure adequate preparation for, response and participate in, regulatory and random compliance surveys.
14. Provide direction and support to subordinate managers and staff to assure departmental effectiveness and efficiency.
15. Adhere to hospital policies and procedures and participate in quality improvement and safety programs.
16. Implement care/services that recognize age/diversity specific needs/issues of customers served.
17. Performs other related duties as required.

B. IDENTIFIED COMPETENCIES

Completes initial and annual Competency Plan for assigned job and department.
Collaborative, creative, and inspiring of all team members involved in this specialty.
Champion of education and specialty certification and promotes these goals/activities.

C. CORE VALUES

Demonstrates personal and interpersonal qualities that support the Core Values of Providence Health System.

D. ESSENTIAL JOB QUALIFICATIONS: (Any equivalent Combination of Knowledge, Skills, Abilities, Education, and Experience)

1. **Education:** Bachelor's degree. Master's degree in CV health services field.
2. **Experience:** Five to ten years of experience in clinical cardiovascular health care operations with at least three years in a management and leadership role.
3. **Licensure/Certification:**
4. **Other Qualifications:** Must possess the knowledge and ability to manage hospital operations through administrative ability, initiative, resourcefulness, executive and analytical ability. Must have experience in strategic planning, organizational assessment, and have highly developed leadership and interpersonal skills.
5. **Attendance:** Regular attendance is a requirement of this position.
6. **English Language:** Must be able to read, write, and speak English well.

PROVIDENCE HEALTH SYSTEM IN ALASKA JOB DESCRIPTION

JOB CODE: 24800-198M
JOB TITLE: CATH LAB REGISTERED NURSE (RN)
PROCESS LEVEL: 198-PROVIDENCE MEDICAL CENTER
REPORTS TO: DIRECTOR, MANAGER, SUPERVISOR
SUPERVISES: N/A

DESCRIPTION STATUS: NEW: 10/96; NEW 11/03

SUPERSEDES:

POSITION SUMMARY

Provides professional nursing care in the cardiovascular and interventional radiology unit using a multidisciplinary approach. Delegates aspects of patient care consistent with team members level of educational training. Coordinates care planning with other disciplines and team members. Assists physicians in performing and completing invasive, interventional and therapeutic cardiovascular procedures in labs using a variety of specialized equipment, monitors, devices and supplies. Knowledgeable in Cardiac, Vascular and Pediatric Procedural practice as well as emergent techniques/protocol. Assists with pre and post procedure monitoring per hospital protocol. Assists in Quality Control checks /Quality Improvement Program. Performs in a manner which promotes "team" concept and reflects the Sisters of Providence mission and philosophy. Able to observe hospital and departmental policies on confidentiality. CVS patients served range from neonates to senior citizens. Serves as the point of contact for patient information.

ESSENTIAL JOB FUNCTIONS:

(Responsibilities, Accountabilities, and Competencies; May not include all duties of this job)

A. JOB DUTIES: (For performance review, assess competence for each essential function using "C" for competent and "NI" for needs improvement)

1. Responsible for patient care in cardiovascular / interventional radiology Labs, Pre-operative preparation includes obtaining patient status report from Cardiovascular Observation, or Nursing Units, procedural documentation sheet information, informed consent, recent lab values, orders, IV site patency, pre-op medications, allergies, History and Physical, teaching, vital signs, preparation of invasive procedure sites. Intra-operative includes scrubbing, circulating, or monitoring the case and alerting Physician to changes in patient status, the administration of appropriate oral and intravenous medications under the direction of the performing physician, assures good patient communication for comfort/status assessment and vital signs. Post-operative includes Procedure documentation, vital signs, teaching, insertion site assessment, removing sheaths, use of vascular closure devices per department policy, applying

vascular pressure, monitoring/alerting Physician to changes , and documenting reports to Nursing unit. Works on-call rotation to meet the needs of department after regular business hours.

2. Assesses patient. Obtains history and other pertinent information. Alerts physician to any specific patient needs. Provides quality patient care in accordance with hospital standards.
3. Preparation of sterile procedure trays/set-ups. Adhering to "sterile" technique in all procedures(patient,equipment,supplies.)
4. Accurate patient positioning for optimal visualization and minimal radiation exposure to patients, staff and physicians.
5. Maintaining communication with family and/or significant others before, during, and after procedure. Acquisitioning Pastoral care prn.
6. Directly assists the CV Physicians with all CV procedures (Vascular, Cardiac, Adult, Pediatric) as scrub assistant, circulator, control-computer operator,responsible for proper image aquisition , archival and film processing specific to procedure type.
7. Assuring standard completion of patient/computer reports, calculations, and appropriate procedural charges.
8. Establishes/maintains professional training/educational expertise through appropriate continuing education according to Departmental plan.
9. Promotes positive working relationships and "teamwork" concept within Department and throughout hospital.
10. Able to assist in troubleshooting and minor equipment repair in Labs. Stocks supplies, instruments, and equipment according to protocol and storage allocations. Alerts/notifies Supervisor, and/or management about equipment/supply concerns or problems with operational performance.
11. Participates in Quality Improvement Program and knowledgeable in its components and results that affect patient care and quality control issues. Participates in the orientation of new staff.
12. Responsible for review/knowledge of Departmental policies and procedures/guidelines, skills checklist, medications review, and safety and disaster guidelines annually. Regularly attends staff meetings, inservices and skills labs.
13. Functions/acts as charge person when approved/delegated by Cath Lab Supervisor or Director of CVS.
14. Implements care/services that recognize age/diversity specific needs/issues of customers served.

15. Performs other related duties as required.

B. IDENTIFIED COMPETENCIES

Completes initial and annual Competency Plan for assigned job and department.

C. CORE VALUES

Demonstrates personal and interpersonal qualities that support the Core Values of Providence Health System.

D. ESSENTIAL JOB QUALIFICATIONS: (Any equivalent Combination of Knowledge, Skills, Abilities, Education, and Experience)

1. **Education:** Graduate of an accredited/approved school of Nursing.
2. **Experience:** Two years experience in critical care nursing/emergency nursing, and or two years experience in cardiovascular, interventional radiology and or electrophysiology.
3. **Licensure/Certification:** Licensed as a Registered Nurse in the State of Alaska. BLS, ACLS, PALS for cath lab.
4. **Other Qualifications:** Requires basic knowledge of anatomy and physiology, invasive Cardiovascular practices/techniques/pressures, basic EKG analysis and emergency protocols. Requires an ability to deal tactfully and compassionately with patients/families/significant others under potentially stressful conditions. Responsible for effective and constructive communication with staff/physicians/management and units. Schedule varies to meet department needs. Must be able to prioritize multiple tasks, and work with a variety of health unit teams.
5. **Attendance:** Regular attendance is a requirement of this position.
6. **English Language:** Must be able to read, write, and speak English.

This Job Description reflects Providence Health System in Alaska's best effort to describe the essential functions and qualifications of the job described. It is not an exhaustive statement of all the duties, responsibilities or qualifications of the job. This document is not intended to exclude an opportunity for modifications consistent with providing reasonable accommodation. This is not intended to be a contract. Your signature indicates you have read this Job Description and understand the essential functions and essential qualifications of the job.

Employee Printed Name: _____ Date: _____

Employee Signature: _____ SSN: _____

PROVIDENCE HEALTH SYSTEM IN ALASKA JOB DESCRIPTION

JOB CODE:	28401-198
JOB TITLE:	CARDIOVASCULAR CATH LAB TECHNOLOGIST
PROCESS LEVEL:	198-PROVIDENCE ALASKA MEDICAL CENTER
REPORTS TO:	DIRECTOR, MANAGER, SUPERVISOR
SUPERVISES:	N/A
DESCRIPTION STATUS:	8/04
SUPERSEDES:	N/A

POSITION SUMMARY

Assists cardiovascular Physicians in performing and completing invasive, interventional and therapeutic cardiovascular procedures in Labs using a variety of complicated/advanced equipment, monitors, devices, and supplies. Knowledgeable in Vascular, Cardiac, and Pediatric Procedural practice as well as emergent techniques/protocol. Assists in Quality Control checks/Quality Improvement Program. Performs all duties in a manner which promotes "team" concept and reflects the Sisters of Providence mission and philosophy. Able to observe hospital and departmental policies on confidentiality. CVS patients served range from neonates to senior citizens.

ESSENTIAL JOB FUNCTIONS:

(Responsibilities, Accountabilities, and Competencies; May not include all duties of this job)

A. JOB DUTIES: (For performance review, assess competence for each essential function using "C" for competent and "NI" for needs improvement)

1. Responsible for patient care in cardiovascular/interventional radiology Labs. Pre-operative preparation includes obtaining patient status report from Nursing Units, SP Documentation Sheet information, Permit, lab studies, Physician orders, IV site, pre-op medications, allergies, contrast history/information/teaching, vital signs, preparation of invasive procedural sites, EKG/physiologic monitoring equipment/positioning, and surgical preparation. Intra-operative includes scrubbing, circulating, or monitoring the case and alerting Physician to changes in patient status, the administration of appropriate oral and intravenous medications under the direction of the performing physician, assures safe radiation protection protocol, maintaining good patient communication/rapport for comfort/status assessment, and vital signs. Post-operative includes SP Documentation Sheet information/vital signs, teaching, insertion site assessment, removing sheaths, use of vascular closure devices per department policy, applying vascular pressure, monitoring/alerting Physician to changes, and

documenting reports to Nursing Unit. Works on-call rotation to meet the needs of the department after regular business hours.

2. Preparation of sterile procedure trays/set-ups. Adhering to "sterile" technique in all procedures (patient, equipment, supplies.)
3. Maintaining communication with family and/or significant others before, during, and after procedure. Acquisitioning Pastoral care prn.
4. Accurate patient positioning and assistance in selection of radiographic techniques for optimal visualization and minimal radiation exposure to patients, staff and CV Physicians.
5. Directly assists the CV Physicians with all CV procedures (Vascular, Cardiac, Adult, Pediatric) as scrub assistant, circulator, control-computer operator, responsible for proper image acquisition, archival and film processing specific to procedure type.
6. Assuring standard completion of patient/computer reports, calculations, and appropriate procedural charges.
7. Establishes/maintains professional training/educational expertise through appropriate continuing education according to Departmental plan.
8. Promotes positive working relationships and "teamwork" concept within Department and throughout hospital.
9. Able to assist in troubleshooting and minor equipment repair in Labs. Stocks supplies, instruments, and equipment according to protocol and storage allocations. Alerts/notify Supervisor, and/or management about equipment/supply concerns or problems with operational performance.
10. Participates in Quality Improvement Program and knowledgeable in its components and results that affect patient care and quality control issues. Participates in the orientation of new staff.
11. Responsible for review/knowledge of Departmental policies and procedures/guidelines, skills checklist, medications review, and safety and disaster guidelines annually. Regularly attends staff meetings, inservices and skills labs.
12. Functions/acts as charge person when approved/delegated by Cath Lab Supervisor or Director of CVS.
13. Implements care/services that recognize age/diversity specific needs/issues of customers served.
14. Performs other related duties as required.

B. IDENTIFIED COMPETENCIES

Completes initial and annual Competency Plan for assigned job and department.

C. CORE VALUES

Demonstrates personal and interpersonal qualities that support the Core Values of Providence Health System.

D. ESSENTIAL JOB QUALIFICATIONS: (Any equivalent Combination of Knowledge, Skills, Abilities, Education, and Experience)

1. **Education:** Graduation from an accredited school with supervised clinical experience in invasive Cardiovascular, and/or interventional radiological procedures preferred.
2. **Experience:** Knowledge base of Hospital radiology techniques, theory, and procedures necessary. Previous Special Procedures/Cath Lab Cardiovascular Technician experience preferred.
3. **Licensure/Certification:** Should be ARRT, RCIS or CVT registered. BLS, ACLS mandatory, PALS preferred. If new graduate registry or licensure must be completed within one year from date of hire.
4. **Other Qualifications:** Requires basic knowledge of anatomy and physiology, invasive Cardiovascular practices/techniques/pressures, basic EKG analysis, and emergency protocols/BLS. Requires an ability to deal tactfully and compassionately with patients/families/significant others under potentially stressful conditions. Responsible for effective and constructive communication with CV staff/Physicians/Management/Hospital Departments and Units. Participates as a CV "team" member in supporting a working environment conducive to high quality care/morale, and cost effectiveness.
5. **Attendance:** Regular attendance is a requirement of this position.
6. **English Language:** Must be able to read, write, and speak English.

Optimal Resources for the Examination and Endovascular Treatment of the Peripheral and Visceral Vascular Systems

AHA Intercouncil Report on Peripheral and Visceral Angiographic and Interventional Laboratories

John F. Cardella, MD, William J. Casarella, MD, James A. DeWeese, MD, Gerald M. Dorros, MD, Joel E. Gray, PhD, Barry T. Katzen, MD, John H. Laragh, MD, David C. Levin, MD, Victoria M. Marx, MD, Edward L. Nickoloff, ScD, Michael J. Pentecost, MD, Gary S. Roubin, MD, Eric C. Martin, MD (Task Force Chair)

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HISTORICAL PERSPECTIVE

In 1969 the Intersociety Commission for Heart Disease Resources was established through a contract with the American Heart Association under Public Law 89-239. Its responsibility was to produce guidelines defining optimal medical resources and care for the prevention and treatment of cardiovascular disease, including guidelines for radiologic facilities (1). This resource guideline was revised in 1976 (2) and again in 1983 (3).

The Intersociety Commission was disbanded shortly thereafter, but a joint ad hoc task force of the American Heart Association and the American College of Cardiology continued this work with "Guidelines for Cardiac Catheterization and Cardiac Catheterization Laboratories" (4), published in 1991. The task force concluded that "... while noncardiac diagnostic and therapeutic procedures are growing in number ... guidelines for these services are beyond the scope of this document."

These documents have charted the evolution of cardiac catheterization

from a procedure performed in a few highly specialized laboratories for cardiovascular research to one performed in a number of interventional cardiac laboratories. The documents also have provided useful optimal resource guidelines. In the 1983 report similar standards for angiographic facilities were implied but never specifically stated, with the emphasis always on the heart. Nevertheless, the report mentioned angiographic facilities and considerable involvement by radiologists.

Just as cardiac catheterization has evolved, so too have peripheral and visceral angiography. Diagnostic angiography proliferated in the 1960s and the 1970s, and interventional radiology emerged in the 1980s. Nevertheless, optimal resource standards have never been promulgated except in an abbreviated form (5).

In 1989 the Council Affairs Committee of the AHA approved the formation of a committee on peripheral vascular disease under the auspices of the Council on Cardiovascular Radiology. In 1992 an ad hoc task force was created, with members from the Councils on Cardiovascular Radiology, Cardio-Thoracic and Vascular Surgery, Clinical Cardiology, and Kidney in Cardiovascular Disease, to develop guidelines for peripheral and visceral angiographic and interventional labo-

ratories. Task force members are Eric C. Martin, MD, chair; William J. Casarella, MD (Council on Cardiovascular Radiology); Barry T. Katzen, MD (Council on Cardiovascular Radiology); Gerald M. Dorros, MD (Council on Clinical Cardiology); Gary S. Roubin, MD (Council on Clinical Cardiology); James A. DeWeese, MD (Council on Cardio-Thoracic and Vascular Surgery); and John H. Laragh, MD (Council on Kidney in Cardiovascular Disease). The task force is grateful for the contributions of the following consultants: John F. Cardella, MD; Joel E. Gray, PhD; Victoria M. Marx, MD; Edward L. Nickoloff, ScD; Michael J. Pentecost, MD; and David C. Levin, MD.

INTRODUCTION AND STATEMENT OF PURPOSE

In the past three decades the role of the angiographic laboratory has progressed from diagnosis of disease by a study of the arterial and venous systems to definitive treatment of certain patients by endovascular means. These facilities have also been used for nonvascular interventional radiology: the diagnosis and treatment of nonvascular disease. However, optimal resources for peripheral and visceral angiographic and interventional facilities have never been formally examined.

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During the past decade invasive vascular imaging studies (arteriography and venography) have achieved a new level of complexity and sophistication. With this high degree of specialization has come the need to design angiographic facilities capable of meeting the demands of current practice. This report describes the optimal angiographic facility in which peripheral and visceral vascular studies, both diagnostic and therapeutic, should be performed; this will also be the model for nonvascular procedures. The equipment and personnel requirements are unique and distinct from the requirements of a dedicated cardiac catheterization laboratory or neuroradiology facility.

In this report all aspects of a modern peripheral, visceral, and interventional facility are discussed. It is recognized that many existing facilities have developed slowly and do not meet these standards. These statements should therefore be viewed as recommendations only.

Every reasonable attempt has been made to seek opinions and guidance from the cardiovascular and interventional community and those with whom they most frequently interact. Although standards of practice documents touch on the equipment required for particular procedures, they represent minimum standards. This report describes guidelines for the optimal management of peripheral and visceral vascular disease and its interventional management and should serve as a model for future installations.

OPERATIONS

Utilization

Complex diagnostic and therapeutic procedures should only be performed in rooms designed for this purpose. Optimal performance requires a caseload sufficient to maintain the skill and efficiency of the staff. Diagnostic quality may be compromised and procedures may be unnecessarily prolonged if physicians are not adequately trained in these procedures, thereby increasing risk to the patient and subjecting patients and staff to excessive radiation. The task force endorses the principle that procedures should be performed by

trained personnel who maintain their skills. These matters have been addressed by several credentialing documents, most notably "Training Standards for Physicians Performing Peripheral Angioplasty and Other Percutaneous Peripheral Interventions" (6), an AHA intercouncil medical/scientific statement prepared by radiologists, cardiologists, and cardiovascular surgeons. In addition, the report "Guidelines for Performance of Peripheral Percutaneous Transluminal Angioplasty" (7) was issued by the Society of Cardiac Angiography and Interventions to define standards for cardiologists performing peripheral angioplasty and was followed by "Recommendations for Peripheral Transluminal Angioplasty: Training and Facilities" (8), issued by the ACC. The Society of Cardiovascular and Interventional Radiology issued "Angioplasty Standard of Practice" (9) and "Standards for Interventional Radiology" (10). The latter report covers procedural standards for peripheral and visceral arteriography; peripheral, renal, and visceral angioplasty; and outpatient angiography. Both reports were endorsed by the American College of Radiology. The Society of Vascular Surgery (North American chapter) and the International Society for Cardiovascular Surgery issued a report entitled "Endovascular Surgery, Credentialing, and Training for Vascular Surgeons" (11).

In 1983 the Intersociety Commission for Heart Disease Resources wrote of the compelling economic reason for the high utilization of facilities and suggested that the cost of laboratory radiology equipment be amortized over 5 to 7 years (3). Although there has been little change in the life expectancy of major x-ray equipment since that time, the task force does not believe it is valuable to calculate amortization costs here but believes that the principle remains valid.

Patient Management

Ideally, procedures should be performed in a hospital, in a dedicated peripheral vascular and visceral interventional laboratory. The range of procedures involved seldom allows for the optimum management of patients in a free-standing facility, although selected procedures may be performed

on some outpatients. Standards of practice for angiography (10) and peripheral angioplasty (9,12) have already been published. The most recent document, "Guidelines for Peripheral Percutaneous Transluminal Angioplasty of the Abdominal Aorta and Lower Extremity Vessels" (12), is an intercouncil AHA medical/scientific statement. The optimal standards of care are summarized below.

Preprocedural care. A note should be written in the patient's record summarizing indications for study, pertinent history, physical findings, and indications for the procedure. The patient's medications, history of allergy, relevant medical and surgical history, and any vascular risk factors, including smoking, hypertension, and hyperlipidemia, should also be noted.

A physical examination should be performed, including a detailed vascular examination and a general examination of sufficient detail to exclude concurrent acute illnesses. For patients with chronic lower extremity atherosclerotic disease, noninvasive flow studies, including ankle-brachial systolic indexes and pulse volume recordings, should be performed and the results recorded.

Informed consent must be obtained from all patients and documented and must include indications, risks, and alternatives. Surgical consultation may be advisable for many interventional procedures, and it is preferable that decisions about therapy be made in consultation with all physicians involved. In emergencies, when informed consent cannot be obtained from the patient or a family member, individual hospital policies should be followed. These customarily require written statements by the patient's physician, countersigned by a hospital officer, that the procedure is indicated.

Laboratory evaluation may be necessary, including measurement of hemoglobin, hematocrit, creatinine, electrolytes, coagulation parameters, and electrocardiogram, as well as blood lipids when applicable.

Procedural care. All patients should undergo cardiac monitoring continuously during the procedure, with intermittent blood pressure monitoring. A record of vital signs should be maintained.

All patients should have secure intravenous access for the administra-

tion of fluids and medications as needed.

If the patient is to receive conscious sedation, pulse oximetry or end-tidal carbon dioxide monitoring should be used. A registered nurse whose primary responsibility is to monitor the patient should be present. Records should be kept of medications given, including doses and times of administration, in conformance with hospital policy.

During intravascular studies continuous pressure measurement should be available.

A physician should be available during the period immediately after the procedure to ensure that there is adequate compression at the puncture site and that the patient is stable before transfer to the postprocedure care area. Initial stabilization is best provided in a recovery area adjacent to the angiography suite by nurses familiar with the procedures performed.

Postprocedural care. A physician's procedure note should be written in the patient's chart summarizing the major findings of the study and any immediate complications.

All patients should be confined to bed rest and observed after the procedure. Depending on the site and size of the vascular puncture and the risk factors, bed rest may be required for up to 24 hours. During the first 4 to 6 hours after the procedure, skilled nurses or other appropriate staff should periodically monitor the puncture site and the status of the pulses distal to the puncture site. The patient should be monitored for urinary output, cardiac symptoms, pain, and other indications of systemic complications; this period may be extended for the full 24 hours of bed rest.

The patient's initial ambulation must be supervised. Vascular perfusion, puncture site stability, and independent patient function and mobility must be ensured.

When either treatment or vascular access requires catheter manipulation in the thoracic aorta or brachiocephalic vessels, the neurologic status should be assessed periodically.

The operating physician or a designate should evaluate the patient after the procedure, and the findings should be summarized in a progress note. The physician or designate should be available for continuing care

during hospitalization and after discharge.

Selection criteria for short-term observation. The duration of observation after the procedure must be decided on an individual basis. Diagnostic arteriography may be performed on some patients with only a short period of postprocedure observation (less than 8 hours) before they go home. Other patients require overnight care. Short-term observation may be considered when all of the following conditions can be met:

1. The patient should be capable of independent ambulation before the procedure and must have demonstrated stable independent ambulation after the procedure. Alternatively, a nonambulatory patient should have assistance after discharge from the hospital that is adequate to provide care as needed.
2. The patient must be able to follow instructions and detect changes in symptoms. Alternatively, patients with impaired mental status should have assistance adequate to provide care as needed after discharge from the hospital.
3. A responsible adult should be present during the first night after discharge from the hospital.
4. The patient should be free of concurrent serious medical illness that might contribute to a significantly increased risk of complications.
5. The patient must have recovered from the effects of sedation.
6. Travel time to the hospital or another acute care facility from the place where the patient is to spend the first night after the procedure should be reasonably brief.
7. The patient should have transportation to and from the hospital.

Contraindications to short-term observation. Several factors must be considered in determining the length of skilled nursing care needed after the procedure. Some of the relative contraindications to short-term observation are listed below. This list is not meant to be comprehensive, and any clinical

circumstance that might predispose the patient to a significant complication should prompt overnight admission:

1. Poorly controlled hypertension in patients who have an increased risk of hematoma formation
2. A significant risk of contrast-induced renal injury that might be avoided by periprocedural intravenous hydration
3. Coagulopathy or electrolyte abnormalities that require correction
4. Insulin-dependent diabetes in patients who have significantly elevated or labile serum glucose levels
5. Complications occurring during or after angiography or angioplasty, eg, a large hematoma, nausea and vomiting, neurologic deficits, or thromboembolic events
6. Hemodynamic instability or significant arrhythmias during or after the procedure

The decision about short-term or longer-term postprocedure observation must be made on an individual basis, and patient care may vary from these criteria for sound clinical reasons. In each case the decision must be made by the operating physician after a review of all pertinent data.

Monitoring equipment. The facility should be capable of electrocardiographic, heart rate, and blood pressure monitoring and pulse oximetry; the equipment should be available in each laboratory and in the recovery room. Responsibility for patient monitoring rests primarily with the registered nurse supervised by the operating physician.

Sterile Technique

Angiographic and interventional procedures should be performed in strictly aseptic conditions. Scrub suits should be worn by all personnel in the laboratory. Primary and secondary operators should wear sterile gowns and gloves as well as surgical caps and masks. Glasses should be worn to protect the eyes against splashes. In the preparation of side tables and during the passage of equipment and devices to the primary operators, aseptic tech-

nique should be followed by all personnel (13,14).

Sterile, impervious barriers should be available to cover any part of the equipment that may contaminate the field. Either sterilizable handles or disposable transparent covers for the controls should be available. The handling of needles, syringes, and other contaminated sharp devices should be in accordance with Occupational Safety and Health Administration regulations and hospital policies. Disposal containers for needles and other sharp instruments should be readily available in the laboratory. There should be an institutional policy about stab wounds from contaminated instruments. Universal precautions should be practiced with every patient, and all personnel should be protected from contact with body fluids (15-24). Appropriate receptacles for contaminated items should be readily available.

Emergency Management

Resuscitation equipment and personnel trained and experienced in its use must be immediately available for dealing with a variety of complications that can arise during angiographic and interventional procedures, including cardiac arrest, life-threatening hemorrhage, anaphylactic contrast reaction (25-28), vasovagal reactions, and sedation-related respiratory compromise (29-32). All personnel in the facility should be trained in emergency resuscitation. A peripheral vascular and interventional radiology suite should be equipped with a standard, approved hospital crash cart containing the full complement of resuscitative drugs, a defibrillator with monitoring capability, intubation equipment, and an Ambu bag for temporary ventilation. The hospital should have electrical pacing capability. There should be plans for the expedient transfer of patients to suitable facilities for emergency surgery when necessary. For this reason surgical consultations are desirable for all patients who may be at risk for emergency surgery.

Information and Film Handling

As films are processed they should be reviewed by the primary operator

for both diagnostic content and technical acceptability. Films should be read on a daily basis. Films should also be available for consultation, which may require the filing of cases over the short term in the angiographic and interventional facility. Typewritten or audiotaped reports of the procedures should be available within 24 hours of performance. It is preferable that films be placed on large-capacity film alternators.

Anesthesia

The vast majority of procedures can be performed with the patient under local anesthesia supplemented by intravenous analgesia and anxiolytics. Midazolam and fentanyl are commonly used. In long, painful interventional procedures, standby anesthesia may be valuable, while general anesthesia may also be used electively or, very occasionally, on an emergency basis (29-32). Accordingly, the room size must be adequate for the necessary equipment (see "Department Layout").

Equipment and Inventory Control

The number of catheters, wires, and devices required for angiography and interventional procedures continues to increase rapidly. Not only is significant storage space required (see "Department Layout"), but an inventory control system is rapidly becoming necessary. Such a system must take into account expiration dates of catheters and guidewires. Some equipment will need to be resterilized, and facilities for cleaning and gas sterilization should be available.

STAFFING

Physician Staff

Peripheral vascular and interventional facility director. The director should be a physician with the experience and leadership qualities necessary to control the laboratory environment. The director should be board certified in his or her specialty and fully trained in cardiovascular and interventional procedures. Recently appointed directors should be fellowship

trained and thoroughly experienced in performing the procedures specific to the laboratory. The director will supervise the procedures performed in the section and will be responsible for directing the laboratory. The director should be responsible for the quality assurance program. A continuing education program should be maintained, and CME attendance should be documented.

Attending staff. All physicians credentialed to operate in the laboratory (including the director) should have met the training standards recently developed by the involved specialties for physicians performing peripheral angioplasty and associated percutaneous peripheral interventions. In sum, these involve board eligibility or certification and require qualification by training in a fellowship program or documented experience (6-8,11). Staff physicians should spend enough time doing procedures to fulfill the obligations of the laboratory and should perform a sufficient number of procedures to maintain proficiency and competence (6-8,11).

Staffing should be appropriate for the caseload, with adequate emergency coverage. Many procedures may require the presence of two staff members. The staffing level should be sufficient for consultation with clinicians and completion of the caseload within the limits of reasonable radiation exposure. The facility should have a caseload sufficient to meet the credentialing requirements for staff and any trainees.

Fellows. Fellowship training is recommended for all practitioners participating in these procedures. Fellows should only be trained at facilities with caseloads sufficient to meet the requirement of the appropriate credentialing standards and standards of practice documents (6-8,10-12).

Residents. It should be the goal of the peripheral vascular and interventional section to provide residents with the opportunity to master general diagnostic angiography in the peripheral vascular and visceral areas. Residents must be closely supervised by the laboratory director or a designated staff member. Training facilities for residents should meet the appropriate credentialing standards (6-8,11).

Nursing Staff

It is recommended that facilities performing peripheral vascular, visceral, and interventional procedures should have a minimum, per room, of one full-time registered nurse with special training in critical-care nursing. Nurses should be fully conversant with intravenous techniques, patient monitoring, including electrocardiography and pulse oximetry (31), and intravenous sedation, analgesia, pressure measurements, and other pertinent laboratory procedures. The nursing staff should be responsible for maintaining records of patients' vital signs, medication logs, and drug inventory records.

Technical Staff

Technologists working in the peripheral vascular and interventional laboratory should be registered and certified radiologic technologists with additional training in angiographic and interventional procedures. The rapidly changing nature of the specialty requires that technologists receive additional continuing education by the facility director or physician staff. The technologist staff should be under the direct administrative supervision of a chief technologist who has sufficient experience to manage and train the staff. All technologists working in the laboratory should have a good working knowledge of the inventory and specialized equipment.

Service Support Personnel

Service support personnel should maintain and record in a service log the preventive maintenance schedule on all radiographic equipment in the angiographic and interventional laboratory. Service personnel should be under the direction of the medical physicist and the facility director.

Medical Physics Staff

Image quality, radiation safety, and all quality control data should be reviewed at least annually by a medical physicist with special expertise in diagnostic imaging. The medical physicist should be board certified in diagnostic medical physics by the American Board of Radiology, or di-

agnostic imaging physics by the American Board of Medical Physics, or possess equivalent qualifications.

Computer Scientist

Computers are playing ever-increasing roles in diagnostic imaging, and it is essential to ensure that computer-generated data are correct. Any modifications to software, or software written for a specific application, must be thoroughly evaluated in accordance with procedures similar to those required by the Food and Drug Administration for software verification and quality assurance to ensure proper performance. In addition, the computer scientist, in cooperation with the medical physicist, should test any software providing quantitative data from medical images to ensure the accuracy of the data.

ARCHITECTURE

Depending on the size of the institution, one or several peripheral vascular and interventional laboratories will be required. The facility should be self-contained, with the laboratories and support space constituting a definable entity.

Department Layout

Laboratory. An angiographic and interventional suite must have adequate space for radiographic equipment, ancillary and monitoring equipment, and any emergency care equipment as well as adequate space for patient access and care during the procedure. The optimum size is 700 ft², not including the control room. Oversized lead-lined doors are required at patient entrance and exit points, with a minimum door width of 48 in. The ideal ceiling height is 12 ft, with at least a 3-ft mechanical access space above the ceiling. This ceiling height permits adequate focal spot-to-patient distance and focal spot-to-film distance for long-leg cut film imaging. In newly constructed facilities the ceiling should be washable. The facility should be equipped with the following utility features:

1. Three-phase 220V and 440V AC power with a minimum of 100 amperes per phase
2. Hot and cold water in the room

with a scrub sink in or very near the room

3. A "dirty" sink just outside the room
4. Suction and 100% oxygen-any inhalational anesthetic gases needed may be brought on the anesthesia cart, and a scavenging system for medical gases may be appropriate
5. A ceiling-mounted surgical light
6. Fully rheostated ceiling lights for infinite control of the room lighting during fluoroscopy (fluorescent lighting does not provide the range of lighting adjustments required in these rooms, and fluoroscopic activation of dimming is desirable)
7. Ample counter and cupboard space in the room for preparation of equipment and materials used during a procedure, and glass-fronted storage cabinets on the available free wall space
8. Sealed floor and walls; or the floor and walls should have a continuous, hard, washable surface (floor electrical troughs should be avoided whenever possible to allow for appropriate cleaning)
9. Adequate electrical receptacles around the room and angiographic table for ancillary equipment.

Because of the increase in scope of interventional procedures and the imminent availability of stented grafts, new facilities should conform to Association of Operating Room Nurses standards (33).

Control Room

Ideally, at least 120 ft² are provided for this area. The design should allow ready access to all instrumentation. The control room should have leaded glass to allow visual communication with the laboratory. Blinds should be considered to inhibit viewing when necessary. A two-way intercom system is essential.

Equipment Room

Transformers, power modules, and other related electrical equipment may be placed in the procedure room, the control room, or, preferably, in a sep-

arate, cooled room with adequate air flow around the electronics cabinets and computer flooring. If placed in the control room or the laboratory itself, the equipment should be enclosed in a space with adequate cooling and ventilation. There should be adequate access for maintenance. If equipment is placed in the control room, the room should be appropriately larger.

The equipment should be positioned so that high voltage cables do not exceed 50 ft in length. Ready access to the equipment should be provided, and the room should be fully air conditioned. The recommended size for the equipment room is 80 to 100 ft².

Recovery Room

A recovery room should be in close proximity to the laboratory. The area should be divided into individual patient bays with at least one more bay than the number of laboratories. At least 60 ft² should be allocated for each bay. Monitoring equipment that can be readily used in each bay should be available (see "Monitoring Equipment").

Storage Room

Adequate storage space for catheters, wires, and other equipment is essential. Each peripheral vascular and interventional laboratory should have ample in-room storage space for frequently used catheters, wires, interventional devices, and ancillary support equipment. The out-of-room storage space should be at least 250 ft² per procedure room. The storage space should be close to each laboratory.

Ancillary Space

The procedure, control, equipment, storage, and recovery rooms do not constitute a total functioning laboratory unit. Additional support space is required. The following facilities should be available in the immediate vicinity:

- Waiting and holding areas
- Dark room
- Reception area
- Changing rooms for outpatients and staff
- Viewing and reporting area

- Ancillary film file room
- Office space for the director, staff, and allied health personnel
- Storage space for general supplies, linen, etc
- Soiled-laundry utility room
- Secretarial resources
- Blood gas and coagulation factor area

Additional facilities may be shared with other services at more remote locations:

- Conference room
- Library and study room
- Room for teaching aids and files
- Additional office space
- Staff lounge
- Janitorial space
- Equipment storage

These requirements are similar to those in the ACC/AHA guidelines for cardiac catheterization and cardiac catheterization laboratories (4).

Air Conditioning

A professional engineer with expertise in heating, ventilation, and air conditioning should review all plans for the facility. Heat generated by each piece of equipment in the suite should be considered, as should the maximum number of staff working in the room. Potential additional equipment for the suite and increased heat loading that will result from the addition of equipment should be anticipated. There should be adequate capacity for humidification and dehumidification of the facility.

Three factors are important in determining air-conditioning requirements. Cooling of 3 to 4 BTU per hour should be provided for every cubic foot of interior space. In addition, 400 to 1500 BTU per hour should be added for each person continuously present in the room. For equipment that generates heat, the number of BTUs per hour is determined by multiplying the kilowatt-hours of the equipment by 3420. The total load is the sum from these three calculations. In general, the air-conditioning units should have a capacity 30% to 50% greater than needed. Air-conditioning units are often specified in tons of cooling capacity; one ton equals 12 000 BTUs per hour. A laboratory would typically require 40 000 to 70 000 BTUs of cooling per hour.

A comfortable environment, in

terms of both temperature and humidity, should be maintained. The humidity must be maintained between 45% and 55% to prevent static discharge problems on the films and to ensure that the film transport systems function properly.

EQUIPMENT

X-ray Stand

The stand should be a C- or U-type, able to rotate around the patient in both the axial and sagittal planes. The stand should be motor driven, and the angle in each plane should be displayed. Manual override is essential. The mounting should be counterbalanced with the ability to vary the source-to-image receptor distance. Locks should be provided. The C-arm should be a size sufficient for easy access to the patient and should allow performance of procedures from the jugular vein or the axilla as well as the customary femoral and peripheral access sites. The stand should swing away from the patient for access in an emergency. The C-arm should be mounted with a 14-in (36-cm) or larger image intensifier interfaced with a video camera. At present a film changer should be mounted on the stand; in the future this will almost certainly be replaced by digital filming. A 100-mm or 105-mm camera coupled to the image intensifier significantly decreases both the radiation per film and, typically, the study time but increasingly is being replaced by modern digital units.

Table

The table may be ceiling- or floor-mounted. The table (or C-arm) should "step" unless an additional long-leg changer is to be used. The table should rapidly swing out from under the stand for easy access to the patient. The table should have a carbon fiber top with a weight limit of at least 140 kg.

Radiation Source

Generator. The generator should be either a three-phase, 12-pulse generator or a high-frequency inverter generator with a power rating of 80 to 100

kW. A compact, modern generator with self-diagnostics is desirable.

Pulsed progressive fluoroscopy at 30 pulses per second with the image displayed at 60 fields per second reduces the radiation exposure by 30% to 50% and is therefore desirable.

X-ray tube. A dual (0.6-mm and 1-mm or 1.2-mm) or a trifocused (0.3-mm, 0.6-mm, and 1-mm or 1.2-mm) x-ray tube with focal spot sizes as indicated is recommended. The x-ray tube heat capacity should be at least 800 000 to 1 million heat units. The recommended x-ray tube housing heat capacity is at least 1.7 million heat units. The kilowatt rating of the x-ray tube should match the generator chosen and should be 80 to 100 kW for the large focal spot size. There should be an x-ray tube heat monitoring system as a constant reminder of the heat capacity limitations. To avoid anode cut-off, the anode angle should be at least 12° to 13° to accommodate the serial film changer and large-field-of-view image intensifier. A high-speed rotor with a diameter of at least 6 in (15 cm) should be provided, as should a heat exchanger that cools at the rate of at least 100 000 heat units per minute.

Image Receptors

Angiographic and interventional laboratories need rapid serial film imaging and, for peripheral studies, a "stepping" top table or C-arm or an additional long-leg film changer.

Digital imaging technology has become increasingly important in the past few years. With the introduction of high-resolution gray-scale imaging digital systems, far superior to first-generation units, this technology has been increasingly accepted as a standard feature in current diagnostic and interventional laboratories. Almost every unit sold today is equipped with digital equipment. The real-time availability of digital images without the delay of conventional film processing is a major advantage, and there will be additional benefits when digital manipulation and transmission become readily available. The remaining obstacle is digital archiving, and it is likely that in 5 years, if not before, an all-digital laboratory will be feasible.

Nevertheless, for the present, a serial, large-film capability is essential. Even if digital imaging is to be used,

14 in (36 cm) is the minimum diameter recommended for the image intensifier. Sixteen-inch (41-cm) intensifiers are currently available, and larger intensifiers are being developed. The width of the pelvis and the length of the peripheral vascular system make multiple injections necessary to cover the whole system. A 9-in (23-cm) intensifier would impose a significant additional contrast load and an increased radiation dose, both to the operator and the patient. If a 9-in intensifier is to be used for fluoroscopy, the imaging requires a rapid serial film changer and film screen technique. Furthermore, in the extremities, slow distal flow may require prolonged filming, sometimes on the order of 30 to 60 seconds, which is beyond the scope of cine filming. Even if possible, cine filming would impose an unreasonable radiation dose on both operator and patient.

Film Changer

Serial film changer and film. The serial film changer should have a film size of 14x14 in² (36x36 cm²) and be capable of holding 20 to 30 films. It should have a selectable, digital programming unit able to film for a 40-second period at variable rates up to at least three films per second. The selected program should be key entered and should be displayed. The film/screen system should have 600 to 800 speed with a high-contrast film, and quantum mottle should be minimal. The average film gradient should be at least 3.0 and the maximum film density should be at least 3.5 density units. The screen should be cleaned at least monthly. As digital imaging becomes more acceptable, a film changer detachable from the x-ray stand would be desirable. Currently, the film changer should be mounted on the x-ray stand.

Long-leg changer. These devices remain a matter of preference. An alternative is a rapid serial film changer and a moving-top table or a stepping gantry.

Because a superficial femoral artery occlusion may back-fill via collaterals, and because delayed filming may demonstrate the length of the occlusion to be shorter than it appears on images made on a moving-top table, long-leg changers are advantageous

because they film the whole of the extremity with each exposure. A suitable compensation filter system should be used to minimize density variations when filming the legs. A modern system uses rotating vanes. The disadvantages of long-leg changers are the lack of available collimation (and hence increased scatter), the size of the device, and the requirement of an additional x-ray tube.

Image Intensifier

The image intensifier should be of the large-field-of-view (14 to 16 in) (36 to 41 cm) variety with three or four modes of magnification. The input phosphor should be cesium-iodide with a titanium window to reduce radiation dose. The conversion gain should be greater than 250 candelas per meter squared per milliroentgen per second measured at 80 KVP (kilovolt peak). The spatial resolution should be at least 2.5 line pairs/mm in the 14-in (36-cm) field of view, 3.3 line pairs/mm in the 9-in (23-cm) field of view, and 4.6 line pairs/mm in the 6-in (15-cm) field of view. Vignetting and nonlinear distortion should be minimal. The image intensifier should be able to visualize a 1/16-in (1.6-mm) hole in a 1-mm aluminum plate contained within a 38-mm-thick aluminum penetrometer. The contrast ratio of the intensifier should be at least 20:1. The veiling glare should be greater than 85%. The system should have automatic brightness control.

Television Chain

Ideally, both the television camera and the monitor should display 1000 raster lines per frame. Flicker-free, high-refresh rate systems are reaching production. The spatial resolution should be equal to or greater than 1.2 line pairs/mm in the 14-in (36-cm) mode, 1.8 line pairs/mm in the 9-in (23-cm) mode, and 2.6 line pairs/mm in the 6-in (15-cm) mode. Television monitors should measure 17 in (43 cm) or more on the diagonal and should have an antiglare coating. The signal-to-noise ratio for the television camera should be more than 1000:1. The system should have a frequency band pass of at least 20 MHz. Lag should be limited. The system should have circular blanking, white compression, dy-

namic range compression, and uniformity corrections.

Digital Subtraction and Acquisition

Digital imaging capabilities should be included in all peripheral vascular and interventional suites.

The system should have a 1024x1024 image matrix and a monitor capable of displaying this matrix. The system should also be able to display compressed images on a 512x512 matrix. It should be operable in both the fluoroscopic and pulsed radiographic modes with scanned progressive readout and should have a freeze-frame mode. The system should be able to acquire and display at least five frames per second in the 1024x1024 mode. Data storage and display should be available in both linear and logarithmic format with a minimum of 10 bits/pixel storage from the analog to digital converter. The console should have both an image display and a text monitor, and a second image display monitor should be located inside the procedure room. The analysis console should have an alphanumeric keyboard, function buttons, a region-of-interest cursor, window level and width controls, and image management functions. A second control console should be available in the procedure room. A handheld control device is ideal. A multiformat laser camera should be used to obtain hard copies of the images.

The unit should contain at least 500 megabytes of CPU. The storage device should be capable of storing at least 4000 compressed images and have a retrieval time of less than 1 second per image. A 2-gigabyte digital optical disc drive may be useful for long-term storage.

The unit should have automatic selection of exposure techniques. An automatic iris device to moderate light output from the image intensifier should be part of the digital system. Entrance exposure into the image intensifier should be less than 1 mR/frame for high-quality digitally subtracted images.

The unit should have the following capabilities:

- Frame averaging to form masks
- Post-image acquisition enhancement (smoothing and edge enhancement)

- Histogram creations
- Pixel shifting for reregistration
- Annotation
- Cine display
- Flow measurements and profiles
- Windowing
- Contrast and brightness adjustments
- Region-of-interest and distance measurements
- Roadmapping
- Stenosis quantification
- Vessel size determination
- Image management functions

The unit should also be capable of resolving a 0.4-mm vessel with 1% iodine contrast. The high-contrast spatial resolution should be comparable to the television system spatial resolution and should be at least 2.5 line pairs/mm in the 6-in (15-cm) field of view. The dynamic range of the system must be at least 1000:1, and the radiographic mottle should be acceptable to the operating physicians. Time jitter and lag in the system should be minimal to permit dynamic studies to be accurately evaluated.

The digital monitor is a good location for the display of additional information such as intraluminal ultrasound. In the future, simultaneous viewing of multiple images from different modalities will become commonplace. This will be developed first at the workstation, but it will also be desirable in the procedure room.

BEAM MODIFICATION DEVICES

Grids. Standard grids prevent some of the scattered x-rays from entering the image intensifier, so the patient entrance exposure must be increased by a factor of about two to compensate for the loss of these photons. The additional radiation also results in about twice the additional scatter radiation exposure to the operator. For this reason it has been suggested that grids be removed for patients in whom the scatter radiation does not significantly degrade image quality and in whom the highest quality fluoroscopy is not required (34). Carbon fiber grids, by nature of their construction, maintain the improved image quality associated with standard grids with only a 60% dose increase. Procedures requiring both high resolution and contrast can benefit from the use of a grid; the carbon

fiber grid is a reasonable compromise. It is desirable that it be easily removed. A 6:1 to 10:1 grid ratio is recommended for the image intensifier. The focal length of the grid should match the source-to-image receptor distance of the unit. A similar grid would be suitable for the serial film changer.

Filters. Federal regulations specify a minimum half value layer of 2.3 mm of aluminum at 80KVP. However, the radiation dose can be reduced by adding additional filtration to the x-ray tube without significantly degrading image quality. Metals with atomic numbers less than 42 are as acceptable as aluminum. Usually 2 mm of aluminum or other equivalent material can be added to the minimum filtration provided by the manufacturer. By increasing the half value layer to 3 mm of aluminum, the entrance exposure rate can be reduced by approximately 30% without degrading image quality or increasing the x-ray tube heat loading substantially.

Collimators. The collimators should be adjusted so that the edges are just visible inside the fluoroscopic image. Because digital imaging is becoming more and more important and ultimately will replace conventional filming, additional iris or rectangular collimation is necessary. Rotating collimators should be provided to replace external devices used to administer boluses.

Automatic gain and iris control. Both features contribute to reduced patient exposure and are desirable. Automatic gain control of the video camera allows greater penetration for less exposure, and automatic opening of the iris allows additional light into the camera. Both, however, result in noisier images.

Contrast Injector

Power injectors should be capable of very slow injection rates as well as injection rates up to 50 mL/s. They should be flow rate-controlled but should have a mechanical stop and a pressure limit control. The syringe should be electrically isolated, the injector should have a ground cable attached to the patient support ground, and there should be an audible warning sound with current flows of more than 20 μ A. The syringe should be

transparent and disposable and should have an electric heater to maintain the contrast temperature at 37°C.

Physiologic Monitoring

A mechanism for monitoring the patient's blood pressure and cardiac rhythm is necessary for the safe performance of angiography. Intravascular pressures are most commonly recorded from fluid-filled catheters connected to strain gauge transducers. Transducers should have a linear response from -10 to 400 mm Hg. Two pressure channels and two ECG channels should be available, and a strip chart readout is desirable, as are a junction box and underfloor cabling. Currently, the waveforms are displayed on a separate oscilloscopic monitor. Ideally, they should be displayed full size on the fluoroscopic monitor when it is not in use and should be compressed to the bottom of the monitor when fluoroscopy is on.

Intravascular Imaging

Intravascular ultrasound. Intravascular ultrasound has been demonstrated to provide accurate diagnostic information about atherosclerotic occlusive disease (35). By providing real-time, two-dimensional, cross-sectional images of the vessel wall, it allows better determination of the extent of disease and the true extent of luminal compromise (36). Intravascular ultrasound provides detailed differentiation of the vessel wall layers, a unique characteristic (37). It also may allow more accurate determination of the end point in complex interventions such as percutaneous atherectomy and intravascular stent deployment (38). Images may be further enhanced by three-dimensional reconstruction. Accurate measurements of luminal diameter and cross-sectional area may be made with intravascular ultrasound, and there is promise of further development of tissue characterization.

Although the technology has improved rapidly, the limitations of intravascular ultrasound include the prolonged catheter time and the additional expense of catheters and capital equipment. The technology is a useful adjunct to angiographic equipment and, though not essential, it is proba-

bly desirable for the optimal environment.

Angioscopy. Some investigators feel that the use of percutaneous angioscopy can be beneficial. The miniaturization of fiber-optic devices has produced catheters as small as 4Fr. The advantages of angioscopy include visualization of the luminal surface, differentiation of thrombus from plaque, and the ability to directly guide endovascular devices.

Visualization is dependent on the displacement of blood, which is generally accomplished by a continuous, high-volume fluid infusion. This can result in the use of a high volume of fluid, which limits the visualization time. Because optimal visualization occurs in an occluded environment, angioscopy has only limited applications for percutaneous procedures.

CONTINUOUS QUALITY IMPROVEMENT

Personnel

The Joint Commission on the Accreditation of Health Care Organizations mandates that every health care institution have an ongoing quality improvement program to monitor itself and ensure that a high level of quality care is provided. The accreditation manual states that a departmental quality assurance program must "... objectively and systematically monitor and evaluate the quality and appropriateness of patient care, pursue opportunities to improve patient care and clinical performance and resolve identified problems" (39). The essential steps of monitoring and evaluating a continuous quality improvement program are summarized below.

A qualified person should assume responsibility for the monitoring and evaluation of quality in the department. Although the overall responsibility must rest with the physician, he or she may delegate duties to appropriate technologists, nurses, or administrative staff, who in turn must fully incorporate the interventional program into the remainder of the hospital's quality improvement efforts.

The person responsible for quality assurance must identify important aspects of care related to the procedures performed that have measurable outcomes: eg, the success rate of crossing

and performing a primarily successful angioplasty. These data should be collected not only for the whole department but for each physician. It may also be appropriate to report long-term follow-up (40). Suitable reporting standards have been described for peripheral vascular disease (41).

The department should also identify complications pertinent to a particular procedure (eg, hematoma formation after catheterization as well as other relevant morbidities) and, again, report these not only for the whole department but for each operator.

These data should be collected from the facility and compared with national norms. In many instances these have been established by standards-of-practice documents so that standards may be set for the performance of each physician and the department as a whole (12). Another relevant document provides guidelines for establishing a quality assurance program in vascular and interventional radiology (35). It expands considerably on the comments above. Most standards-of-practice documents allow sufficient latitude to permit local adjustment to reflect regional practice differences. With this information, the practitioners and personnel in the facility may compare their performance to outside norms so that care can be improved and this improvement documented (39,42).

Database software to aid in gathering information for the assessment of quality is becoming increasingly available, and some medical organizations have developed peer programs tailored to the needs of interventional departments. Such databases should be considered a supplement to the presence of appropriately trained personnel with a commitment of medical staff leadership to support the assessment and assurance of quality care.

Equipment

Quality control charts should be maintained on the x-ray equipment and photographic processors because this method of data recording allows for early detection of drifts in operating levels. The responsible staff radiologist and technologist should review these data at least quarterly with the people collecting and interpreting data. In addition, all quality control

data should be reviewed by the medical physicist at least semiannually.

The responsible technologist should be familiar with the National Council on Radiation Protection and Measurements (NCRP) document entitled *Quality Assurance for Diagnostic Imaging Equipment* (43) and with the types of quality control tests that should be performed, the frequency of those tests, and a general idea of quantitative data that should be considered "reasonable."

Photographic processors. Daily sensitometric testing of the processor should be performed to ensure proper and consistent film processing conditions, and a quality control chart should be maintained to detect subtle changes and drift in the film processing conditions. Weekly cleaning and regular preventive maintenance should be performed.

X-ray equipment. Daily testing of the fluoroscopic imaging system is necessary. Fluoroscopic image evaluation should include assessment of spatial resolution, image sharpness, and the visibility of low-contrast objects. This information, including the exposure factors, should be recorded to enable comparison with past and future data.

Physics test equipment. Instruments should be available to the physicist(s) to perform routine quality control measurements, radiation protection evaluations, and regulatory compliance assessment on the generator, x-ray tube, and image quality. Equipment for measurement of the ionizing radiation output should also be available.

PATIENT SAFETY

Electrical

Patients are connected to, and may come in contact with, numerous pieces of electrical equipment that have the potential to produce a low-impedance electrical pathway that may cause cardiac arrhythmias. Such problems can be prevented by proper design of the electrical system.

The facility should have a safe electrical primary wiring system; proper electrical isolation of all equipment attached to the patient; an equipotential, hardwired, grounding system for all equipment; and an effective, periodic

(at least quarterly) inspection program for the electrical system. Measurements of electrical current leakage between all pieces of equipment that are attached to the patient and that may come in contact with the patient should be made during these quarterly inspections. The responsible physicist must keep abreast of evolving guidelines to ensure that the facility meets these standards. Electrical safety checks should be reviewed at least annually by a qualified medical physicist.

Mechanical

Mechanical safety checks must cover all aspects of every piece of equipment in the vascular and interventional facility, and defective equipment should be replaced immediately. Safety checks should be reviewed at least annually by a qualified medical physicist.

Radiation Safety

Because no exposure to ionizing radiation can be considered absolutely safe, the National Council on Radiation Protection and Measurements has established guidelines for occupational radiation exposure that are encompassed by the phrase "as low as reasonably achievable" (44). Furthermore, the council has established guidelines for maximum permissible occupational exposure levels (45). There are no maximum dose limits for patients undergoing diagnostic studies using ionizing radiation, because the immediate medical benefit is assumed to outweigh the potential radiation risk (45). The interests of optimum radiation safety, however, are best served when the vascular and interventional laboratory operates under the "as low as reasonably achievable" philosophy with respect to both patient and personnel exposure (46).

The cornerstones of minimizing radiation dose are minimizing exposure time, maximizing distance from the x-ray source, and using appropriate shielding. For angiographic and interventional radiologic procedures, however, in which fluoroscopy is used extensively, distance cannot be altered much: the patient must be close to the x-ray tube and the primary operating physician must be close to the patient.

Therefore, in practice, optimization of radiation safety in the peripheral and interventional laboratory means minimizing fluoroscopy time and maximizing shielding.

Minimizing Radiation Dose to the Patient

The key to minimizing patient radiation dose is to limit the amount of radiation, particularly fluoroscopy (47), needed to accomplish the interventional procedure. Anything that contributes to decreased exposure time, decreased exposure rate, and decreased exposure area will contribute to decreased radiation dose to the patient.

Specific equipment features. NCRP recommendations for the design of structural shielding (48) and x-ray equipment (49) should be followed. A spacer should be affixed to the output side of the x-ray tube to prevent the table (and patient) from resting directly on the x-ray source. The grid should be detachable and should be removed for procedures that do not require high spatial resolution. Pulsed progressive fluoroscopy, which can decrease patient radiation dose by 30% to 50% compared with standard continuous fluoroscopy, should be available. Last image hold of the fluoroscopic image, as well as rotating lead collimators with manual hand controls within easy access of the operator, should be standard.

Federal regulations regarding maximum fluoroscopic radiation exposure rates must be followed. If high-level control fluoroscopy is available, activation should require specific, separate initiation by the physician; activation of high-level control fluoroscopy by a single two-stage foot pedal is not advisable (50). Activation of this fluoroscopic mode must be accompanied by a continuous audible signal, and the output of the x-ray tube in high level control fluoroscopy mode should be closely monitored and measured and should not exceed 20R/min.

A cumulative monitor of fluoroscopy time should be present and located in a position easily seen by the primary operator. The fluoroscopy time monitor should continuously emit an auditory signal at 5-minute intervals of elapsed fluoroscopy time until reset.

Equipment maintenance. All equipment items in the imaging chain should be maintained in optimal working order. This serves first to ensure the highest possible fluoroscopic image quality which can, in turn, contribute to lowered patient dose by resulting in decreased fluoroscopy time and decreased need for filming. In addition, equipment maintenance can ensure that optimum imaging is being accomplished with the lowest possible radiation output.

Endoluminal equipment. Radiopacity should be one consideration in choosing catheters, guidewires, and other devices for use in interventional procedures. Use of endoluminal tools that are not easily seen on the fluoroscopic image can contribute to prolonged fluoroscopy time.

Operator-controlled factors. All angiographic and interventional physicians must have documented training in radiation physics, radiation biology, and radiation safety. All angiographic and interventional physician trainees should practice only under the supervision of a fully qualified physician. In addition, all physicians should be familiar with the specific features of each piece of x-ray equipment they use to minimize patient and operator dose.

Record keeping. The fluoroscopy time and KVP for each case should be recorded.

Minimizing Radiation Dose to Personnel

Fluoroscopy is the major source of occupational radiation exposure (46). The primary operating physician is most at risk of receiving the maximum occupational dose. Minimizing patient radiation dose will help lower operator dose (51).

When positioned under the table, the x-ray tube will minimize backscatter radiation to the operator's head and neck (52). Fluoroscopic equipment with an overtable x-ray tube is not appropriate for peripheral vascular and interventional laboratories. Long-leg changers have a tube above the table, but these are cut film units only.

Because the staff must be close to the x-ray tube and patient during fluoroscopy, the following shielding devices must be available:

Lead aprons. Lead aprons provid-

ing at least 0.5 mm lead equivalent thickness are necessary for all staff present in the laboratory during procedures. It is recommended that full-time physicians, technologists, and nurses wear custom-fitted aprons to ensure optimum coverage and maximum comfort. A wraparound style is recommended (51). Extra aprons should be available for visitors to the interventional suite, particularly anesthesia personnel, nursing staff, residents, and students.

Maternity aprons providing 1.0 mm lead equivalent thickness to the abdomen front and sides must be available to pregnant workers, especially to full-time physicians who can receive under-lead doses approaching 5 mSv/y (the NCRP-recommended maximum for gestational exposure (45)) with 0.5 mm lead equivalent coverage (53). Like standard aprons, maternity aprons should be custom-fitted for full-time workers. The 1.0 mm lead equivalent thickness provides only a little more protection than 0.5 mm, but this is likely to be perceived as important.

Supplemental shielding devices. Supplemental lead shielding to the head and neck is advisable for the primary operating physician who may have yearly external over-lead (ie, collar badge readings) radiation doses well above the maximum permissible dose of 50 mSv in a single year or 10 mSv/y averaged over a lifetime (53). Reported doses to technologists and nursing staff are much lower, and supplemental shielding devices are not absolutely necessary for these workers (54–56). Doses to anesthesia personnel can be higher (55). Because personal perception of risk varies so much (57), it may be necessary to provide the items listed below to all members of the laboratory upon request, but they are not a substitute for education about radiation protection.

Thyroid collars. If the customized apron does not shield the thyroid gland, the primary operator should wear a thyroid collar. (See "Leaded Face Shields" and "Ceiling-Suspended Leaded Glass Shields" for alternatives.)

Leaded glasses. The lens of the eye is the critical organ not covered by the lead apron (45). Maximum yearly recommended dose to the lens is 150 mSv (15 rem) (45), a dose approached by

busy interventional physicians (53). Therefore, full-time angiographic and interventional physicians should wear leaded glasses with side shields. These can be incorporated into goggles designed for body-fluid shielding. Like the lead aprons, the glasses should be custom-fitted. (See "Leaded Face Shields" and "Ceiling-Suspended Leaded Glass Shields" for alternatives.)

Leaded face shields. An alternative to glasses and thyroid collars are head-mounted or shoulder-mounted leaded face shields. These provide both radiation and body-fluid protection.

Leaded gloves. Because the NCRP-recommended maximum permissible dose to the extremities is 500 mSv/y (45), lead glove protection is optional. These gloves are thicker than standard surgical gloves and should not be worn if they interfere with the technical demands of the physician's task. They only reduce skin dose by about 10% to 20%. The best way to minimize operator hand dose is to use tools designed to keep the hands as far from the primary x-ray beam as possible.

Ceiling-suspended leaded glass shields. Each room should be equipped with a ceiling-suspended leaded acrylic shield (providing at least 0.5 mm lead equivalent protection) that can be placed in front of the operator's face. This can be used in addition to, or instead of, other head and neck shielding. The boom should be mounted on a ceiling track, available for use on both sides of the table as well as at the head. The angiographic and interventional laboratory director should be consulted about the design and placement of the shield at the time the room is being designed. These items are frequently underused because they do not serve the needs of the operating physicians with respect to flexibility of placement and angulation (53).

Other leaded shields. Leaded acrylic shields (providing at least 0.5 mm lead equivalent protection) that can be moved around the floor on wheels should be available (58,59). Appropriate storage racks for lead aprons, thyroid collars, glasses, and face shields should be available in or in close proximity to the laboratory. A regular schedule should be followed to check lead shielding devices for

cracks. Defective shielding items should be repaired or replaced promptly.

Personnel dosimetry. Radiation safety is best managed when the radiation safety officer understands angiographic and interventional procedures and is considered an integral part of the team.

State regulations on personnel dosimetry, including location of dosimeter badges, must be followed. All personnel who work full-time or regularly in the laboratory (eg, anesthesia staff) must wear at least one assigned film badge or thermoluminescent dosimeter. The badges should be read monthly and the results reported to the workers. Doses that exceed monthly or quarterly maximums should be investigated by the radiation safety officer.

Ring badges should be available on request and are recommended for physicians who exceed monthly or quarterly radiation exposure limits as measured by the collar dosimeter. If a ring badge is worn, it should be on the hand usually closest to the primary x-ray beam.

The pregnant worker deserves special consideration with regard to occupational radiation safety. (See above for recommendations for lead apron use.) It is the responsibility of the worker to notify the laboratory director and the radiation safety officer of her pregnancy. It is possible to ensure that the fetal radiation dose remains well below the NCRP maximum permissible doses of 5 mSv for the entire gestational period and 0.05 mSv/mo (52). According to Title VII of the 1964 Civil Rights Act, a pregnant worker cannot be forced to discontinue her standard duties (60). However, the laboratory director and the radiation safety officer must remain sensitive to the fact that personal perception of risk varies, and good-faith attempts should be made to modify the pregnant worker's duties in accordance with her risk perception if she requests a change in her job description during pregnancy. An under-apron waist dosimeter should be provided to the pregnant worker to document skin dose and provide information about her actual exposure levels.

Because angiographic and interventional procedures account for some of the highest occupational exposure lev-

els (61), personnel dosimetry practices in the interventional laboratory may exceed state regulations. Each worker should wear two badges—one at the collar outside the lead apron to register the approximate head/neck dose and one under the apron at waist level to register approximate gonadal dose. The readings of the two badges can be used to estimate (62,63) total body effective dose equivalent as recommended by the International Commission on Radiation Protection (64). Effective dose equivalent calculations provide a way to relate the risk from partial body exposure to equivalent whole-body dose. Therefore, effective dose equivalent calculations may provide a more accurate estimation of radiation risk to partially shielded workers than does the dose to a point dosimeter. In the future, estimated effective dose equivalent rather than point dosimetry (ie, collar badge readings) may be used for monitoring by state regulatory agencies.

Recommendations for occupational exposure to low linear energy transfer radiation are evolving as a result of a report in which it was concluded that the ill effects of low linear energy transfer radiation are two to four times more significant than was previously believed (65). The ICRP has lowered its recommended maximum yearly total body effective dose equivalent from 50 mSv/y to 20 mSv/y for people whose occupations expose them to radiation (64). NCRP recommendations on permissible occupational exposure (44) are used as guidelines by state regulatory agencies in the United States, but not all states have produced legislation in response to this new information. Nevertheless, meticulous attention to radiation safety issues is becoming increasingly important in the practice of angiographic and interventional medicine, and the requirements for optimum resources may change as regulations change.

References

1. Report of the Inter-Society Commission for Heart Disease Resources. Optimal radiologic facilities for examination of the chest and the cardiovascular system. *Circulation* 1971; 43:A-129-A156.
2. Judkins MP, Abrams HL, Bristow JD, Carlsson E, Criley JM, Elliott LP, Ellis KB, Friesinger GC, Greenspan RH, Vi-amonte M Jr. Report of the Inter-Society Commission for Heart Disease Resources. Optimal resources for examination of the chest and cardiovascular system: a hospital planning and resource guideline. *Circulation* 1976; 53:A1-A37.
3. Friesinger G, Adams DF, Bourassa MG, Carlson E, Elliott LP, Gessner IH, Greenspan RH, Grossman W, Judkins MP, Kennedy JW, et al. Examination of the Chest and Cardiovascular System Study Group. Optimal resources for examination of the heart and lungs: cardiac catheterization and radiographic facilities. *Circulation* 1983; 68: 891A-930A.
4. American College of Cardiology/American Heart Association Ad Hoc Task Force on Cardiac Catheterization: Pepine CJ, Allen HD, Bashore TM, Brinker JA, Cohn LH, Dillon JC, Hillis LD, Klocke FJ, Parmley WW, Ports TA, et al. ACC/AHA guidelines for cardiac catheterization and cardiac catheterization laboratories. *Circulation* 1991; 84:2213-2247.
5. Katzen BT. Optimal resources for peripheral vascular intervention. *Circulation* 1991; 83(suppl II):II-43-II-45.
6. Levin DC, Becker GJ, Dorros G, Goldstone J, King SB III, Seeger JG, Spies JB, Spittell JA Jr, Wexler L. Training standards for physicians performing peripheral angioplasty and other percutaneous peripheral interventions: a statement for health professionals from the Special Writing Group of the Councils on Cardiovascular Radiology, Cardio-Thoracic and Vascular Surgery, and Clinical Cardiology, American Heart Association. *Circulation* 1992;86: 1348-1350.
7. The Society for Cardiac Angiography and Interventions, Interventional Cardiology Committee, Subcommittee on Peripheral Interventions. Guidelines for performance of peripheral percutaneous transluminal angioplasty. *Cathet Cardiovasc Diagn* 1990; 21:128-129.
8. American College of Cardiology Peripheral Vascular Disease Committee: Spittell JA Jr, Nanda NC, Creager MA, Ochsner JL, Dorros G, Wexler L, Isner JM, Young JR. Recommendations for peripheral transluminal angioplasty: training and facilities. *J Am Coll Cardiol* 1993; 21:546-548.
9. Standards of Practice Committee of the Society of Cardiovascular and Interventional Radiology. Angioplasty standard of practice. *J Vasc Interv Radiol* 1992; 3:269-271.
10. Standards of Practice Committee of the Society of Cardiovascular and Interventional Radiology: Spies JB, Bakal CW, Burke DR, Husted JW, McLean G, Palestrant AM, Pentecost MJ, Schwarten DE, Spencer MC, Tate CP,

- et al. Standards for interventional radiology. *J Vasc Interv Radiol* 1991; 2:59-65.
11. White RA, Fogarty TJ, Baker WH, Ahn SS, String ST. Endovascular surgery, credentialing and training for vascular surgeons. *J Vasc Surg* 1993; 17:1095-1102.
12. Pentecost MJ, Criqui MH, Dorros G, Goldstone J, Johnston KW, Martin EC, Ring EJ, Spies JB. Guidelines for peripheral percutaneous transluminal angioplasty of the abdominal aorta and lower extremity vessels. *Circulation* 1994; 89:511-531.
13. Proposed recommended practices: sanitation in the surgical practice setting. *AORN J* 1991; 54:1251-1257.
14. Rehork B, Ruden H. Investigations into the efficacy of different procedures for surgical hand disinfection between consecutive operations. *J Hosp Infect* 1991; 19:115-127.
15. Mueller K. Prevention of HIV transmission in the workplace: category II (emergency service) workers. *Am Ind Hyg Assoc J* 1991; 52:A104-A107.
16. Nichols WA. Management of occupational exposure to potential blood-borne infections: considerations for development of office procedures to handle "needlestick injuries." *Ark Dent* 1991; 62:18-22.
17. OSHA requires AIDS, hepatitis protection. *ASHA* 1992; 34:7. News.
18. OSHA mandates AIDS protection. *Caring* 1992; 11:40,42.
19. Catrini VJ. Implementing CDC HIV/HBV guidelines. *Conn Med* 1992; 56: 212. Editorial.
20. West K. The final word: OSHA's final ruling offers firm deadlines for infection control. *Emerg Med Serv* 1992; 21: 15. (See comment in: *Emerg Med Serv*. 1992; 21:40-42, 45-46.)
21. Costello L. OSHA tackles infection control. *Emerg Med Serv* 1990; 19:37-38, 40.
22. Occupational exposure to bloodborne pathogens; correction-OSHA. Final rule, correction. *Federal Register* 1992; 57:29206
23. Occupational exposure to bloodborne pathogens-OSHA. Final rule. *Federal Register*. December 6, 1991; 56:64004-64182.
24. Howard-Martin J. The new OSHA regulations on occupational exposure to bloodborne pathogens. *Healthspan* 1992; 9:18-24.
25. Bush WH. Treatment of systemic reactions to contrast media. *Urology* 1990; 35:145-150.
26. Curry NS, Schabel SI, Reiheld CT, Henry WD, Savoca WJ. Fatal reactions to intravenous nonionic contrast material. *Radiology* 1991; 178:361-362.
27. Greenberger PA, Patterson R. The prevention of immediate generalized reactions to radiocontrast media in high-risk patients. *J Allergy Clin Immunol* 1991; 87:867-872.
28. Lang DM, Alpern MB, Visintainer PF, Smith ST. Increased risk for anaphylactoid reaction from contrast media in patients on beta-adrenergic blockers or with asthma. *Ann Intern Med* 1991; 115:270-276.
29. Fisher DM. Sedation of pediatric patients: an anesthesiologist's perspective. *Radiology* 1990; 175:613-615.
30. Hurlburt BJ, Landers DF. Sedation and analgesia for interventional radiologic procedures in adults. *Seminars Interv Radiol* 1987; 4:151-160.
31. Tremper KK, Barker SJ. Pulse oximetry. *Anesthesiology* 1989; 70:98-108.
32. Windle ML. Chemical reversal of benzodiazepine toxicity. *Seminars Interv Radiol* 1987; 4:203-206.
33. Association of Operating Room Nurses. *AORN Standards of Practice*. Denver, Colo: The Association; 1993: 237.
34. Rudin S, Bednarek DR, Miller JA. Dose reduction during fluoroscopic placement of feeding tubes. *Radiology* 1991; 178:647-651.
35. Katzen BT. Current status of intravascular ultrasonography. *Radiol Clin North Am* 1992; 30:895-905.
36. Pandian NC, Kreis A, O'Donnell T. Intravascular ultrasound estimation of arterial stenosis. *J Am Soc Echocardiogr* 1989; 2:390-397.
37. Gussenhoven EJ, Essed CE, Lancee CT, Mastik F, Frietman P, Van Egmond FC, Reiber J, Rosch H, van Urk H, Roelandt J, et al. Arterial wall characteristics determined by intravascular ultrasound imaging: an in vitro study. *J Am Coll Cardiol* 1989; 14:957-962.
38. Yock PG, Fitzgerald PJ, Linker DT, Angelsen BA. Intravascular ultrasound guidance for catheter-based coronary interventions. *J Am Coll Cardiol* 1991; 17(suppl B):39B-45B.
39. Joint Commission on Accreditation of Hospitals. Monitoring and evaluation of the quality and appropriateness of care: a hospital example. *Q Rev Bull* 1986; 12:326-330.
40. Standards of Practice Committee of the Society of Cardiovascular and Interventional Radiology. Guidelines for Establishing a Quality Assurance Program in Vascular and Interventional Radiology. Reston, Va: The Society; 1993.
41. Rutherford RB, Becker GJ. Standards for evaluating and reporting the results of surgical and percutaneous therapy for peripheral vascular disease. *J Vasc Interv Radiol* 1991; 2:169-174.
42. Chopra PS, Kandarpa K, Harrington DP. Quality assurance in cardiovascular and interventional radiology. *Crit Rev Diagn Imaging* 1992; 33:183-200.
43. National Council on Radiation Protection and Measurements. *Quality Assurance for Diagnostic Imaging Equipment: Recommendations of the National Council on Radiation Protection and Measurements*. Bethesda, Md: The Council; 1988:44. NCRP report 99.
44. National Council on Radiation Protection and Measurements. *Implementation of the Principle of as Low as Reasonable Achievable (ALARA) for Medical and Dental Personnel: Recommendations of the National Council on Radiation Protection and Measurements*. Bethesda, Md: The Council; 1990. NCRP report 107.
45. National Council on Radiation Protection and Measurements. *Recommendations on Limits for Exposure to Ionizing Radiation: Recommendations of the National Council on Radiation Protection and Measurements*. Bethesda, Md: The Council; 1987. NCRP report 91.
46. Edwards M. Development of radiation protection standards. *Radiographics* 1991; 11:699-712.
47. Cascade PN, Peterson LE, Wajszczuk WJ, Mantel J. Radiation exposure to patients undergoing percutaneous transluminal coronary angioplasty. *Am J Cardiol* 1987; 59:996-997.
48. National Council on Radiation Protection and Measurements. *Structural Shielding Design and Evaluation for Medical Use of X-rays and Gamma Rays of Energies up to 10 MeV/G: Recommendations of the National Council on Radiation Protection and Measurements*. Bethesda, Md: The Council; 1976. NCRP report 49.
49. National Council on Radiation Protection and Measurements. *Medical X-ray, Electron Beam, and Gamma-Ray Protection for Energies up to 50 MeV/G (Equipment Design, Performance, and Use): Recommendations of the National Council on Radiation Protection and Measurements*. Bethesda, Md: The Council; 1989. NCRP report 102.
50. Cagnon CH, Benedict SH, Mankovich NJ, Bushberg JT, Seibert JA, Whiting JS. Exposure rates in high-level-control fluoroscopy for image enhancement. *Radiology* 1991; 178:643-646.
51. Russell JBG, Hufton AP. Lead thickness in shielding in the protection of radiodiagnostic staff. *Br J Radiol* 1988; 61:128-132.
52. Boone JM, Levin DC. Radiation exposure to angiographers under different fluoroscopic imaging conditions. *Radiology* 1991; 180:861-865.
53. Marx MV, Niklason L, Mauger EA. Occupational radiation exposure to in-

- terventional radiologists: a prospective study. *J Vasc Interv Radiol* 1992; 3:597-606.
54. Renaud L. A 5-y follow-up of the radiation exposure to in-room personnel during cardiac catheterization. *Health Phys* 1992; 62:10-15.
55. Berthelsen B, Cederblad A. Radiation doses to patients and personnel involved in embolization of intracerebral arteriovenous malformations. *Acta Radiol* 1991; 32:492-497.
56. Bush WH, Jones D, Brannen GE. Radiation dose to personnel during percutaneous renal calculus removal. *AJR* 1985; 145:1261-1264.
57. Broadbent MV, Hubbard LB. Science and perception of radiation risk. *Radiographics* 1992; 12:381-392.
58. Britton CA, Wholey MH. Radiation exposure of personnel during digital subtraction angiography. *Cardiovasc Intervent Radiol* 1988; 11:108-110.
59. Santen BC, Kan K, Velthuyse HJM, Julius HW. Exposure of the radiologist to scattered radiation during angiography. *Radiology* 1975; 115:447-450.
60. Federal radiation protection guidance for occupational exposure. Federal Register. January 27, 1987;52.
61. Hendee WR. Estimation of radiation risks: BEIR V and its significance for medicine. *JAMA* 1992; 268:620-624.
62. Faulkner K, Harrison RM. Estimation of effective dose equivalent to staff in diagnostic radiology. *Phys Med Biol* 1988; 33:83-91.
63. Webster EW. EDE for exposure with protective aprons. *Health Phys* 1989; 56:568-569.
64. Recommendations of the International Commission on Radiological Protection. Elmsford, NY: Pergamon Press; 1991; 21:1-25. ICRP publication 60.
65. Committee on the Biological Effects of Ionizing Radiations, National Research Council. Health Effects of Exposure to Low Levels of Ionizing Radiation: BEIR V. Washington, DC: National Academy Press; 1990.