1. Budget, Biographies, and Environment

1.1. Total Resource Budget

This section details the Total Resource Budget starting with the first renewal year (resource year 14) beginning August 1, 1986.

TOTAL RESOURCE BUDGET

PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: E. H. Shortliffe

DETAILED BUDGET FOR FIRST 12 MONTH BUDGET PERIOD DIRECT COSTS ONLY

FROM 8/1/86 THROUGH 7/31/87

DOLLAR AMOUNT REQUESTED (Omit cent

PERSONNEL (Applicant organization only) NAME	POSITION TITLE	TIME/EFFORT %	Hours per Week	SALARY	FRINGE BENEFITS	TOTALS
	Principal Investigator					
see attached sheet						
	SUBTOTALS →			660,335	168,940	829,275

CONSULTANT COSTS

EQUIPMENT (Itemize)

Resource host and network equipment	$14,000
Experimental Lisp Machines	$75,000

89,000

SUPPLIES (Itemize by category)

Office supplies	4,350
Computer supplies	4,250
Engineering supplies	7,500

16,100

TRAVEL	DOMESTIC	9,500	9,500
	FOREIGN		
PATIENT CARE COSTS	INPATIENT		
	OUTPATIENT		

ALTERATIONS AND RENOVATIONS (Itemize by category)

CONSORTIUM/CONTRACTUAL COSTS

OTHER EXPENSES (Itemize by category) File server maintenance: $19,200; Terminal maintenance: $1,350; Lisp Machine maintenance: $30,000; Misc. software: $1,800; Aux. computing services: $3,000; Documentation: $1,000; Books/publications: $2,650; Office telephones: $13,100; Dataphone lines: $4,000; Repro/services: $2,700; Prorated 2060 Opns Costs (80%): $347,582 — 426,382

TOTAL DIRECT COSTS (Also enter on page 1, item 7) → 1,370,257

First Year Personnel Detail

		%	SALARY	BEN	TOTAL
RESOURCE MANAGEMENT					
E. Shortliffe	Principal Invest.	15			
E. Feigenbaum	Co-Principal Inv.	10			
T. Rindfleisch	Resource Director	70			
L. Fagan	AIM Liaison/ONC Proj. Mgr.	25			
W. Yeager	Asst. Resource Dir.	90			
P. McCabe	Administrator	75			
M. Timothy	Secretary	100			
Open	Receptionist	75			
CORE SYSTEM DEVELOPMENT					
A. Sweer	Systems Pgmr.	10			
F. Gilmurray	Systems Pgmr.	70			
W. Croft	Systems Pgmr.	100			
R. Acuff	Systems Pgmr.	60			
C. Schmidt	Systems Pgmr.	60			
N. Veizades	Electronics Engr.	40			
I. Torres	Engr. Aid	40			
CORE BASIC AI RESEARCH					
B. Buchanan	Professor of Comp. Sci.	10			
B. Hayes-Roth	Sr. Res. Assoc.	15			
H. Brown	Sr. Res. Assoc.	10			
P. Nii	Res. Assoc.	10			
M. Hewett	Programmer	40			
P. Karp	Res. Asst.	62			
A. Garvey	Res. Asst.	62			
J. Brugge	Res. Asst.	62			
CORE ONCOCIN RESEARCH					
C. Jacobs	ONCOCIN Investigator	5			
R. Lenon	Clinical Spec.	25			
C. Lane	Systems Pgmr.	60			
S. Tu	Sci. Programmer	50			
D. Combs	Sci. Programmer	50			
D. Vian	Administrator	25			
J. Rohn	Data Mgr.	100			
A. Grant	Secretary	50			
T. Barsalou	Res. Asst.	62			
L. Perreault	Res. Asst.	62			
SYSTEM OPERATIONS SUPPORT					
R. Tucker	Opns. Mgr.	20			
P. Ryalls	System Mgr.	20			
	SUBTOTAL DIRECT SALARIES		660335		
	STAFF BENEFITS		168940		
	TOTAL OF PERSONNEL		829275		

TOTAL RESOURCE BUDGET PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: E. H. Shortliffe

BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD
DIRECT COSTS ONLY

BUDGET CATEGORY TOTALS		1st BUDGET PERIOD *(from page 4)*	ADDITIONAL YEARS SUPPORT REQUESTED			
			2nd	3rd	4th	5th
PERSONNEL *(Salary and fringe benefits.) (Applicant organization only)*		829,275	891,340	989,154	1,063,465	1,143,264
CONSULTANT COSTS						
EQUIPMENT		89,000	95,230	101,897	109,029	116,661
SUPPLIES		16,100	17,228	18,433	19,723	21,104
TRAVEL	DOMESTIC	9,500	10,165	10,877	11,638	12,453
	FOREIGN					
PATIENT CARE COSTS	INPATIENT					
	OUTPATIENT					
ALTERATIONS AND RENOVATIONS						
CONSORTIUM/ CONTRACTUAL COSTS						
OTHER EXPENSES		78,800	84,317	90,219	96,533	103,290
Prorated 2060 Opns		~~347,582~~	~~279,616~~	~~200,050~~	~~107,304~~	~~0~~
TOTAL DIRECT COSTS		1,370,257	1,377,896	1,410,630	1,407,692	1,396,772

TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD *(Also enter on page 1, item 8)* → $ 6,963,247

JUSTIFICATION (Use continuation pages if necessary): Describe the specific functions of the personnel and consultants. If a recurring annual increas in personnel costs is anticipated, give the percentage. For *all* years, justify any costs for which the need may not be obvious, such as equipment, foreig travel, alterations and renovations, and consortium/contractual costs. For any additional years of support requested, justify any significant increases i any category over the first 12 month budget period. In addition, for COMPETING CONTINUATION applications, justify any significant increases ove the current level of support.

1.2. 2060 Operations Budget

The budget in this section is for the projected operations costs of the 2060 mainframe system that has been the main resource for national and local users. We will be phasing this link with the past out over the 5-year term of this grant in favor of the new distributed workstation environment we plan to develop. As the first step in the phase-out, we have included 80% of the first-year 2060 operating costs in the first-year Total Resource Budget above. In future years, we include proportionately less of these costs, reducing the pro rata share by 20% per year.

2060 OPERATING BUDGET

PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: E. H. Shortliffe

DETAILED BUDGET FOR FIRST 12 MONTH BUDGET PERIOD DIRECT COSTS ONLY

FROM 8/1/86 THROUGH 7/31/87

DOLLAR AMOUNT REQUESTED *(Omit cents*

PERSONNEL *(Applicant organization only)*		TIME/EFFORT				
NAME	POSITION TITLE	%	Hours per Week	SALARY	FRINGE BENEFITS	TOTALS
	Principal Investigator					
see attached sheet						
	SUBTOTALS →			186,268	47,655	233,923

CONSULTANT COSTS

EQUIPMENT *(Itemize)*

2060 Accessories and Equipment	6,000	
		6,000

SUPPLIES *(Itemize by category)*

Office supplies	920	
Computer supplies	8,000	
Engineering supplies	1,500	
		10,420

TRAVEL	DOMESTIC	1,500	1,500
	FOREIGN		
PATIENT CARE COSTS	INPATIENT		
	OUTPATIENT		

ALTERATIONS AND RENOVATIONS *(Itemize by category)*

CONSORTIUM/CONTRACTUAL COSTS

OTHER EXPENSES *(Itemize by category)* 2060 maintenance: $92,300; DEC software maintenance: $3,950; Software licenses: $6,800; Documentation: $1,200; Books/publications: $625; Office telephones: $2,935; Dataphone lines: $14,000; Repro/services: $825; TYMNET network services: $60,000

182,635

TOTAL DIRECT COSTS *(Also enter on page 1, item 7)* → $434,478

First Year Personnel Detail for 2060 Operations

		%	SALARY	BEN	TOTAL
MANAGEMENT					
T. Rindfleisch	Resource Director	10			
W. Yeager	Asst. Resource Dir.	10			
P. McCabe	Administrator	25			
SYSTEM STAFF					
A. Sweer	Systems Pgmr.	90			
F. Gilmurray	Systems Pgmr.	30			
ELECTRONICS STAFF					
N. Veizades	Electronics Engr.	20			
I. Torres	Engr. Aid	20			
OPERATIONS SUPPORT					
R. Tucker	Opns. Mgr.	80			
P. Ryalls	System Mgr.	80			
M. Blattel	Student Oper.	47			
N. Dolhert	Student Oper.	22			
A. Jong	Student Oper.	22			
	SUBTOTAL DIRECT SALARIES		186268		
	STAFF BENEFITS		47655		
	TOTAL OF PERSONNEL		233923		

PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: E. H. Shortliffe

BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD
DIRECT COSTS ONLY

BUDGET CATEGORY TOTALS		1st BUDGET PERIOD *(from page 4)*	ADDITIONAL YEARS SUPPORT REQUESTED			
			2nd	3rd	4th	5th
PERSONNEL *(Salary and fringe benefits.) (Applicant organization only)*		233,923	251,433	270,510	290,830	312,656
CONSULTANT COSTS						
EQUIPMENT		6,000	6,420	6,869	7,350	7,865
SUPPLIES		10,420	11,149	11,929	12,765	13,658
TRAVEL	DOMESTIC	1,500	1,605	1,717	1,838	1,966
	FOREIGN					
PATIENT CARE COSTS	INPATIENT					
	OUTPATIENT					
ALTERATIONS AND RENOVATIONS						
CONSORTIUM/ CONTRACTUAL COSTS						
OTHER EXPENSES		182,635	195,420	209,099	223,737	239,396
TOTAL DIRECT COSTS		434,478	466,027	500,124	536,520	575,541

TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD *(Also enter on page 1, item 8)* ⟶ $ 2,512,690

JUSTIFICATION (Use continuation pages if necessary): Describe the specific functions of the personnel and consultants. If a recurring annual increas in personnel costs is anticipated, give the percentage. For *all* years, justify any costs for which the need may not be obvious, such as equipment, foreig travel, alterations and renovations, and consortium/contractual costs. For any additional years of support requested, justify any significant increases any category over the first 12 month budget period. In addition, for COMPETING CONTINUATION applications, justify any significant increases ov the current level of support.

Of these costs, the following are included in the resource budget:

Year 1: $347,582 (80%)
Year 2: $279,616 (60%)
Year 3: $200,050 (40%)
Year 4: $107,304 (20%)
Year 5: -0- (0%)

1.3. Budget Explanation and Justification

1.3.1. Total Resource Budget

This section explains the details of our resource budget plan over the proposed five year grant term, including both the SUMEX renewal and the merged ONCOCIN Dissemination Studies core research (see page 53). Details of the 2060 operations costs are explained in the next section.

In overview, this budget covers a portion of the resource core research and management costs, basic workstation and network environment operations costs and a prorated share of the mainframe computing facility operations costs for the local and national communities. Reviewers will note that only portions of most resource staff members are charged to this budget, the remaining salary support coming from other funding for individual core research and collaborative projects (see page 105). Also, the proposed funding for experimental Lisp machine hardware is a small fraction of the total workstation hardware investment already in place from support received from NIH, DARPA, ONR, and industrial gifts. As a benchmark of the relative magnitude (and hence leverage) of the proposed funding for this resource grant, as compared to other sources of support for this work, consider a snapshot of the year 1 budget. The proposed $1.37M direct cost funding translates to approximately $2.25M in total costs (including indirect costs) as compared to well over $6M in annual total cost funding for KSL work at Stanford. This does not include estimates of the funding base for non-Stanford collaborative users of the resource. It should be emphasized though that this DRR support of the SUMEX-AIM computing resource has been and remains an essential enabling complement to the other sources of support and makes possible the overall scope of our work.

Reviewers will also note that our 5-year budget is essentially flat, despite the inclusion of 7% annual inflation factors. This is because we have linearly phased-out requested DRR support for what has been the mainstay SUMEX-AIM resource, the DEC 2060. In the coming era of workstations, we feel it is important to withdraw support from that part of the resource, but to do so in a responsible fashion that allows time for the national community of projects to find alternative sources of computing support and for core system developments to offer alternatives for our own work and that of the national community. We budget no DRR support for the DEC 2020 demonstration machine or the shared VAX 11/780 time-sharing machine.

Indirect costs are not shown in the budget and will be awarded separately on the basis of Modified Total Direct Costs. The indirect cost rate of 69%, is based on an agreement with the Office of Naval Research (ONR) dated September 14, 1984.

Personnel

The proposed personnel budget is based on current staffing necessary for the proposed work. The estimates are derived from actual salaries for our project staff, including resource management, core research and development, and operations support for collaborative projects. The salary estimates are increased at 7% per year to cover estimated inflation. Staff benefits are computed using the following rates projected by the university for all personnel: 25.4% (9/85-8/86), 25.6% (9/86-8/87), 26.2% (9/87-8/88), 26.9% (9/88-8/89), 27.5% (9/89-8/90) and 28.1% (9/90-8/91).

Resource Management and Overall Technical Direction

Professor Shortliffe (15%) is the resource Principal Investigator, Professor Feigenbaum

(10%) is co-Principal Investigator, and Mr. Rindfleisch (70%) is the Resource Director. All three are responsible for overall resource management and contribute substantially to core research and development efforts as well. Mr. Yeager (90%) is Assistant Resource Director and has responsibility for network and workstation system development. Dr. Fagan (25%[1]) is responsible for liaison with the national AIM community and the AIM management committees and is Manager of the ONCOCIN core research project.

Ms. McCabe (75%) and Ms. Timothy (100%) provide central resource administrative and clerical support for SUMEX and community activities. We plan to hire a receptionist shared between the SUMEX and ONCOCIN/Medical Computer Science groups during the summer of 1985. This person is shown as "Open" and is budgeted at (75%).

Core System Development

The core system development staff, while sharing a substantial joint responsibility for system development, maintenance, user assistance, and operational support, have specific areas of responsibility as follows. Under the direction of Mr. Yeager, already mentioned above, the development of network virtual communications, shared task execution among cooperating workstations, and virtual graphics capabilities will be shared appropriately among staff experts for various relevant environments. In addition, Andy Sweer (10%) and Frank Gilmurray (70%) are responsible for workstation user support and subsystem development such as the merging of text and graphics from various sources and uniform access to printing facilities. William Croft (100%) is responsible for our multiprotocol UNIX file server systems, the development of IP/UDP high-performance file access capabilities, necessary modifications to local area network gateway and interface systems, and network system performance evaluation. Richard Acuff (60%) and Christopher Schmidt (60%) are responsible for Texas Instruments Explorer, Symbolics 3600, and Xerox D-machine support and development. This includes, for example, responsibility of systems support and integration within our Ethernet environment, user support, and vendor liaison. They also are responsible for development of specific system-dependent packages such as electronic mail, text and graphics generation, file management, etc.

Finally, we budget Mr. Nicholas Veizades (40%) as the project electronics engineer and Mr. Israel Torres (40%) his assistant for hardware and maintenance. Mr. Veizades and Mr. Torres are responsible for designing needed special purpose hardware (e.g., communications equipment, intermachine network hardware, and Ethernet interfaces) and for integrating new hardware into the facility, maintaining facility equipment, and correcting communication problems.

Core Basic AI Research

We continue to budget partial support for specific members of the Knowledge Systems Laboratory for core research work to explore basic AI issues relating to biomedical applications and to develop and generalize AI software tools important to the entire SUMEX-AIM community. Prof. Buchanan (10%) will provide managerial and technical direction for staff and students working on proposed core research efforts. Dr. Hayes-Roth (15%) will work on the knowledge-based blackboard control research for the BB1 system which is the tool being used by the PROTEAN project. Dr. Brown (10%) is working on issues of blackboard system design for hierarchical asynchronous

[1]During renewal years 1 and 2, Dr. Fagan is budgeted at only 25%, because part of his salary is supplemented by a New Investigator Award. During years 3-5, when the term of that award ends, he is budgeted at 55%.

concurrency and Ms. Nii (10%) is working of a retrospective of the AGE blackboard system and the ramifications of this control structure for symbolic computing architectures. Mr. Hewett (40%) is a research programmer who will work on knowledge acquisition research. Messrs. Karp, Garvey, and Brugge and graduate Research Assistants who will work on qualitative simulation, learning, and blackboard architecture research respectively.

Core ONCOCIN Dissemination Research

Dr. Charlotte Jacobs (5%) is Co-Principal Investigator on the ONCOCIN Project and is director of the Oncology Clinic at Stanford. She will continue to oversee the clinical implementation of the ONCOCIN workstations in the day-care center. Dr. Rick Lenon (25%), is a clinical oncologist in practice in the community who is dedicating some of his time to assisting with the ongoing development of the ONCOCIN knowledge base. As an expert in oncology and in clinical trials, he takes primary responsibility for the quality and currency of the knowledge base. Christopher Lane (60%) is a systems programmer responsible for integrating and adapting the network virtual communications, shared task execution, and virtual graphics work with ONCOCIN core developments and dissemination experiments. He will also do the development of other ONCOCIN core system tools such as the object-oriented system. Mr. Samson Tu (50%), is a scientific programmer responsible for the EONYX research work under Dr. Fagan's direction. Mr. David Combs (50%), is a scientific programmer responsible for the EOPAL and METAOPAL research described in the body of the proposal. Ms. Janice Rohn (100%) is the data manager and oversees the clinic operation on a day-to-day basis. She also assists in data collection analysis for evaluation of ONCOCIN. Ms. Alison Grant (50%) is secretary for the ONCOCIN Project and co-ordinates all day-to-day office activities.

System Operations Support

Mr. Tucker (20%) is the Operations Manager and is responsible as our network liaison and for technical aspects of software export and overseeing system operations and backup. Ms. Ryalls (20%) acts as the system administrator, taking care of file space and directory allocations, providing system and user support for the resource, accounting, and assisting new projects get started on the resource.

Consultant

We do not plan any consulting support this renewal term.

Equipment Purchase

$14,000 per year is allocated for minor equipment purchases for the resource including communications equipment, Ethernet interfaces, local network gateway and TIP equipment, and workstation memory. We also allocate $75,000 per year for experimental Lisp workstations to support our core system development and dissemination studies. During the first year we expect to buy 4 Xerox 6045-based machines which will market for $18,000-19,000 each. In future years we will select from available machines such as the Texas Instruments VLSI-based machine that is being developed under DARPA funding, a machine that Hewlett Packard is developing, and announcements expected from Japanese manufacturers. These machines will allow us to remain current with the rapidly developing Lisp machine market for our own system development and also to maximize the service we can provide to the national community in developing applicable software for systems that those groups may purchase. This budget is increased by 7% per year to accommodate inflation.

Supplies

Office supplies are budgeted at $4,350 based on our past experience. Computer supplies are budgeted at $4,250 projecting recent workstation operating experience and including paper, disks, tapes, labels, laser printer supplies and other supplies needed for the computer facility. Engineering supplies are budgeted at $7,500 to cover needed parts and spares for maintaining in-house equipment and developing, interfacing, and integrating new equipment. We plan for continued development of Ethernet services needed to support existing and new Lisp machines, printers, and file servers at SUMEX. We have budgeted a 7% per year increase for all supplies

Travel

The travel budget covers domestic travel for staff to professional meetings, management committee meetings, and AIM workshop meetings. We budget $9,500 total for 4 east coast trips ($1400 each), 2 midwest trips ($1,000 each), and 3 west coast trips ($633 each). Future years are inflated by 7% per year.

Other Expenses

Equipment and Software Maintenance

We budget $19,200 per year for community file server maintenance from DEC and third party vendors and $1,350 for Diablo printers and miscellaneous equipment. We budget $30,000 for Lisp machine maintenance. We have relatively little experience with these machines out of warranty but are basing this estimate on partial coverage of time and materials repairs. The contract maintenance prices for these workstations is so high per machine and multi-machine discounts are not available that T&M is a more cost-effective approach. The allocated amount provides for maintenance for 20 machines at an estimated $1,500 per machine per year average cost. We budget $1,800 for software lease costs for packages that are necessary and for which we cannot arrange free access. We have budgeted a 7% per year increase for maintenance costs.

Telephone Services

We budget $13,100 for staff office telephones, and $4,000 for dataphone services for local Stanford community dialup ports on the local network and home terminal telephones for staff and some core research personnel to maximize productive working hours (generally well in excess of 8 hours per day total). Again, these estimates are based on the current configuration of lines and average monthly charges. We periodically review these arrangements to maintain satisfactory service at minimum cost. We anticipate annual increases to average 7%.

Auxiliary Computer Services

We budget $3,000 to cover service charges for AIM community use of other Stanford campus computer resources that complement SUMEX facilities. These include partial use of the Stanford Computer Science Department Dover printer, core research use of the SCORE 2060 machine, and various services from the Stanford ITS facility. We have budgeted 7% increase for each subsequent year.

Services and Documentation

$1,000 is budgeted for current documentation on system facilities and machines and $2650 for technical books and publication expenses. $2,700 is budgeted for photo-

reproduction and various technical services based on previous experience. Each following year will reflect a 7% increase.

Prorated 2060 Operations Costs

As mentioned earlier, we plan to phase out DRR support for the DEC 2060 mainframe resource over the 5-year term of this grant. We plan to do this gradually and responsibly so that our users can relocate to other facilities or move to workstation environments for their research. For the first year we allocate $347,582 to the resource budget, which is 80% of the estimated 2060 operating costs detailed in the following section.

1.3.2. 2060 Operations Budget

This section explains the details of the 2060 operations budget for the proposed five year grant term. The figures in this section represent the *total* estimated 2060 operating costs. Only prorated shares of these costs are allocated to the resource budget as we phase-out the 2060 from our operations in favor of the workstation technologies we will be developing. The phasing is linear over 5 years with 80% of the 2060 costs charged to the resource budget in renewal year 1 (grant year 14), 60% in year 2, 40% in year 3, 20% in year 4, and 0% in year 5. As before, indirect costs are not shown in the budget and will be awarded separately on the basis of Modified Total Direct Costs. The indirect cost rate of 69%, is based on an agreement with the Office of Naval Research (ONR) dated September 14, 1984.

Personnel

Mr. Rindfleisch (10%) and Mr. Yeager (10%) are responsible for overall 2060 facility implementation and management. Ms. McCabe (25%) provides facility administrative support.

The programming staff, Mr. Sweer (90%) and Mr. Gilmurray (30%) share joint responsibility for system development and maintenance, user assistance, subsystem and utility program development, and operational support. These duties include, for example, performance analysis and improvement, bug correction, bringing up new monitor releases, system communications support, special device drivers and diagnostics, scheduler changes to control system allocation, and system maintenance. They also share responsibility for the system software such as user utilities, languages, and network utilities.

Mr. Tucker (80%) is responsible for network vendor interfaces and overseeing system operations and backup. He is assisted in providing file system archive and retrieval service and backup dumps as well as system utility programming support by 3 students (currently Blattel, Dolhert, and Jong). Ms. Ryalls (80%) acts as the system administrator, providing both system and user support for the resource.

Mr. Nicholas Veizades (20%) and Mr. Israel Torres (20%) provide electronics support for system maintenance, including special purpose, in-house designed hardware and terminal and communications equipment.

Personnel estimates are again based on current salaries and are increased by 7% per year for inflation. Staff benefits rates are the same as calculated for the main resource budget.

Consultant

We do not plan any consulting support for the 2060 operations.

Equipment Purchase

We budget $6,000 for minor equipment purchases including communications equipment, Ethernet interfaces, accessories, and other equipment replacements. This budget is increased by 7% per year to accommodate inflation.

Supplies

Office supplies are budgeted at $920 based on past experience. Computer supplies are budgeted at $8,000 projecting recent operating experience and including paper, ribbons,

disks, tapes, labels, and other supplies needed for the computer facility. Engineering supplies are budgeted at $1,500 to cover needed parts and spares for maintaining in-house equipment. We have budgeted a 7% per year increase for all supplies.

Travel

The travel budget covers domestic travel for staff to technical meetings. We budget 1 east coast trip at $1,500. Future years are inflated by 7% per year.

Other Expenses

Equipment and Software Maintenance

The 2060 hardware system is covered on a DEC maintenance contract costing $92,300 per year. We also budget $3,950 for DEC software maintenance to keep up with the latest releases and $6,800 for other software licenses, including NCPCALC, SPSS, and SCRIBE. We have budgeted a 7% per year increase for maintenance costs.

Services and Documentation

$1,200 is budgeted for providing users with up-to-date documentation on system facilities and subsystem programs. Substantial efforts continue to upgrade documentation for the user community. $625 is budgeted for technical books and publication services. $825 is budgeted for photo-reproduction and technical services. Each following year will reflect a 7% increase.

Telephone Services

We budget $2,935 for staff office telephones and $14,000 for dataphone services for local Stanford community dialup ports on the SUMEX Computer and home terminal telephones for staff to increase the hours they can work and facilitate their access to the system at off hours when problems arise. These estimates are based on the current configuration of lines and average monthly charges. We periodically review these arrangements to maintain satisfactory service at minimum cost. We anticipate annual increases to average 7%.

Network Communications Support

We budget $60,000 for continued TYMNET network services for remote SUMEX-AIM users. This amount is estimated based on projections from current experience for TYMNET services (including network interface lines, maintenance, and usage costs). In past years, these funds have been distributed directly from NIH/BRTP through the Rutgers University TYMNET contract so as to maximize the benefit of a volume discount. This may still prove to be the most cost-effective approach and we will work closely with NIH/BRTP to secure these important services at the lowest cost. We include a 7% per year inflation rate.

The SUMEX-AIM ARPANET connection costs are being borne by ARPA Information Processing Techniques Office in support of the Stanford Knowledge Systems Laboratory basic AI research contract. We expect this relationship to continue and that NIH will continue to benefit from this arrangement.

1.4. Biographical Sketches

BIOGRAPHICAL SKETCH

Give the following information for key professional personnel listed on page 2, beginning with the Principal Investigator/Program Director. Photocopy this page for each person.

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
Edward H. Shortliffe	Assoc. Prof. of Medicine	8/28/47

EDUCATION (Begin with baccalaureate or other initial professional education and include postdoctoral training)

INSTITUTION AND LOCATION	DEGREE (circle highest degree)	YEAR CONFERRED	FIELD OF STUDY
Harvard College, Cambridge, MA	A.B.	1970	Applied Math & Comp.Sci
Stanford University School of Medicine, Stanford, CA	Ph.D.	1975	Med. Inf. Science
	M.D.	1976	Medicine

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. Include present membership on any Federal Government Public Advisory Committee. List, in chronological order, the titles and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. DO NOT EXCEED TWO PAGES.

7/76 - 6/77 Intern in Medicine, Massachusetts General Hospital, Boston, MA
7/77 - 6/79 Resident in Medicine, Stanford University Medical Center, Stanford
7/79 - 2/85 Assistant Professor of Medicine, Stanford University School of Medicine
10/79- 2/85 Assistant Professor of Computer Science (by courtesy), Stanford University
1/80 - 2/85 Co-principal Investigator and Medical Liaison, SUMEX-AIM Computing Resource, Stanford University, Stanford, CA
3/85 - Associate Professor of Medicine, Stanford University School of Medicine
3/85 - Associate Professor of Computer Science (by courtesy), Stanford University
3/85 - Principal Investigator, SUMEX-AIM Computing Resource

Honors:

Editorial Boards: Medical Decision Making; Computer Methods and Programs in Biomedicine; Lecture Notes in Medical Informatics; Research Notes in Artificial Intelligence.

Research Career Development Award, NLM, 1979-1984

Henry J. Kaiser Family Foundation Faculty Scholar in General Internal Med., 1983-1986

Selected Publications

Shortliffe, E.H. Computer-Based Medical Consultations: MYCIN, Elsevier/ North Holland, New York, 1976. Japanese language version by Bunkodo Blue Books, Tokyo, 1981 (translated by T. Kaminuma).

Buchanan, B.G. and Shortliffe, E.H. Rule-Based Expert Systems: The MYCIN Experiments of the Stanford Heuristic Programming Project. Reading,MA: Addison-Wesley, 1984.

Clancey, W.J. and Shortliffe, E.H. Readings in Medical Artificial Intelligence: The First Decade. Reading, MA: Addison-Wesley, 1984.

Shortliffe, E.H., Axline, S.G., Buchanan, B.G., Merigan, T.C., and Cohen, S.N. "An artificial intelligence program to advise physicians regarding antimicrobial therapy." Comput. Biomed. Res. 6:544-560 (1973).

Shortliffe, E.H. and Buchanan, B.G. "A model of inexact reasoning in medicine." Math. Biosci. 23:351-379 (1975).

Shortliffe, E.H., Davis, R., Axline, S.G., Buchanan, B.G., Green, C.C., and Cohen, S.N. "Computer-based consultations in clinical therapeutics: explanation and rule-acquisition capabilities of the MYCIN system." Comput. Biomed. Res. 8:303-320 (1975).

Wraith, S.M., Aikins, J.S., Buchanan, B.G., Clancey, W.J., Davis, R., Fagan, L.M., Hannigan, J.F., Scott, A.C., Shortliffe, E.H., van Melle, W.J., Yu, V.L., Axline, S.G., and Cohen, S.N. "Computerized consultation system for selection of antimicrobial therapy." Amer. J. Hosp. Pharm. 33:1304-1308 (1976).

Biographical Sketch - Edward H. Shortliffe (con't)

Davis, R., Buchanan, B.G., and Shortliffe, E.H. "Production rules as an approach to knowledge-based consultation systems." Artificial Intelligence 8:15-45 (1977).

Scott, A.C., Clancey, W., Davis, R., and Shortliffe, E.H. "Explanation capabilities of knowledge-based production systems." Amer. J. Computational Linguistics, Microfiche 62, 1977.

Yu, V.L., Buchanan, B.G., Shortliffe, E.H., Wraith, S.M., Davis, R., Scott, A.C., Axline, S.G., and Cohen, S.N. "Evaluating the performance of a computer-based consultant." Comput. Prog. Biomed. 9:95-102 (1979).

Shortliffe, E.H., Buchanan, B.G., and Feigenbaum, E.A. "Knowledge engineering for medical decision making: A review of computer-based clinical decision aids." Proceedings of the IEEE, 67:1207-1224 (1979).

Shortliffe, E.H. "The computer as clinical consultant" (editorial). Arch. Int. Med. 140:313-314 (1980).

Fagan, L.M., Shortliffe, E.H., and Buchanan, B.G. "Computer-based medical decision making: from MYCIN to VM." Automedica 3:97-106 (1980).

Teach, R.L. and Shortliffe, E.H. "An analysis of physician attitudes regarding computer-based clinical consultation systems." Comput. Biomed. Res. 14:542-558 (1981).

Shortliffe, E.H. "The computer and clinical decision making: good advice is not enough" (guest editorial). IEEE Engineering in Medicine and Biology Magazine, 1(2):16-18 (1982).

Wallis, J. and Shortliffe, E.H. "Explanatory power for expert systems: studies in the representation of causal relationships for medical consultation systems." Meth. Info. Med., 21:127-136 (1982).

Gerring, P.E., Shortliffe, E.H., and van Melle, W. "The Interviewer/Reasoner model: an approach to improving system responsiveness in interactive AI systems." AI Magazine 3(4):24-27 (1982).

Suwa, M., Scott, A.C., and Shortliffe, E.H. "An approach to verifying completeness and consistency in a rule-based expert system." AI Magazine 3(4): 16-21 (1982).

Duda, R.O. and Shortliffe, E.H. "Expert systems research." Science, 220(4594):261-268 (1983).

Aikins, J.S., Kunz, J.C., Shortliffe, E.H., and Fallat, R.J. "PUFF: An expert system for interpretation of pulmonary function data." Comput. Biomed. Res., 16:199-208 (1983).

Langlotz, C.P. and Shortliffe, E.H. "Adapting a medical consultation system to critique physicians' therapy plans." Int. J. Man-Machine Studs., 19:479-496 (1983). Reprinted in Developments in Expert Systems (M.J. Coombs, ed.), pp. 77-94, London: Academic Press, 1984.

Kunz, J.C., Shortliffe, E.H., Buchanan, B.G., and Feigenbaum, E.A. "Computer-assisted decision making in medicine." Journal of Philosophy and Medicine 9:135-160 (1984).

Shortliffe, E.H. "Reasoning methods in medical consultation systems: artificial intelligence approaches." Comput. Prog. Biomed., 18:5-14 (1984).

Gordon, J. and Shortliffe, E.H. "A method for managing evidential reasoning in a hierarchical hypothesis space." Accepted for publication in Artificial Intelligence, Summer 1985.

Shortliffe, E.H. "Consultation systems for physicians: the role of artificial intelligence techniques." Proceedings of the Third National Conference, Canadian Society for Computational Studies of Intelligence, Victoria, British Columbia, 14 May 1980. Also in Readings in Artificial Intelligence, (B. Webber and N. Nilsson, eds.), Tioga Publishing Co., Menlo Park, CA, 1981.

BIOGRAPHICAL SKETCH

Give the following information for key professional personnel listed on page 2, beginning with the Principal Investigator/Program Director. Photocopy this page for each person.

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
FEIGENBAUM, Edward A.	Professor, Computer Science	January 20, 1936

EDUCATION *(Begin with baccalaureate or other initial professional education and include postdoctoral training)*

INSTITUTION AND LOCATION	DEGREE *(circle highest degree)*	YEAR CONFERRED	FIELD OF STUDY
Carnegie Institute of Technology, Pittsburgh, Pennsylvania	B.S.	1956	Electrical Enginee
Carnegie Institute of Technology Pittsburgh, Pennsylvania	Ph.D.	1959	Industrial Admin.

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. Include present membership on any Federal Government Public Advisory Committee. List, in chronological order, the titles and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. DO NOT EXCEED TWO PAGES.

EXPERIENCE

University of California, Berkeley

Associate Professor, School of Business Administration, 1964-1965
Assistant Professor, School of Business Administration, 1960-63
Research Appointment, Center for Human Learning, 1961-64
Research Appointment, Center for Research in Management Science, 1960-64

Stanford University, Stanford, California

Professor of Computer Science, 1969-
Principal Investigator, Heuristic Programming Project, 1965-
Principal Investigator, SUMEX-AIM Project, national computer resource for application of artificial intelligence to medicine and biology, 1978-1985
Chairman, Computer Science Department, 1976-1981
Associate Professor of Computer Science, 1965-68
Director, Stanford Computation Center, 1965-68
Professor (by Courtesy), Department of Psychology, 1976-

Member, Computer and Biomathematical Sciences Study Section, National Institutes of Health, Bethesda, Md., 1968-72.
Member, Committee on Mathematics in the Social Sciences, Social Science Research Council, New York, NY, 1977-78.
Member, Computer Science Advisory Committee, National Science Foundation, 1977-80
Member, Advisory Committee on Mathematics in Naval Research, NRC/ONR, 1979-82
Member, National Advisory Committee, University of Missouri Health Care Technology Center (previous)
Member, Editorial Board, Journal of Artificial Intelligence
Editor, Computer Science Series, McGraw-Hill Book Co., 1965-1979
President, American Association for Artificial Intelligence (AAAI), 1980-81
Member, Council of American Association for Artificial Intelligence (AAAI), 1979-82
Member, Council of Cognitive Science Society, 1979-82
Member, DARPA Advisory Committee

PROFESSIONAL SOCIETIES

American Association for Artificial Intelligence (President, 1980-81)
Cognitive Science Society (Member, Governing Board, 1979-)
American Association for the Advancement of Science, (Fellow, 1983-)
Association for Computing Machinery (Member of National Council of ACM, 1966-68)
American College of Medical Informatics (Fellow, 1984-)

CONSULTANTSHIPS

IntelliCorp
Sperry Corporation

BOOKS AND MONOGRAPHS

Feigenbaum, E.A., & McCorduck, P. (1983). *The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World.* New York: Addison-Wesley

Barr, A., Cohen, P., & Feigenbaum, E.A. *eds.* (1981, 1982). *Handbook of Artificial Intelligence* (Three Volumes). Los Altos, CA: Wm. Kaufmann Inc.

Buchanan, B., Feigenbaum, E.A., Lindsay, R., & Lederberg, J. (1980) *Applications of Artificial Intelligence for Organic Chemistry: The DENDRAL Project.* New York: McGraw-Hill.

Feigenbaum, E.A., & Feldman, J. *eds.* (1963). *Computers and Thought.* New York: McGraw-Hill.

Feigenbaum, E.A., Newell, A., Tonge, F., Mealy, G., et al. (1961). *Information Processing Language V Manual.* Englewood Cliffs, N.J.: Prentice-Hall.

Feigenbaum, E.A. (1959). *An Information Processing Theory of Verbal Learning.* Santa Monica, The RAND Corporation Paper P-1817 (Monograph).

SOME RECENT AND SELECTED PAPERS

Feigenbaum, E.A., & Simon, H. (1984) EPAM-like Models of Recognition and Learning *Cognitive Science 8,* 4 (Oct.-Dec.), 305-336.

Kunz, J., Feigenbaum, E.A., Buchanan, B., & Shortliffe, E.H. (1984). Comparison of Techniques of Computer-Assisted Decision Making in Medicine. in *Modeling and Analysis in Biomedicine.* Singapore: World Press. (335-367).

Kunz, J., Shortliffe, E.H., Buchanan, B.G., & Feigenbaum, E.A. (1984). Computer-Assisted Decision Making in Medicine. *Journal of Philosophy and Medicine, 9,* (135-160).

Feigenbaum, E.A. (1984). Knowledge Engineering: The Applied Side of Artificial Intelligence. In *Annals of the New York Academy of Sciences, 426,* (91-107).

Fagan, L.M., Kunz, J.C., Feigenbaum, E.A., & Osborn, J.J. (1979). Representation of Dynamic Clinical Knowledge: Measurement Interpretation in the Intensive Care Unit. In *Proceedings of the Sixth International Joint Conference on Artificial Intelligence.* Tokyo, Japan. (216-262).

Fagan, L.M., Kunz, J.C., & Feigenbaum, E.A. (1979). A Symbolic Processing Approach to Measurement Interpretation in the Intensive Care Unit. In *Proceedings of the Third Annual Symposium on Computer Applications in Medical Care.* Silver Spring, Maryland.

Fagan, L.M., Kunz, J.C., Feigenbaum, E.A., & Osborn, J.J. (1979). Knowledge Engineering for Dynamic Clinical Settings: Giving Advice in the Intensive Care Unit. In *Proceedings of the Sixth IJCAI 79,* (260-262).

BIOGRAPHICAL SKETCH

Give the following information for key professional personnel listed on page 2, beginning with the Principal Investigator/Program Director. Photocopy this page for each person.

NAME	TITLE	BIRTHDATE *(Mo., Day, Yr.)*
RINDFLEISCH, Thomas C.	Senior Research Associate/ Resource Director	December 10, 1941

EDUCATION *(Begin with baccalaureate or other initial professional education and include postdoctoral training)*

INSTITUTION AND LOCATION	DEGREE *(circle highest degree)*	YEAR CONFERRED	FIELD OF STUDY
Purdue University, Lafayette, Indiana	B.S.	1962	Physics
California Institute of Technology, Pasadena	M.S. Ph.D.	1965 Thesis to be completed; all cour work and examinations completed.	Physics

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. Include present membership on any Federal Government Public Advisory Committee. List, in chronological order, the titles and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. DO NOT **EXCEED TWO PAGES.**

Stanford University:

1985 - present	Senior Research Associate/Director, Knowledge Systems Laboratory (KSL), Department of Computer Science, and Director, Symbolic Systems Resources Group (SSRG), including SUMEX, Department of Medicine
1982 - 1985	Senior Research Associate/Director, Heuristic Programming Project (HPP), Department of Computer Science
1976 - 1982	Senior Research Associate/Director, SUMEX Computer Resource, Departments of Medicine and Computer Science
1974 - 1976	Research Associate/Director, SUMEX Computer Project, Departments of Medicine and Computer Science
1971 - 1976	Research Associate, DENDRAL Project, Department of Genetics

Jet Propulsion Laboratory, California Institute of Technology, Pasadena:

1969 - 1971	Supervisor of Image Processing Development and Applications Group
1968 - 1969	Mariner Mars 1969 Cognizant Engineer for Image Processing
1962 - 1968	Engineer, design and implement image processing computer software

PUBLICATIONS (see attached sheet)

Publications:

1. Rindfleisch, T. and Willingham, D., "A Figure of Merit Measuring Picture Resolution," JPL Technical report 32-666, September 1965.
2. Rindfleisch, T. and Willingham, D., "A Figure of Merit Measuring Picture Resolution," Advances in Electronics and Electron Physics, Volume 22A, Photo-Electronic Image Devices, Academic Press, 1966.
3. Rindfleisch, T., "A Photometric Method for Deriving Lunar Topographic Information," JPL Technical Report 32-786, September 1965.
4. Rindfleisch, T., "Photometric Method for Lunar Topography," Photogrammetric Engineering, March 1966.
5. Rindfleisch, T., "Generalizations and Limitations of Photoclinometry," JPL Space Science Summary, Volume III, 1967.
6. Rindfleisch, T., "The Digital Removal of Noise from Imagery," JPL Space Science Summary 37-62, Volume III, 1970.
7. Rindfleisch, T., "Digital Image Processing for the Rectification of Television Camera Distortions," Astronomical Use of Television Type Image Sensors, NASA Special Publication SP-256, 1971.
8. Rindfleisch, T., Dunne, J., Frieden, H., Stromberg, W., and Ruiz, R., "Digital Processing of the Mariner 6 and 7 Pictures," Journal of Geophysical Research, Volume 76, Number 2, January 1971.
9. Pereira, W. E., Summons, R. E., Reynolds, W. E., Rindfleisch, T. C. and Duffield, A. M., "The Quantitation of Beta-Aminoisobutyric Acid in Urine by Mass Fragmentography," Clinica Chimica Acta, 49, 1973.
10. Summons, R. E., Pereira, W. E., Reynolds, W. E., Rindfleisch, T. C., and Duffield, A. M., "Analysis of Twelve Amino Acids in Biological Fluids by Mass Fragmentography," Analytical Chemistry, Vol. 46, No. 4, April 1974.
11. Pereira, W. E., Summons, R. E., Rindfleisch, T. C., and Duffield, A. M., "The Determination of Ethanol in Blood and Urine by Mass Fragmentography," Clin. Chim. Acta, 51, 1974.
12. Pereira, W. E., Summons, R. E., Rindfleisch, T. C., Duffield, A. M., Zeitman, B., and Lawless, J. G., "Stable Isotope Mass Fragmentography: Quantitation and Hydrogen-Deuterium Exchange Studies of Eight Murchison Meteorite Amino Acids," Geochem. et Cosmochim. Acta, 39, 163, 1975.
13. Dromey, R. G., Stefik, M. J., Rindfleisch, T. C., and Duffield, A. M., "Extraction of Mass Spectra Free of Background and Neighboring Component Contributions from Gas Chromatography/Mass Spectrometry Data", Analytical Chemistry, 48, page 1368, 1976.
14. Smith, D. H., Yeager, W. J., Anderson, P. J., Fitch, W. L., Rindfleisch, T. C., and Achenbach, M., "Historical Library Search. An Approach to Quantitative Comparison of GC/MS Profiles of Complex Mixtures," Analytical Chemistry, 49, page 1623, 1977.
15. Rindfleisch, T. C., Smith, D. H., Yeager, W. J., Achenbach, M, W., and Wegmann, A., "Advances in Data Acquisition and Analysis Systems for Applications of Gas Chromatography/Mass Spectrometry," in Biomedical Applications of Mass Spectrometry (First Supplementary Volume), edited by G. R. Waller and O. C. Dermer, page 55, John Wiley & Sons, New York, 1980.
16. Feigenbaum, E. A., Brown, H., Delagi, B. A., Gabriel, R. P., Nii, H. P., and Rindfleisch, T. C., "Advanced Architectures Project: Scope and Approach," Stanford Heuristic Programming Project Report HPP-84-40, October 1984.

BIOGRAPHICAL SKETCH

Give the following information for key professional personnel listed on page 2, beginning with the Principal Investigator/Program Director. Photocopy this page for each person.

NAME	TITLE	BIRTHDATE *(Mo., Day, Yr.)*
YEAGER, William J.	Systems Programmer/Assistant Director	June 16, 1940

EDUCATION *(Begin with baccalaureate or other initial professional education and include postdoctoral training)*

INSTITUTION AND LOCATION	DEGREE *(circle highest degree)*	YEAR CONFERRED	FIELD OF STUDY
University of California, Berkeley	B.A.	1964	Mathematics
California State University, San Jose	M.A.	1967	Mathematics
University of Washington, Seattle Doctoral studies (1969-70)	None	--	Mathematics

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. Include present membership on any Federal Government Public Advisory Committee. List, in chronological order, the titles and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. DO NOT **EXCEED TWO PAGES.**

1985 - present Assistant Director, SUMEX Computer Project, Department of Medicine, Stanford University

1978 - 1985 Systems Programmer, SUMEX Computer Project, Department of Medicine, Stanford University

1975 - 1978 Scientific Programmer, Instrumentation Research Laboratories, Department of Genetics, Stanford University

1971 - 1975 Programmer, Bendix Field Engineering, Moffett Field, California

1970 - 1971 Programmer, WELLSCO Data Corp., San Francisco, California

1968 - 1969 Mathematics Instructor, Gavilan Jr. College, Gilroy, California

1967 - 1968 Mathematics Instructor, California Western Univ., San Diego

1966 - 1967 Mathematician/Programmer, Applied Physics Laboratory, Seattle, Washington

1966 Systems Representative, Burroughs Corp., San Jose, California

PUBLICATIONS Technical Report (Pending): Yeager, W.J.: "Ether TIPs and Gateways at SUMEX."

BIOGRAPHICAL SKETCH

Give the following information for key professional personnel listed on page 2, beginning with the Principal Investigator/Program Director. Photocopy this page for each person.

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
JACOBS, Charlotte	Asst Prof of Medicine	January 27, 1946

EDUCATION (Begin with baccalaureate or other initial professional education and include postdoctoral training)

INSTITUTION AND LOCATION	DEGREE (circle highest degree)	YEAR CONFERRED	FIELD OF STUDY
University of Rochester, Rochester, NY	B.A.	1968	Biology
Washington University School of Medicine, St. Louis, MO	M.D.	1972	
	Int,Jr Res,	1972 - 1974	Medicine
Univ of Ca, San Francisco, San Francisco,CA	Sr Res	1974 - 1975	Medicine
Stanford Univ, Stanford, CA 94305	Fellow	1975 - 1977	Oncology

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. Include present membership on any Federal Government Public Advisory Committee. List, in chronological order, the titles and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. DO NOT EXCEED TWO PAGES.

POSITIONS

1977 - 1980 Acting Assistant Professor, Department of Medicine, Division of Medical Oncology, Stanford University Medical Center, Stanford, CA

1977 - Present Director, Oncology Day Care Center, Department of Medicine, Stanford University Medical Center, Stanford, CA

1980 - Present Assistant Professor, Department of Medicine, Division of Medical Oncology, Stanford University Medical Center, Stanford, CA

OTHER EXPERIENCE

Drug Advisory Board, FDA (1984 - 1986)
Head and Neck Intergroup, Chairman (1984 - 1986)
Faculty Senate (1984 - 1986)

HONORS

Phi Beta Kappa
Alpha Omega Alpha
Kaiser Award for Excellence in Teaching (1983, 1985)
American Cancer Society Junior Faculty Clinical Fellowship (1981)
Janet Glasgow Scholastic Citation Award of the American Medical Women's Association (1972)
Missouri State Medical Association Award (1972)
Medical Alumni Scholarship Award (1971)
Lange Medical Book Awards (1969, 1970)
Janet Park Howell Award in Science (1968)

PUBLICATIONS

1. Jacobs C, Portlock CS, Rosenberg SA. Prednisone in MOPP chemotherapy for Hodgkin's disease. Br Med J 1976; 2:1469-1471.
2. Kim H, Jacobs C, Warnke RA, Dorfman RF. Malignant lymphoma with a high content of epitheloid histiocytes. Cancer 1978; 41:620-635.
3. Jacobs C, Bertino JR, Goffinet DR, Fee WE, Goode RL. Cis-platinum chemotherapy in head and neck cancers. Otolaryngol Head and Neck Surg 1978; 86:780-783.
4. Jacobs C, Bertino JR, Goffinet DR, Fee WE, Goode RL. 24-hour infusion of cis-platinum in head and neck cancers. Cancer 1978; 42:2135-2140.
5. Jacobs C. Hodgkin's disease - a patient teaching tool. Cancer Nursing 1979; 86:780-783.
6. Jacobs C. The role of cisplatin in the treatment of recurrent head and neck cancer. Cisplatin Current Status and New Developments. Edited by Prestayko AW, Crooke ST, Carter SK. Academic Press, 1980; 423-430.

7. Levi J, Jacobs C, Kalman SM, McTigue M, Weiner MW. Mechanism of cis-platinum nephrotoxicity: I. Effects on sulfhydryl groups in rat kidneys. J Pharmacol Exp Ther 1980; 213:545-550.
8. Dobyan DC, Levi J, Jacobs C, Kosek J, Weiner MW. Mechanism of cis-platinum nephrotoxicity: II. Morphologic observations. J Pharmacol Exp Therap 1980; 213:551-556.
9. Jacobs C, Kalman SM, Tretton M, Weiner MW. Renal handling of cis-diamminedichloroplatinum (II) Cancer Treat Rep 1980; 64:1223-1226.
10. Jacobs C. High-dose methotrexate and cis-platinum in the treatment of recurrent head and neck cancer. Recent Results Cancer Res 1981; 76:290-295.
11. Jacobs C, Donaldson SS, Rosenberg SA, Kaplan HS. Management of the pregnant patient with Hodgkin's disease. Ann Intern Med 1981; 95:669-675.
12. Jacobs C, Ross R. The psychological assessment of cancer patients. Recent Advances in Clinical Oncology. Edited by Williams CJ, Whitehouse JMA. Churchill Livingstone, 1982; 365-374.
13. Mead G, Jacobs C. The changing role of chemotherapy in the management of head and neck cancer. Am J Med 1982; 73:582-595.
14. Jacobs C. Chemotherapy and combined modality treatment of head and neck cancer. Current Concepts in Oncology, Vol 4, No. 3, 1982.
15. Jacobs C. The use of methotrexate + 5-fluorouracil for recurrent head and neck cancer. Cancer Treat Rep 1982; 66:1925-1928.
16. Jacobs C, Ross R, Walker I , Stockdale FE. Behavior of cancer patients: A randomized study of the effects of education and peer support groups. Am J Clin Oncol 1983; 6:347-350.
17. Jacobs C, Meyers F, Hendrickson C, Kohler M, Carter S. A randomized phase III study of cisplatin with or without methotrexate for recurrent squamous cell carcinoma of the head and neck. Cancer 1983; 52:1563-1569.
18. Weiner MW, Jacobs C. Mechanism of cisplatin nephrotoxicity. Fed Proc 1983; 42:2974-2978.
19. Campbell AB, Kalman S, Jacobs C. Plasma platinum levels: Relationship to cisplatin dose and nephrotoxicity. Cancer Treat Rep 1983; 67 (2):169-172.
20. Coleman CN, Friedman MK, Jacobs C et al. Phase I trial of intravenous Melphalan plus the sensitizer Misonidazole. Cancer Res 1983; 43:5022-5025.
21. Jacobs C. The use of chemotherapy in the combination with radiotherapy in the treatment of head and neck squamous cancers. Advances in Treatment and Research. Edited by Wolf GT. Martinus Nijhoff Publishers, Boston, MA, 1984:265-286.
22. Jacobs C, Coleman CN, Rich L, Hirst K, Weiner MW. Inhibition of cisplatin secretion by the human kidney with probenecid. Cancer Res 1984; 44:3632-3635.
23. Jacobs C. The biophysiology of antineoplastic chemotherapy for head and neck cancers. Otolaryngology/Head and Neck Surgery. Edited by Cummings, Frederickson, Harker, Krause, Schuller. C.V. Mosby Company, St. Louis, MO 1985 (In press).
24. Shortliffe EH, Scott AC, Bischoff MD, Campbell AB, van Melle W, Jacobs C. An expert system for oncology protocol management. Rule-Based Expert Systems. The Mycin Experiments of the Stanford Heuristic Programming Project. Edited by Buchanan BG, Shortliffe EH. Addison-Wesley Company, Menlo Park, CA 1984:653-655.
25. Schreiber D, Jacobs C, Rosenberg SA, Cox R, Hoppe RT. The potential benefits of therapeutic splenectomy in Hodgkin's disease and non-Hodgkin's lymphomas. Int J Oncol Biol Phys 1984; 11:31-36.
26. Jacobs C, Hoppe RT. Non-Hodgkin's lymphomas of the head and neck extranodal sites. Int J Radiat Oncol Biol Phys 1984; 11:357-364.
27. Jacobs C. The role of chemotherapy in the treatment of head and neck cancer. Cisplatin Current Status and New Developments. Academic Press, 1985 (In Press).
28. Connors JM, Andiman WA, Howarth CB, Liu E, Merigan TC, Savage ME, Jacobs C. Treatment of nasopharyngeal carcinoma with human leukocyte interferon. J Clin Oncol 1985 (In Press).