Johns Hopkins Pathology Informatics

- Joel Saltz, MD, PhD - Director
  - Support to Johns Hopkins Pathology
  - Research in Medical Informatics
  - Research in Computer Science
  - Development of External Software Products
  - Management Consulting
  - Partnership with Computer Science Department, University of Maryland College Park
    - substantial ongoing externally funded applications-driven computer science research program

JHMI/UMCP Informatics/Computer Science Research Program

- Joel Saltz
- Merwyn Taylor
- Jerry Rottman
- Alan Sussman
- John Davis
- Kilian Stoffel
- Mike Beynon
- Renato Ferriera
- Asmara Afework
- Charlie Chang

Pathology Informatics

- Pathology Data Systems
  - M based laboratory information system
- Data Repository
  - Relational, object-relational database and knowledge base systems
  - Supports ad-hoc queries, data mining, quality control, decision support
- Pathology image management
  - Telepathology, digital archiving of anatomic pathology imagery, electrophoresis data, flow cytometric, DNA sequencing and cytogenetic data

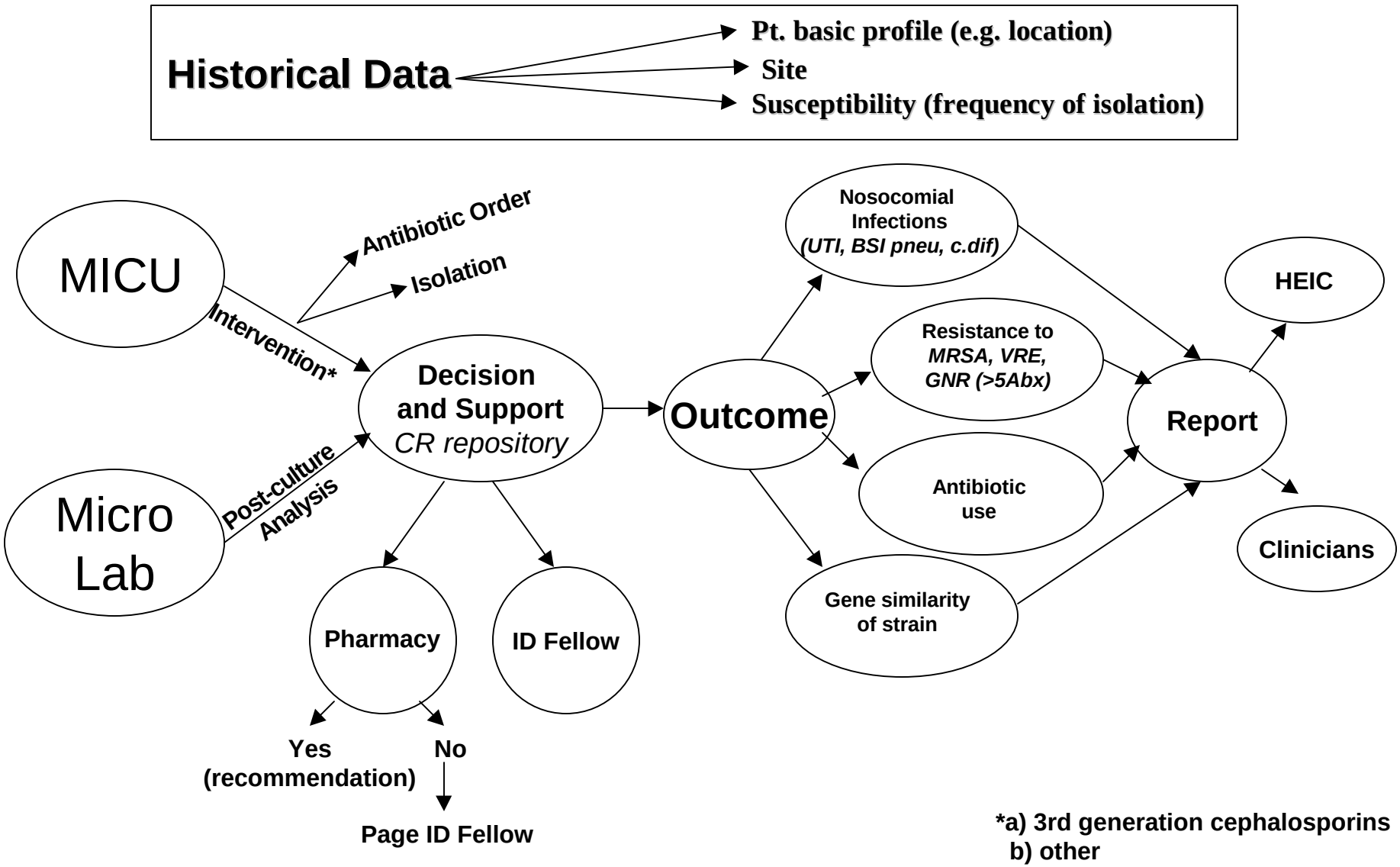
PathologyInformatics

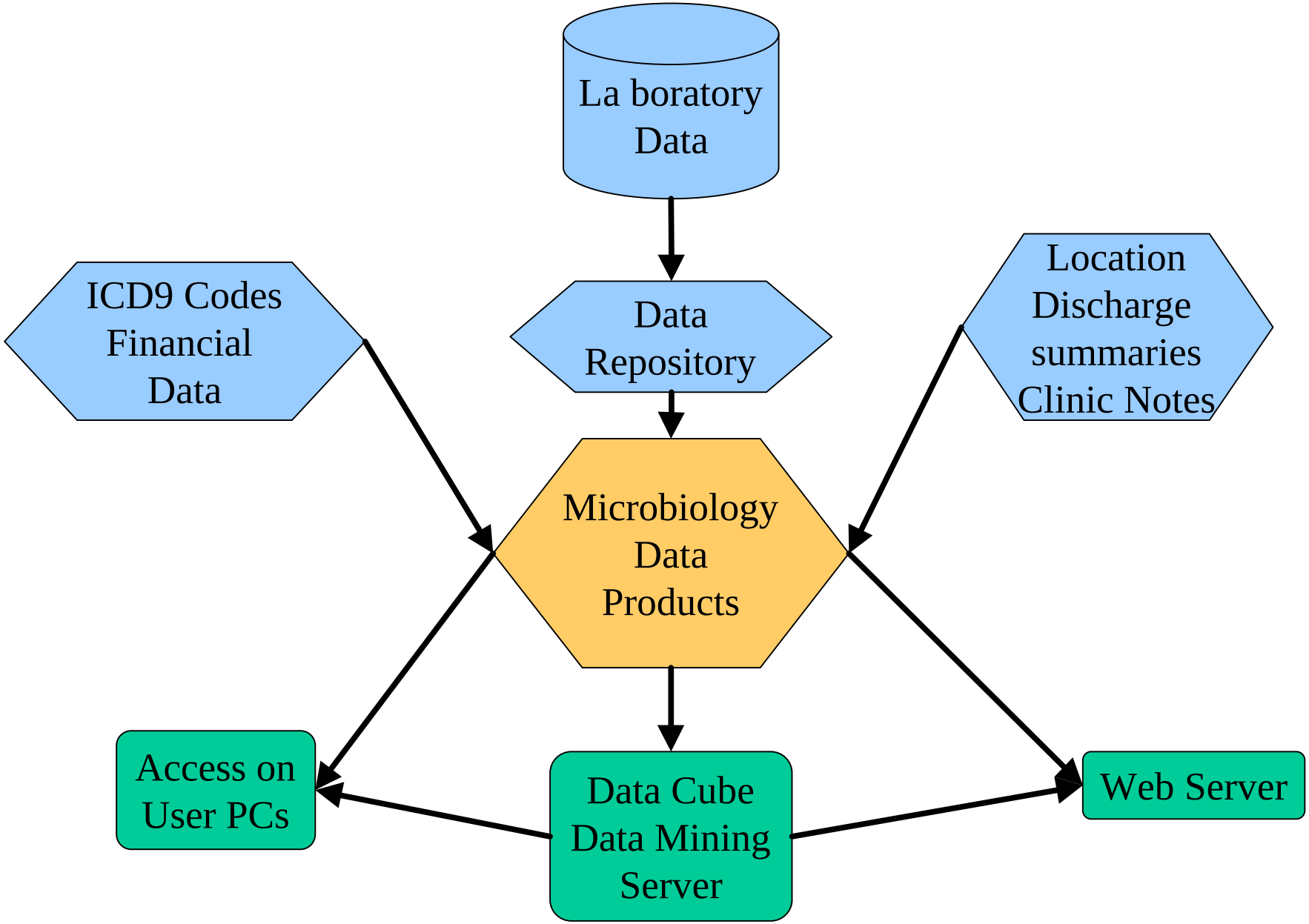
- Support for generation of interpretations
  - Support for interpretation of laboratory tests and for surgical pathology
  - Marshal data from LIS, electronic patient records, SPEP and UPEP results, surgical pathology imagery
  - Develop rules to generate a “first pass” interpretation
- Management Consulting
  - Combine data from multiple sources to analyze workflow, costs
- Research
  - Externally funded research that leads to new products and to new concepts in computer science

Applications

- Management of Patient Care : *Gather and synthesize laboratory, clinical, cost and reimbursement data from many information systems to carry out long term management of large patient populations*
  - Antibiotic use and infection control (in development)
    - software to track and categorize infections
    - brings together laboratory, clinical and pharmacy data
    - flags unsuitable antibiotic use
    - flags antibiotic usage patterns that may lead to development of antibiotic resistance
    - screens for hospital acquired infections
      - potential for reducing antibiotic costs and for increasing accuracy of medical coding (with consequent increased hospital revenues)

CDC Nosocomial Infection Pilot Plan




La boratory Data
ICD9 Codes Financial Data
Data Repository
Location Discharge summaries Clinic Notes
Microbiology Data Products
Access on User PCs
Data Cube Data Mining Server
Web Server

Management of Patient Care

- Near Patient Testing (in development)
  - capture of patient laboratory data, combine with clinical data and intervene when clinically indicated
  - identify patients who would be appropriate candidates for new medical services
- Blood product use
  - evaluation of platelet use, response and reactions to transfusion therapy

Applications

- Coordinated support for distributed laboratories: software to coordinate operation of laboratory and point of care laboratory testing devices (in development)
  - common management of data from point of care and laboratory instruments
  - ongoing assessment of quality of test results and of operator competence
  - use of all available data in quality assessments
  - real time feedback to prevent errors and to flag critical values
  - wedge for management consulting activities
    - assessment and reorganization of laboratory and near patient testing activities
  - interface with laboratory information systems

Applications

- Dynamic digital telemicroscopy (in development)
  - software that allows local and remote users to capture, view, annotate and manipulate microscopy datasets
  - crucial addition to working medical record
  - facilitates comparison with other specimens from same and other patients
  - computerized medical education, conferences that involve multiple sites, certification, platform to run algorithms that grade tumors using morphometry, platform for pattern recognition algorithms
  - market would include both clients for viewing microscopy data and servers for storing and managing data

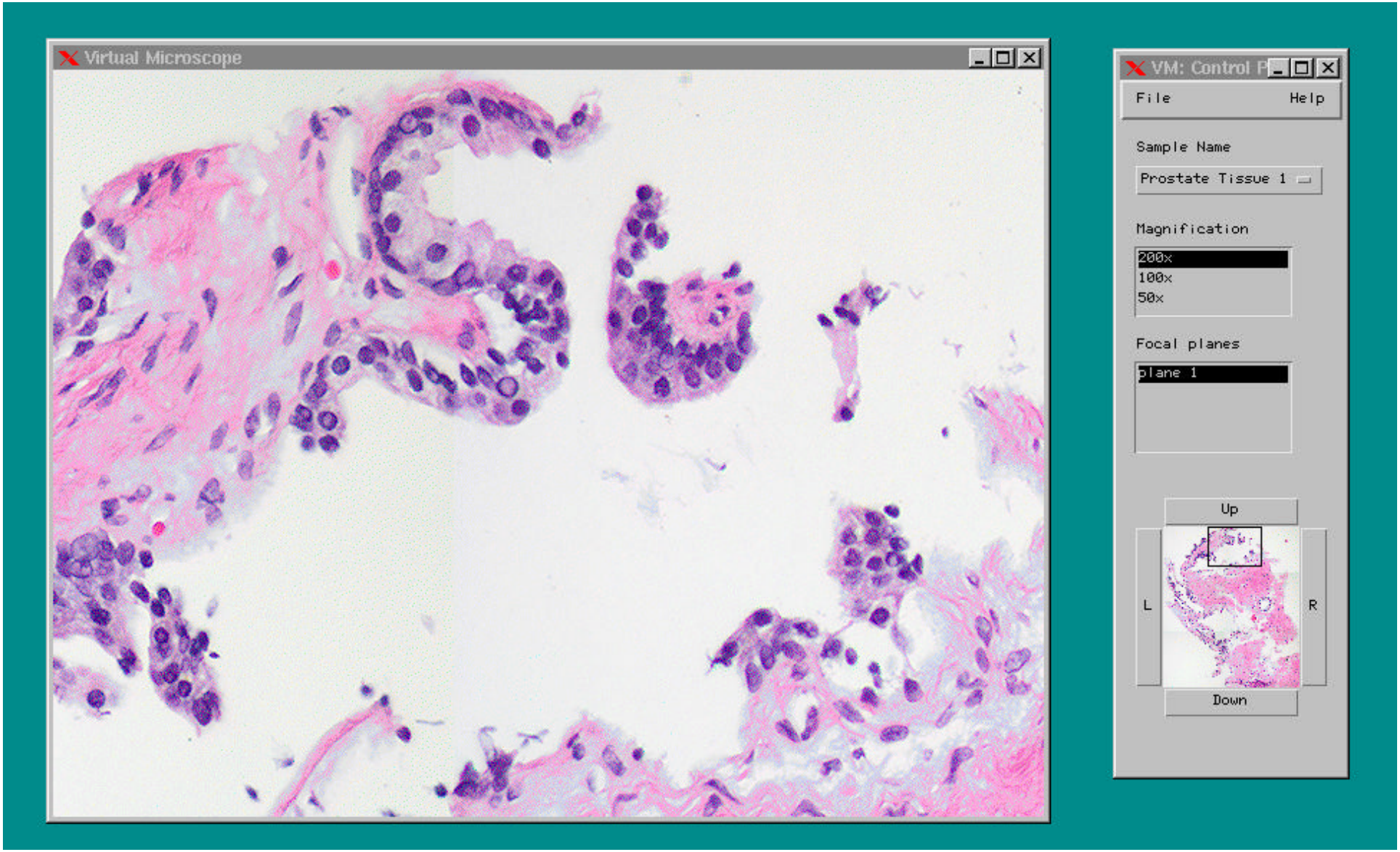
Virtual Microscope

- World wide access to global collection of full digitized cases
  - no need to rely on slides available at local institution
  - compare specimens with earlier cases
- Research community can explore significance of morphology
  - compositing and 3-D reconstruction
  - quantitative immunohistochemistry analysis
  - run analysis programs on common data sets
- Links to relevant portions of digitized cases from medical information systems, electronic publications and textbooks.

Training and Conference Environment

- Collection of institutions can carry out didactic conferences or collaborate on diagnosis
- Needle in haystack training
  - crucial skill often involves locating portions of case with interesting findings
- Multiple sites can
  - extends behavior of microscope - *independently* cruise through virtual pathology cases
    - users can change focus, magnification and move virtual stage
    - can track expert's examination of slide
  - capture whole case exploration process,
    - support combined medical record, demographic, pathology queries

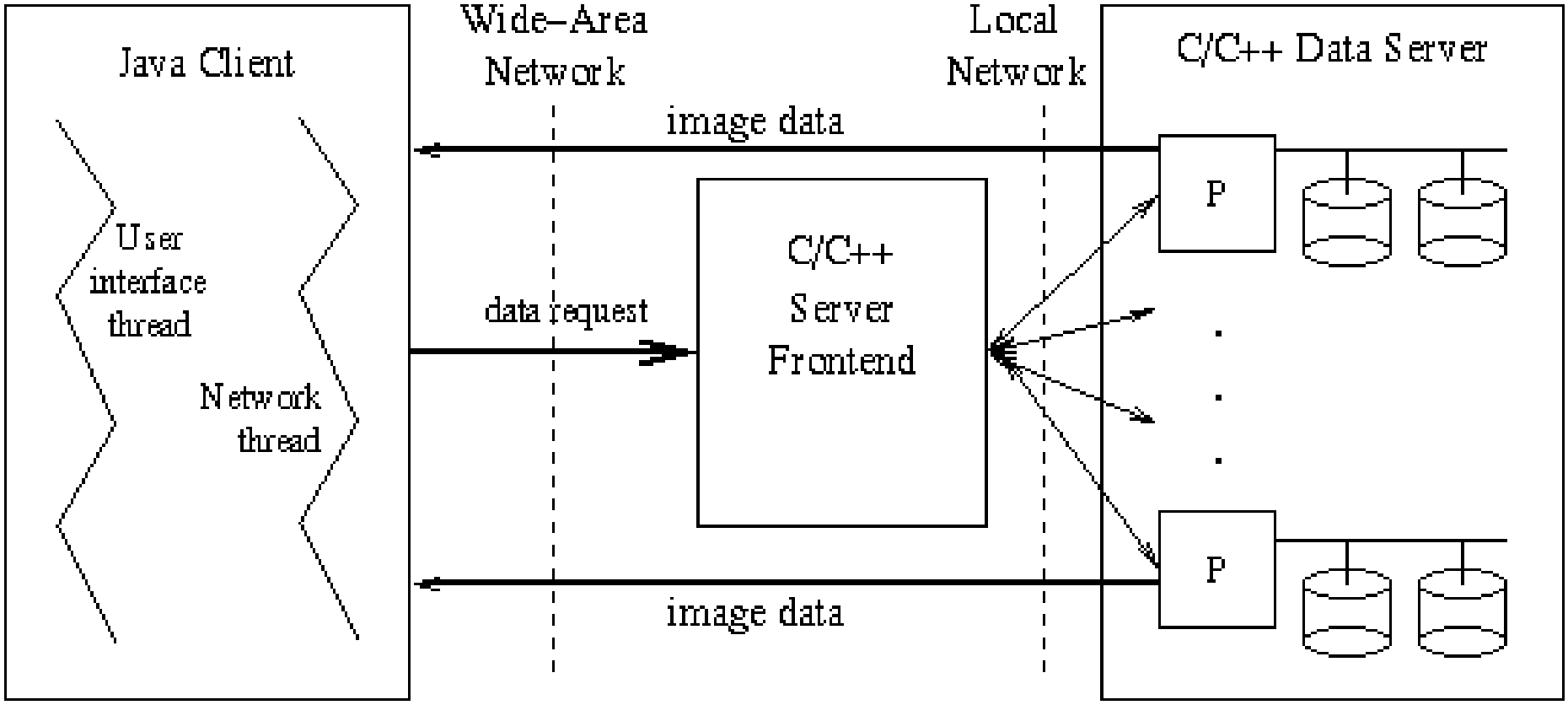
Virtual Microscope Client



Virtual Microscope Design

- Java based client
  - Client tested using Sun JDK and Microsoft J++
- Two part server (Currently runs on Windows, Solaris, AIX)
  - Front end -- accepts client queries, schedules queries and forwards to back end
  - Back end -- runs on multiple processors, retrieves and processes data from multiple disks

Virtual Microscope Architecture



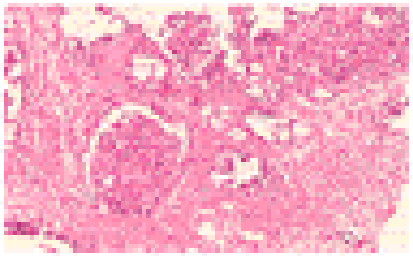
Back end

Virtual Microscope Test Slides - Microsoft Internet Explorer

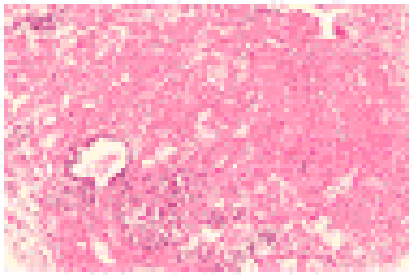
File Edit View Go Favorites Help

Address http://www.cs.umd.edu/users/ftsang/vmscope/

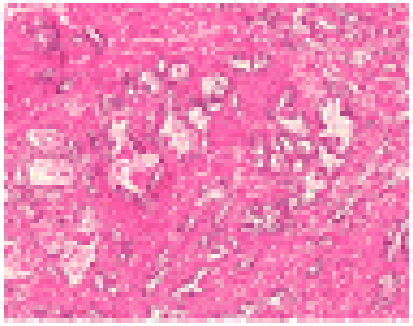
Virtual Microscope Test Slides



Breast tissue 1: (The diagnosis is atypical ductal epithelial hyperplasia). The clinical history is: The patient is a 63 year old woman with a prior history of total abdominal hysterectomy and bilateral salpingo-oopherectomy for well differentiated endometrial carcinoma and benign breast cysts who is found to have focally clustered microcalcifications on routine mammography. An incisional biopsy is performed. The attached slide is a representative section of this patients histology



Breast tissue 3: (The diagnosis is non-atypical ductal epithelial hyperplasia (papillomatosis) arising in the setting of fibrocystic disease of the breast). The clinical history is: The patient is a 35 year old with no significant past medical history but a family history of breast and colon cancer in first degree relatives who noticed a rubbery firm mass in the right breast on routine self examination. The patient underwent incisional biopsy of a 2.5 cm. mass; histology showed fibrocystic changes (cysts, apocrine metaplasia, stromal fibrosis) in most sections. One section is submitted for your review.



Prostate tissue 2: (The diagnosis is adenocarcinoma of the prostate, Gleason grade 3+3=6, and background benign prostatic hyperplasia). The clinical history is: The patient is a 68 year old man with a prior history of colorectal adenomas, diverticulitis for which he underwent a left hemicolectomy, and several basal cell carcinomas of the skin and a family history of prostate carcinoma who presented with complaint of urge incontinence, nocturia, frequency, diminished force of his urinary stream and occasional dysuria. A screening prostatic specific antigen assay performed three months prior to the current evaluation was 5.5 (ng/ml); subsequent resistant biopsies showed no tumor.

Internet zone

Data Mining and On line Analytical Processing

- On-line analytical processing tools to support queries that involve laboratory, pharmacy, clinical and financial data
  - complex hierarchies of categories
    - antibiotics, organisms, laboratory tests by particular test, clinical category, panel, test instrument
  - use hierarchies to formulate queries
    - screening for hospital acquired infections
    - targeting antibiotic use to optimize efficacy, reduce development of resistant organism strains, reduce costs
  - data cube and data mining software

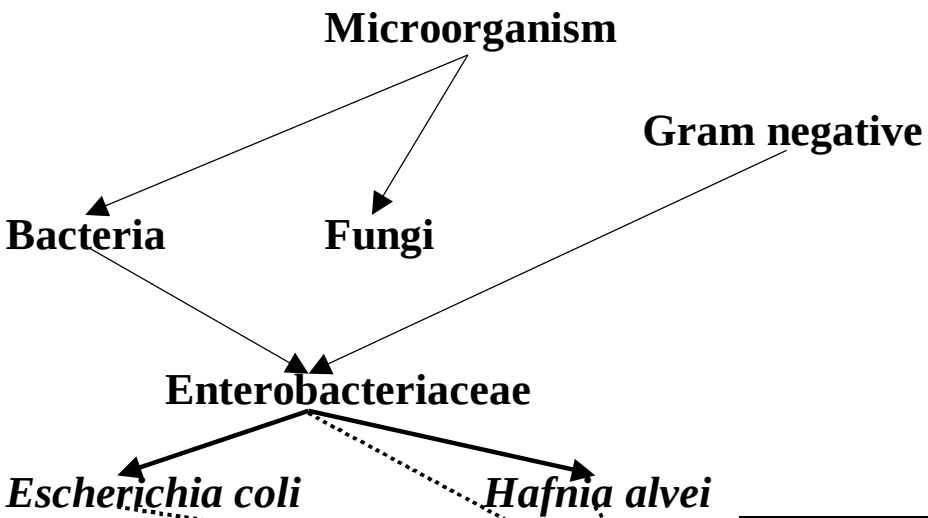
Microbiology Queries

- For all classes of aerobic bacteria (ranging from general categories like gram negative rods to specific organisms like Yersinia enterocolitica) characterize resistance to all beta lactam antibiotics
- Compare effectiveness of different possible antibiotic protocols for neutropenic oncology patients
  - e.g. Trimethoprim/Sulfa + piperacillin v.s. Trimethoprim/Sulfa + piperacillin/tazobactam
- Screen for changes over time in antibiotic susceptibility

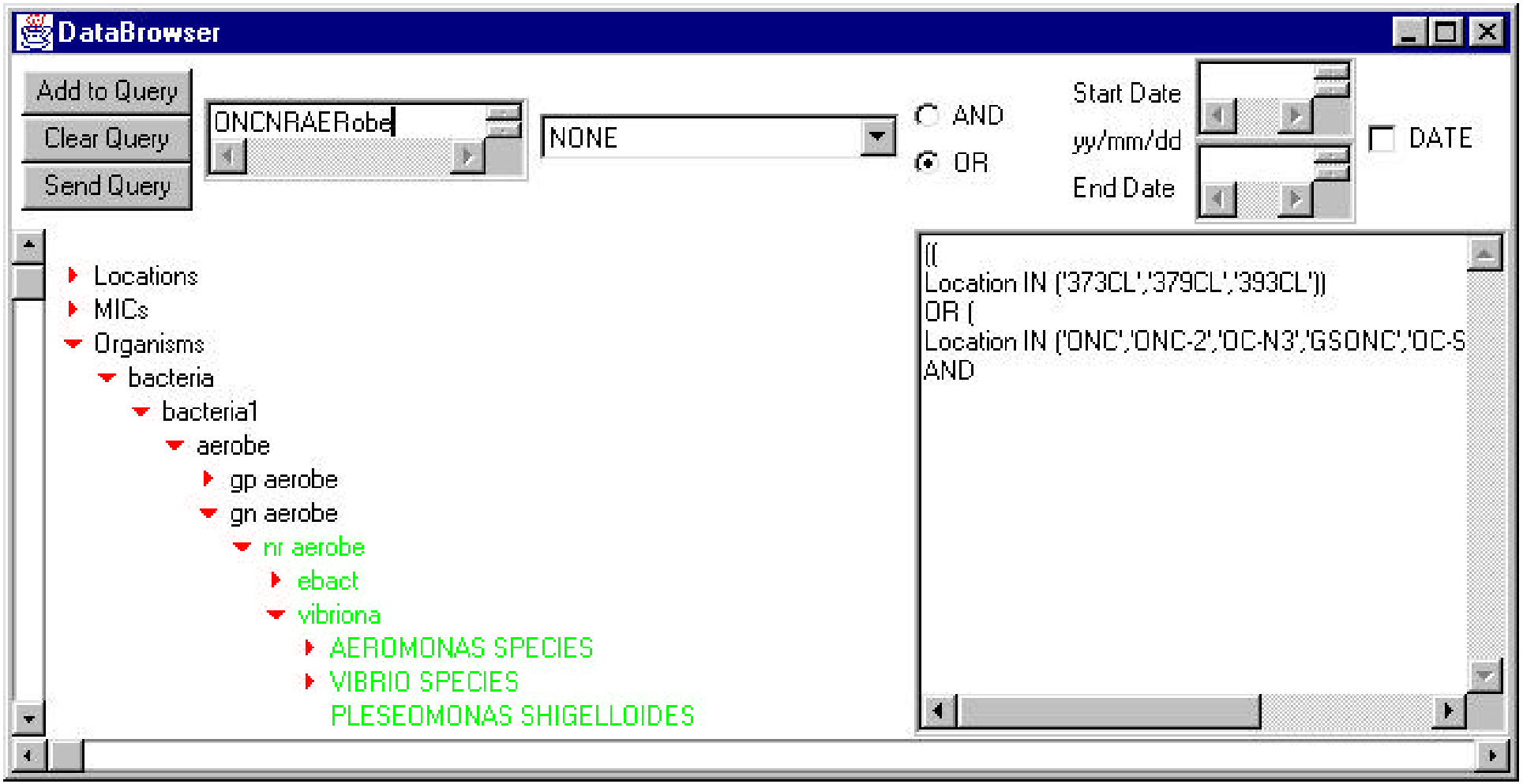
Hierarchies and Databases

- Domain specific knowledge represented by hierarchies
- Graphical user interface or programmer API (currently two different versions) make it possible for the user to select portions of a hierarchy
- User can use a hierarchy to select a patient subset
  - user can then use other hierarchies to carry out data cube operation
  - e.g. for oncology patients, tabulate third generation cephalosporin antibiotic resistance in all classes of non-fermenter microorganisms

Relationship between an Ontology and a Database



Patient	Microorganism	Age
AA	*Escherichia coli*	34
BB	*Enterobacteriaceae*	52
CC	*Hafnia alvei*	19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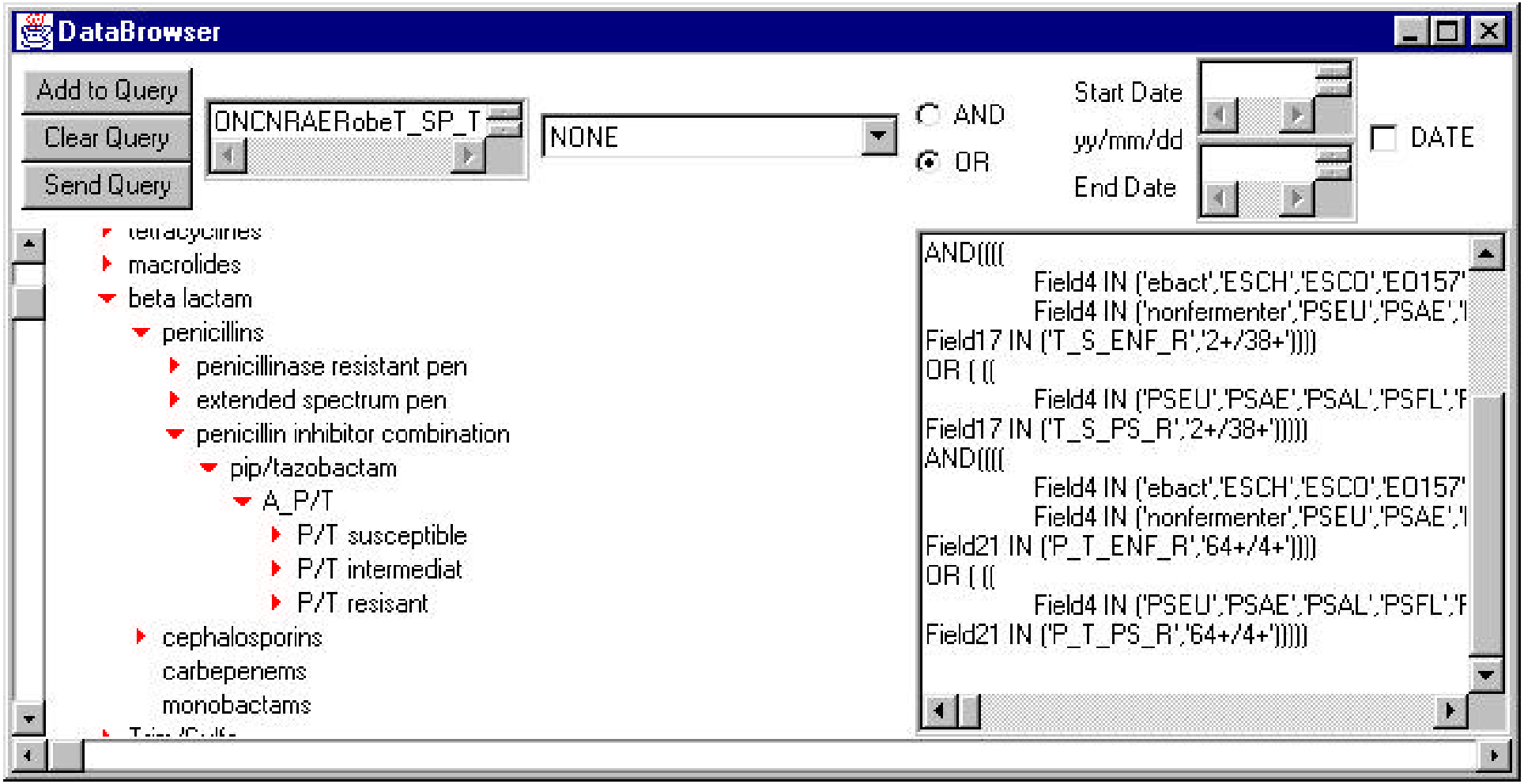
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extended spectrum pen
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P/T intermediat
P/T resisant
cephalosporins
carbepenems
monobactams
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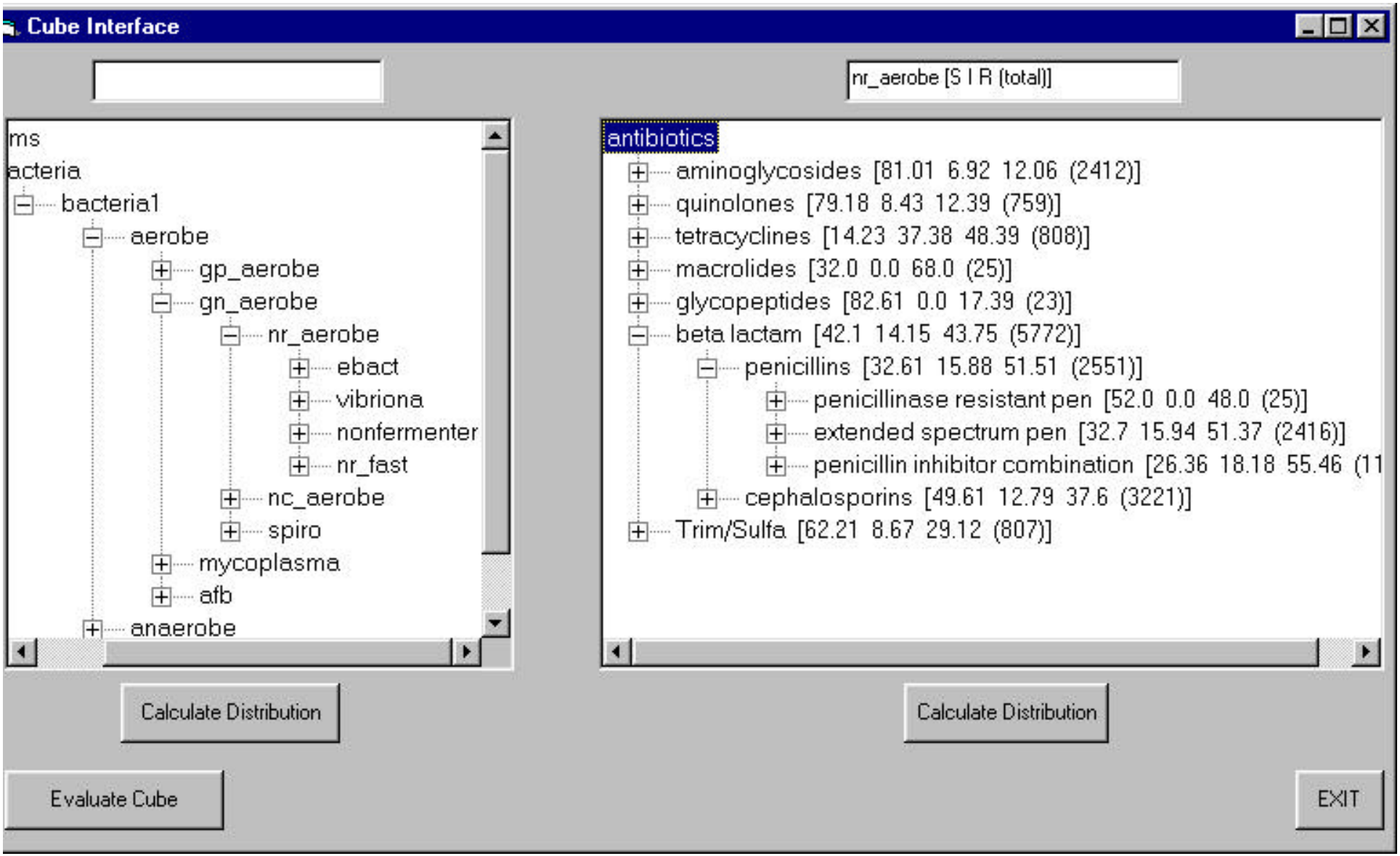
Cube Interface
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cephalosporins [49.61 12.79 37.6 (3221)]
Trim/Sulfa [62.21 8.67 29.12 (807)]
Calculate Distribution
Calculate Distribution
Evaluate Cube
EXIT