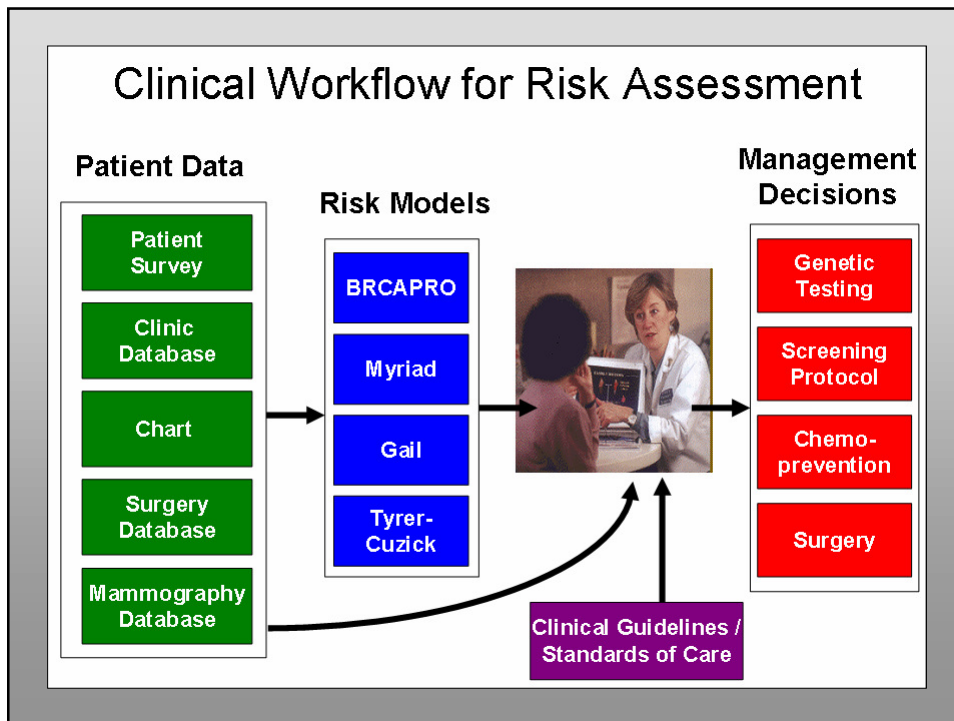


Using the EHR for the identification of patients at high risk for hereditary breast and ovarian cancer.

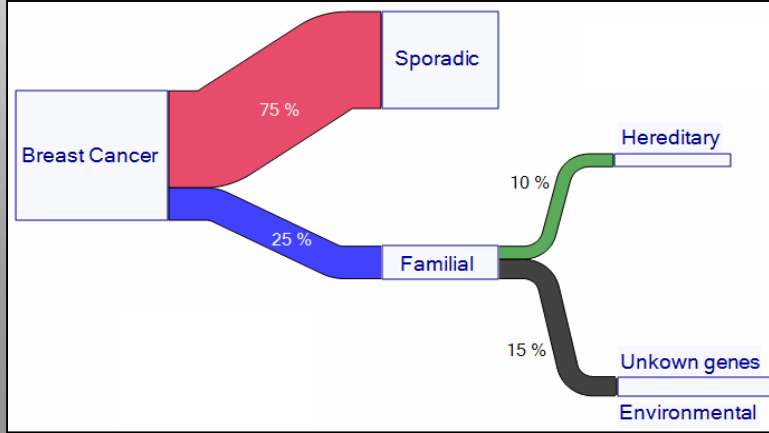
Brian Drohan
University of Massachusetts
5/30/08



A Glance at Breast Cancer Epidemiology

Different patterns of disease incidence means different:

- Risk Factors
- Analysis Techniques
- Management Decisions



A Glance at Breast Cancer Risk Models

1. The Prevalence of Colorectal Mutations in BRCA1 and BRCA2 Excludes Individuals of Ashkenazi Descent

Family History (Excludes at least one first or second degree relative)	BRCA1 (mutated <50 in one allele, no mutation in any relative <50 in any relative)	BRCA2 (mutated <50 in one allele, no mutation in any relative <50 in any relative)	BRCA1/2 (mutated <50 in one allele, no mutation in any relative <50 in any relative)	BRCA1/2 (mutated <50 in one allele, no mutation in any relative <50 in any relative)	BRCA1/2 (mutated <50 in one allele, no mutation in any relative <50 in any relative)
No breast cancer at any age	3.1%	4.2%	0.4%	5.0%	9.2%
BRCA1 carrier at any age	3.0%	5.7%	11.2%	5.6%	12.1%
BRCA2 carrier at any age	6.0%	16.3%	30.7%	17.6%	27.3%
BRCA1/2 carrier at any age	12.2%	24.9%	39.2%	22.7%	33.3%*
BRCA1 carrier at any age and BRCA2 carrier at any age	9.0%	22.8%	43.1%	19.5%	34.3%
BRCA1 carrier at any age and BRCA2 carrier at any age	15.7%	28.8%	41.9%	25.5%	52.2%
BRCA1/2 carrier at any age and BRCA2 carrier at any age	41.0%	55.1%	66.0%	71.1%	72.7%*

*100% for BRCA1 carriers with breast cancer; 100% for BRCA2 carriers with breast cancer; 100% for BRCA1/2 carriers with breast cancer.

$$-0.74948 + 0.09401 (AGEMEN) + 0.52926(NBIOPS) + 0.21863(AGEFLB) + 0.95830(NUMREL) + 0.01081(AGECAT) - 0.28804(NBIOPL) \times AGECAT - 0.19081(AGEFLB \times NUMREL).$$

Full Name	Parents	Sex	Age
BRCA1 carrier	mother	F	4
BRCA1 carrier	father	M	7
BRCA2 carrier	mother	F	4
BRCA2 carrier	father	M	3
BRCA1/2 carrier	mother	F	2
BRCA1/2 carrier	father	M	2
BRCA1/2 carrier	mother	F	3
BRCA1/2 carrier	father	M	3
BRCA1/2 carrier	mother	F	4
BRCA1/2 carrier	father	M	4
BRCA1/2 carrier	mother	F	5
BRCA1/2 carrier	father	M	5
BRCA1/2 carrier	mother	F	6
BRCA1/2 carrier	father	M	6
BRCA1/2 carrier	mother	F	7
BRCA1/2 carrier	father	M	7
BRCA1/2 carrier	mother	F	8
BRCA1/2 carrier	father	M	8
BRCA1/2 carrier	mother	F	9
BRCA1/2 carrier	father	M	9
BRCA1/2 carrier	mother	F	10
BRCA1/2 carrier	father	M	10
BRCA1/2 carrier	mother	F	11
BRCA1/2 carrier	father	M	11
BRCA1/2 carrier	mother	F	12
BRCA1/2 carrier	father	M	12
BRCA1/2 carrier	mother	F	13
BRCA1/2 carrier	father	M	13
BRCA1/2 carrier	mother	F	14
BRCA1/2 carrier	father	M	14
BRCA1/2 carrier	mother	F	15
BRCA1/2 carrier	father	M	15
BRCA1/2 carrier	mother	F	16
BRCA1/2 carrier	father	M	16
BRCA1/2 carrier	mother	F	17
BRCA1/2 carrier	father	M	17
BRCA1/2 carrier	mother	F	18
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BRCA1/2 carrier	father	M	98
BRCA1/2 carrier	mother	F	99
BRCA1/2 carrier	father	M	99
BRCA1/2 carrier	mother	F	100
BRCA1/2 carrier	father	M	100

$$P(MH) = \frac{P(HM)P(M)}{P(H)}$$

$$LR = \frac{P(HM)}{P(HN)}$$

$$P(MH) = \frac{LR}{LR + P(N)/P(M)}$$

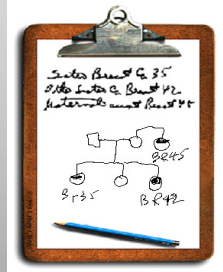
Women With Breast Cancer

$$LR = \frac{b_1(age)}{b_2(age)}$$

Woman Free of Cancer

$$LR = \frac{1 - B_1(age)}{1 - B_2(age)}$$

Techniques for collecting FH data



FAMILY HISTORY OF CANCER
1. Mark the chart below for blood relatives.

TYPE CANCER	AT AGE				
	Breast Ovary	Under Age 35	36-39	40-50	OVER 50
Mother	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sister 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sister 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Daughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grandmother (Mother's side)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grandmother (Father's side)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aunt1 (Mother's sister)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aunt2 (Mother's sister)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aunt1 (Father's sister)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aunt2 (Father's sister)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cousine (Mother's side)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cousine (Father's side)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Has any man in your family had breast cancer? Yes No



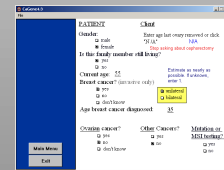
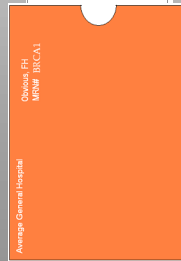
Average General Hospital
Breast Imaging
Patient: Obvious, FH MRW BRCA1
Family History
Mother: Breast Cancer 54
Sister: Breast Cancer 27
Mother's Sister: Ovarian Cancer 46
Gravida 4 Para 5
Age FLB: 21
Prior Biopsies: 2 left
Age Menarche: 13
Atypical Hyperplasia: None



Cancer Risk Assessment Survey
Which females in your family have had breast cancer?
(Please check each box that has had the cancer, do not check the box next to it.)

Relationship	Side	Age at diagnosis
Sister	Mother	<input type="checkbox"/>
Daughter	Niece, Mother's side	<input type="checkbox"/>
Grandmother, Mother's side	Cousin (Female), Mother's side	<input type="checkbox"/>
<input checked="" type="checkbox"/> Aunt, Mother's side	Niece, Father's side	<input type="checkbox"/>
Grandmother, Father's side	Cousin (Female), Father's side	<input type="checkbox"/>
Aunt, Father's side		<input type="checkbox"/>

How many Aunts, Mother's side have had Breast Cancer?
1
Next >



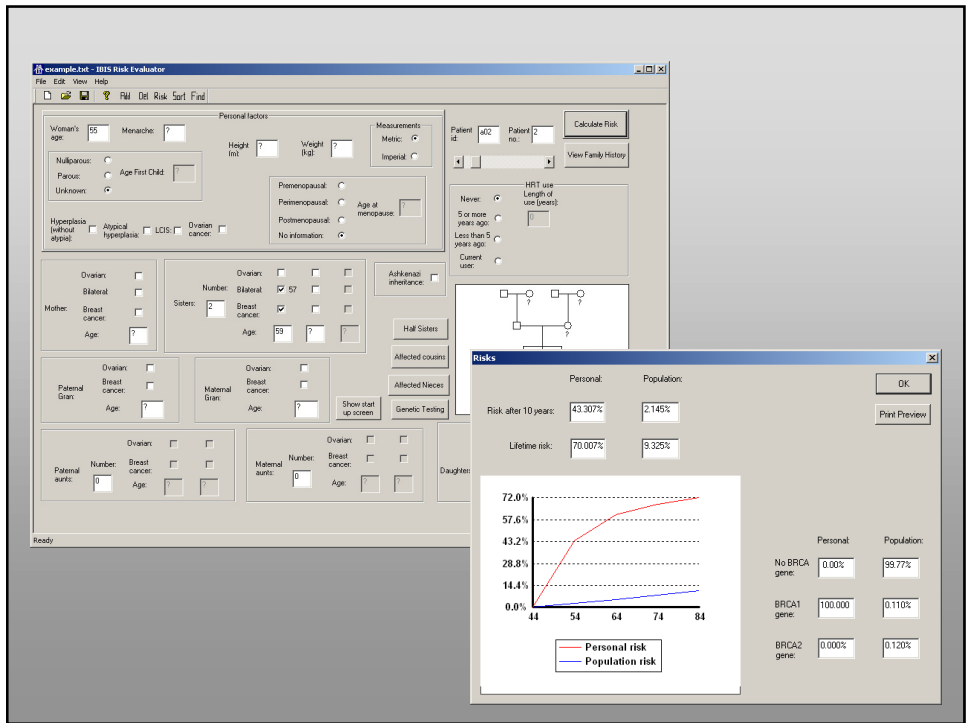
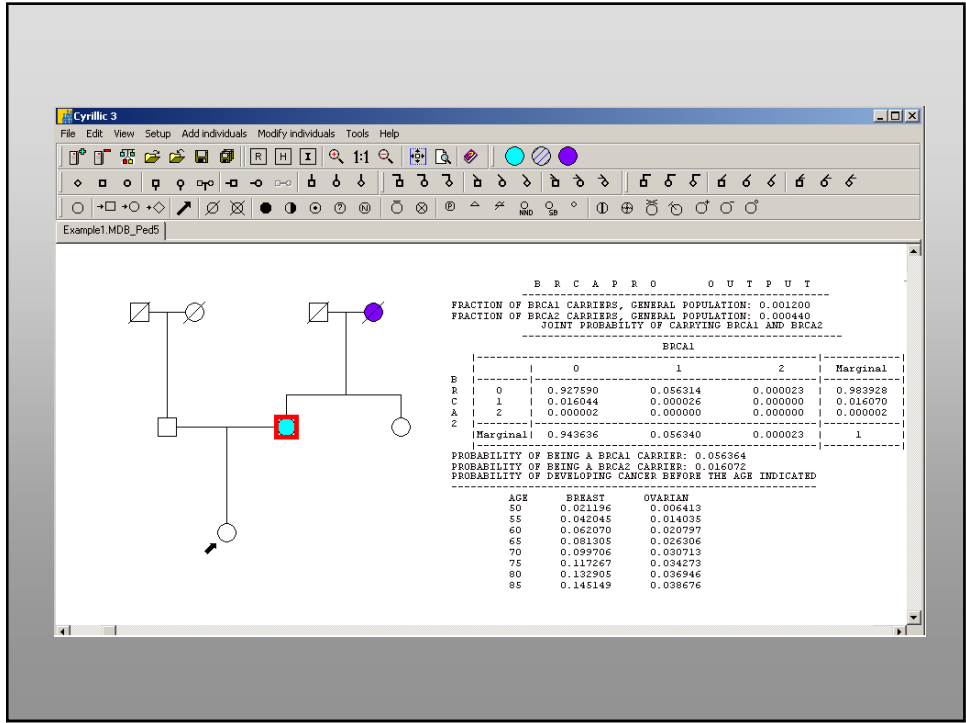
RAD.NEW (C:/LIVE.MIS 739)
Options Edit Help

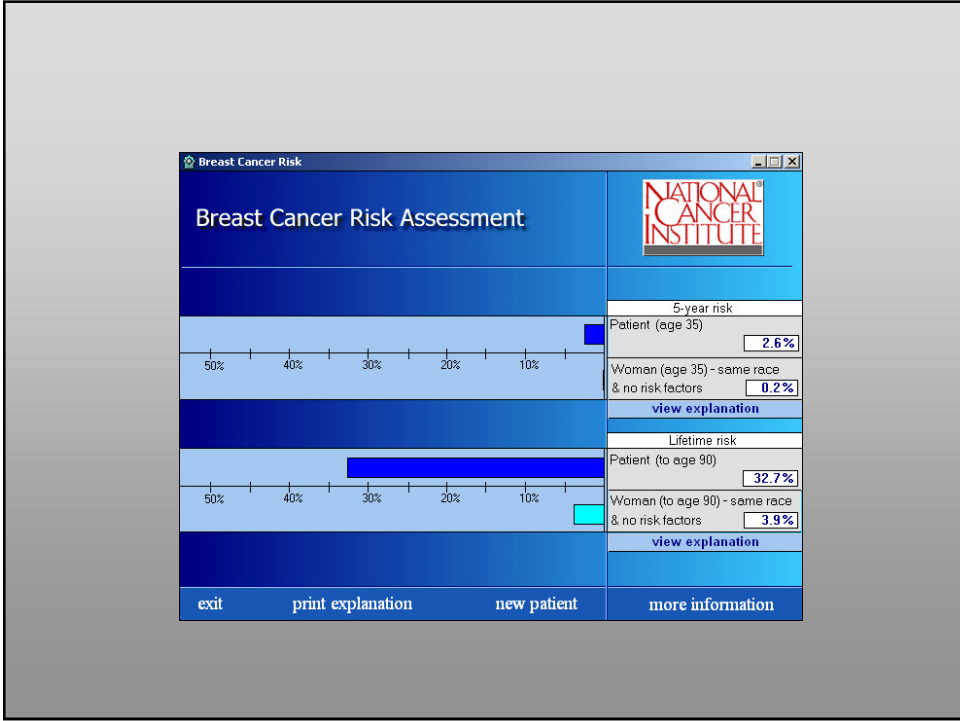
ASSESSMENT SCREENS - MAMMO
08/24/2005 MAMMO-MAMM MAMMO-RM2 0830

Implants: Side (Right or Left): [redacted] Date(s): [redacted]
Other Breast Surgery: Side (R or L): [redacted] Date(s): [redacted]
Cyst Aspiration within last month: [redacted]
Comments: [redacted]
Breast Cancer History:
Relation: [redacted] Age at diagnosis: [redacted] Side: [redacted]
Relation: [redacted] Age at diagnosis: [redacted] Side: [redacted]
Relation: [redacted] Age at diagnosis: [redacted] Side: [redacted]
Relation: [redacted] Age at diagnosis: [redacted] Side: [redacted]
Other Relatives: [redacted]
Family History of Cancer - Other than breast:
Relation: [redacted] Type: [redacted]
Relation: [redacted] Type: [redacted]
Relation: [redacted] Type: [redacted]
Other Relatives: [redacted]

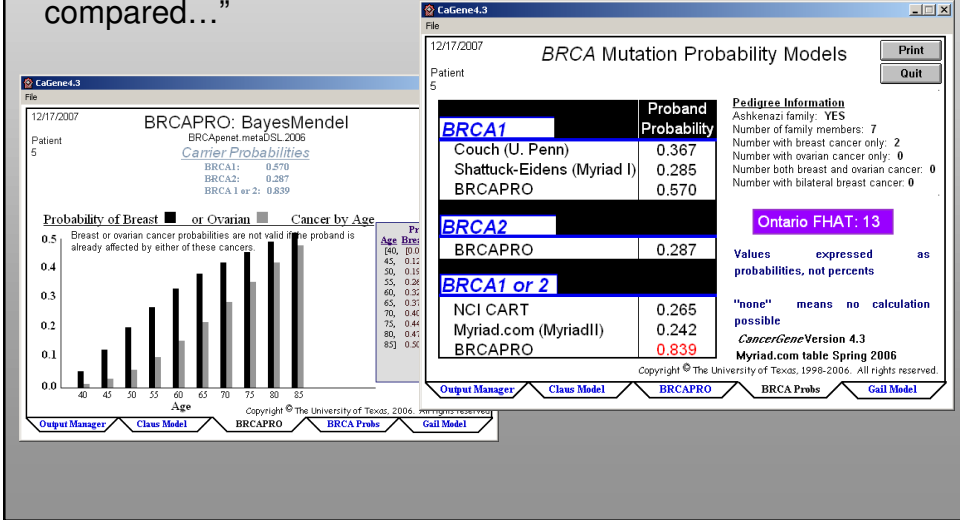
Screen 2 of 5
↓ = Down a Field ↑ = Up a Field Shft-Del = Erase Current Field
PgUp = Previous Screen PgDn = Next Screen F12 = File Data
Esc = Exit F4 = Clr All Flds F9 = Lookup

Start Microsoft Outlook RAD.NEW (C:/LIVE.MIS ... 11:22 AM





“...The strengths and weaknesses of the various models described here become apparent as the different output screens are accessed and compared...”



Synthesis Of Risk

Patient Name: JANE.DOE Unit Number: 99937832 Date Of Birth: 12/12/1965

Synthesis Of Risk

Breast/Ovarian Colon

	5 Year Breast	Lifetime Breast	5 Year Ovarian	Lifetime Ovarian	
Population Risk	N/A	N/A	N/A	N/A	
Model	Relative Risk	5 Year Breast	Lifetime Breast		
Gal	N/A	1.83 %	24.17 %		
Bodian (LCIS)	N/A	N/A	N/A		
Model	Risk of Mutation	5 Year Breast	Lifetime Breast	5 Year Ovarian	Lifetime Ovarian
BRCA Pro	30.38 %	3.52 %	23.45 %	0.85 %	13.4 %
Mynad	14 %	1.95 %	16.74 %	0.41 %	7.51 %
Synthesis Of Risk	35 %	3.97 %	25.36 %	0.98 %	17.42 %

Genetic Testing Recommendation:

Buttons: Exit, < Back, Next >, Explain

Patient Name: Test Patient One Unit Number: 99999789 Date Of Birth: 06/20/1975

Breast Colorectal

Mutation Risk

Model	Percent Chance of Mutation
Myriad 24	~25%
BRCAPro 38	~40%
Clinician 38	~40%

Risk of Cancer by Age

Age	Without Testing	Negative Test	BRCA1 Pos	BRCA2 Pos
55	0.08	0.05	0.12	0.10
60	0.15	0.08	0.20	0.18
65	0.22	0.12	0.28	0.25
70	0.28	0.15	0.35	0.32
75	0.32	0.18	0.40	0.38
80	0.35	0.20	0.42	0.40
85	0.38	0.22	0.44	0.42

Guideline: Test patient (no avail relatives) ?

Clinician: Test patient (no avail relatives)

Intervention	No Testing	Positive Test	Negative Test
Mastectomy	Consider	Consider	Not Recommended
Oophorectomy	Consider	Recommended	Not Recommended
MRI	Yearly	Yearly	Not Recommended
Clinical Breast Exam	Every 6 months	Every 6 months	Yearly

Buttons: Exit, Next

Patient Name: Test Patient One Unit Number: 99999789 Date Of Birth: 06/20/1975

Breast Colorectal

Colorectal Ovarian Breast

Mutation Risk

Risk of Cancer by Age

As her risk of mutation is 10% or greater, and her lifetime risk of breast cancer is 20% or greater, the patient does meet the ACS guidelines for MRI screening. While we will begin MRI screening now, it will be useful to consider genetic testing, which may provide us with sufficient information to possibly stop doing MRI.

Guideline: Test patient (no avail relatives) ?

Clinician: Test patient (no avail relatives)

Intervention	No Testing	Positive Test	Negative Test
Mastectomy	Consider	Consider	Not Recommended
Oophorectomy	Consider	Recommended	Not Recommended
MRI	Yearly	Yearly	Not Recommended
Clinical Breast Exam	Every 6 months	Every 6 months	Not Recommended

Exit

Next

Patient Name: Test Patient One 975

Breast Colorectal

Colorectal Ovarian Breast

Guideline: Test patient (no avail relatives)

Clinician: Test patient (no avail relatives)

Exit

Next

Accession Number: S99X41314 Report Status: Final Type: Surgical Pathology Pathology Report: S99-X41314 OPERATION DATE: 30 AUG 99 ACCESSIONED ON: 30 AUG 99 at 13:15
 CLINICAL DATA: Ductal carcinoma in situ with positive margin and residual calcium on outside biopsy.

***** FINAL DIAGNOSIS *** BREAST (LEFT), RE-EXCISION: ATYPICAL DUCTAL HYPERPLASIA, MULTIPLE FOCI, ADJACENT TO BIOPSY CAVITY, AND FOCALLY PRESENT AT MARGINS OF THE SPECIMEN. **LOBULAR NEOPLASIA (LOBULAR CARCINOMA IN SITU), LARGE STROMAL CALCIFICATIONS ADJACENT TO BIOPSY SITE, FIBROCYSTIC CHANGES WITH MICROCALCIFICATIONS. BREAST (LEFT FINAL SHAVED MARGINS): ATYPICAL DUCTAL HYPERPLASIA, SMALL FOCI.** Diagnosis by: MARYAM S. MOHAMMADKHANI, MD Signed On: 07 SEP 99 at 09:17

***** GROSS DESCRIPTION: Received fresh in the Frozen Section Laboratory, labeled with the patient's name, unit number, and "re-excision left breast," is an ovoid piece of breast tissue, 5.0 X 4.0 X 2.0 cm, the specimen is inked black, the superior margin marked by a short stitch is overinked yellow; the posterior margin, overinked orange; the inferior margin overinked blue. The lateral margin is oriented by the long black stitch. Serial sectioning reveals a biopsy cavity 1.5 X 1.0 X 0.8 cm, surrounded by fibrotic tissue with fat necrosis. This cavity is 0.3 cm from the anterior (closest margin). The remaining breast parenchyma appears grossly unremarkable. Also received is an additional fragment of unremarkable skin-covered fibrofatty tissue measuring 2.2 x 1.5 x 0.8 cm. SECTION CODE A and D: Biopsy cavity with anterior and superior margin. B and C: Biopsy cavity with anterior and inferior margin. E: Representative normal parenchyma (also posterior margin). F: Separate skin-covered fragment. J-M: Additional sections of biopsy cavity and surrounding parenchyma. Received fresh, labeled with the patient's name, unit number, and "left breast final shaved margin," are unoriented fragments of fibrofatty breast tissue, loosely aggregating to 3.5 X 3.0 X 0.7 cm. Submitted entirely in G-I. Resident: ANUPAMA GUPTA, MD *** INTRA-OPERATIVE DIAGNOSIS *** GROSS DIAGNOSIS, BREAST (LEFT), RE-EXCISION: PREVIOUS BIOPSY SITE: NO LESION GROSSLY SUSPICIOUS. O.R. Resident: VIKRAM DESHPANDE, MD O.R. Diagnosis by: Gurnaulgaur P. Nielsen, MD SOURCE OF CARE UNIT: SAME DAY SURGICAL UNIT - ACC3 REPORTS TO: Barbara Lynn Smith, M.D. PART A: BREAST (LEFT), RE-EXCISION PART B: BREAST (LEFT FINAL SHAVED MARGINS)

The screenshot shows a software interface with a search bar and an 'Assign selected' button. Below this is a table of 'IDC' Entities:

Entity	Entity Type
<input type="checkbox"/> DUCTAL ADENOCARCINOMA	IDC
<input type="checkbox"/> DUCTAL CARCINOMA INVADING	IDC
<input type="checkbox"/> INFILTRATING DUCTAL CARCINOMA	IDC
<input type="checkbox"/> INVASIVE CARCINOMA AND DUCTAL	IDC
<input type="checkbox"/> invasive carcinoma Grade of ductal	IDC
<input type="checkbox"/> INVASIVE CARCINOMA WITH DUCTAL	IDC
<input type="checkbox"/> INVASIVE DUCT CARCINOMA	IDC
<input type="checkbox"/> invasive ductal carcinoma	IDC

MRN	Key:	Imaging	Biopsy	Surgery
810798	171703	171503	172803	172803
824035	171503	172803	212003	212003
830117	212003	212003	212003	212003
830117	212003	212003	212003	212003
848722	312003	312003	312003	312003
848722	312003	312003	312003	312003
848722	312003	312003	312003	312003
848722	312003	312003	312003	312003
851244	423003	423003	423003	423003
851244	423003	423003	423003	423003
851244	423003	423003	423003	423003
870701	423003	423003	423003	423003
870701	423003	423003	423003	423003
871638	423003	423003	423003	423003
872810	423003	423003	423003	423003
872810	423003	423003	423003	423003
872810	423003	423003	423003	423003
872810	423003	423003	423003	423003
878051	423003	423003	423003	423003
878051	423003	423003	423003	423003
878051	423003	423003	423003	423003
878051	423003	423003	423003	423003
878051	423003	423003	423003	423003
878051	423003	423003	423003	423003

Patient Name: Test Patient One Unit Number: 99999789 Date Of Birth: 06/20/1975

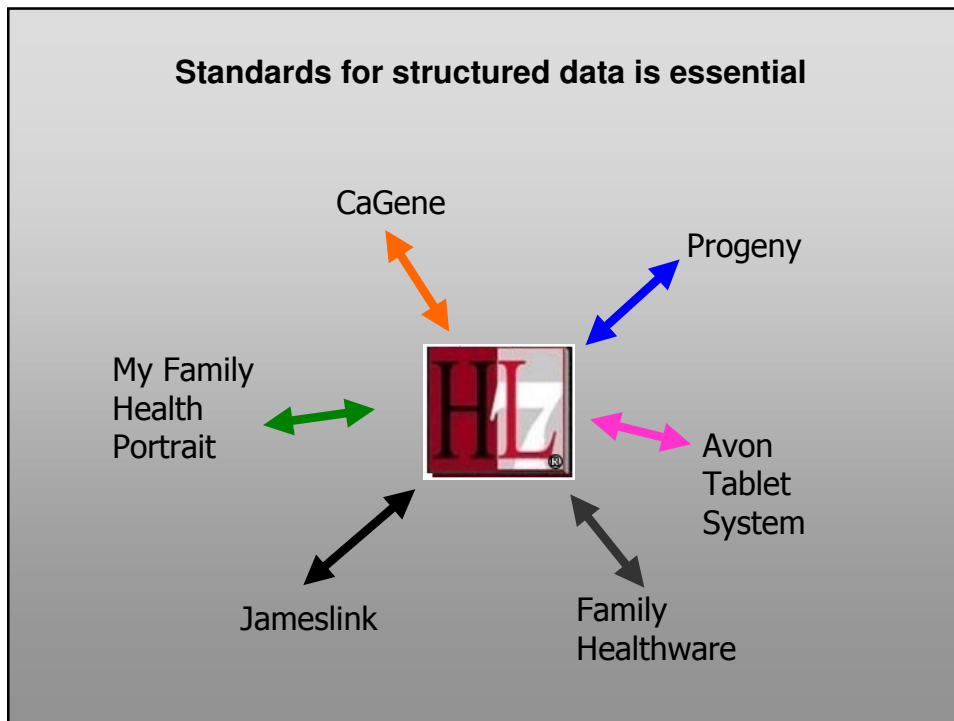
(2,049 Days,0.0) — Series 0 6/18/2008 — 12/4/2007 - 6/18/2008

Name	Value
Tumor size:	1.8 cm.
Grade:	3
Lymphatic vessel invasion:	Not identified.
Blood vessel invasion:	Not identified.
Margin of invasive carcino...	Invasive carcinoma extend...
Location of ductal carcino...	Within and beyond the regi...
Margin of ductal carcino...	Ductal carcinoma in-situ ex...
Diagnosis by:	Grace T.
McKee,MD Signed On:	27 AUG 01 at 15:21 Constu...

Menstrual History
 Age at first period: 12
 Still having periods:
 Age periods stopped:
 Hysterectomy:
 Hysterectomy age:
 Both ovaries removed:
 Menopausal Status:

Estrogen Replacement Therapy
 Used hormones:
 Age started:
 # years taken:

Chemoprevention
 Tamoxifen:
 Raloxifene:



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