THE IMPORTANCE OF COMORBIDITY TO CANCER STATISTICS – NEW YORK STATE TUMOR REGISTRY ASSOCIATION PRESENTATION COPYRIGHT NOTICE

The Importance of Comorbidity to Cancer Statistics

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Introduction

- Patients with cancer often have other diseases, illnesses, or conditions in addition to their index cancer
- These other conditions are generally referred to as *comorbidities*
- Although not a feature of the cancer itself, comorbidity is an important attribute of the patient
- Comorbidity has direct impact on the care of patients and the assessment of the quality of care

- In many cancers, comorbidity prognostically more important than tumor size or TNM stage
- Particularly important for slow growing cancers and cancers which affect older people
  - For example: breast; prostate; oral cavity, pharynx and larynx; bladder; ovary; uterus; and non-Hodgkin's lymphoma

IMPACT OF PROGNOSTIC COMORBIDITY ON FIVE-YEAR SURVIVAL RATES

Prognostic Comorbidity	Rectum Cancer	Larynx Cancer	Endometrial Cancer	Larynx Cancer	Prostate Cancer
Absent	85/264 (32%)	93/172 (54%)	102/131 (78%)	123/166 (74%)	137/229 (60%)
Present	6/54 (11%)	3/20 (15%)	3/11 (27%)	4/27 (15%)	6/38 (16%)
Total	91/318 (29%)	96/192 (50%)	105/142 (74%)	127/193 (66%)	143/267 (54%)
χ^2	9.76	10.94	3.54	36.27	25.41
p value	0.0018	0.0009	0.0599	<0.0001	<0.0001

Denominators- number of patients in each category
Numerators- corresponding number of five-year survivors

Comorbidity Impact on Therapy

- The use of preferred therapy might be contraindicated due to the presence of comorbid ailments
- There are two distinct ways that comorbid ailments might impact on type of therapy

- The comorbid ailment(s) may render an overall prognosis so poor for the patient that she may be denied an otherwise desirable treatment for the index cancer

- A particular type of comorbid ailment(s) may affect the patient's ability to tolerate a particular type of therapy

Prostate Cancer Example

- Desch et al studied treatment recommendations for local or regional prostate cancer
- As comorbidity increased, the proportion of men receiving no treatment rose correspondingly
- Fewer than 30% of men with the most significant level of comorbidity received surgery, radiation therapy, or combinations of aggressive therapy as compared with almost 55% of men who had no comorbid ailments

Breast Cancer Example

- Greenfield et al conducted a retrospective review to examine whether physicians provide less vigorous treatment for elderly patients with breast cancer
- Sample included women with breast carcinoma that received their primary cancer management at one of seven hospitals in southern California
- Appropriate treatment defined according to *criteria map* that incorporates widely accepted practice standards

Relation of the Comorbidity Index (CI) to Physician Management of Breast Cancer

	Number (%) of Patients With Treatment		
CI Score	Inappropriate	Appropriate	Total
0-1	53 (19)	231 (81)	284
2	37 (41)	53 (59)	90
Total	90 (24)	284 (76)	374 (100)

$P<0.001$ $\chi^2=17.640$ Yates corrected

Head and Neck Cancer Example

Prognostic Comorbidity	Initial Treatment Radiation Therapy Only	Odds Ratio (95% CI)
Absent	84/311 (27%)	1.0
Present	23/45 (51%)	2.82 (1.50-5.29)
Total	107/356 (30%)	

Quality of Care Example

Greenfield et al studied whether differences in mortality rates for 969 patients with incident cases of breast, colorectal, and prostate cancers across seven hospitals in southern California could be accounted for, in part, by patient's differing levels of comorbidity on admission

- Of the seven hospitals, the three with the highest mortality had been pinpointed by the *Los Angeles Times* as high mortality outliers
- The percentage of patients with severe comorbidity scores ranged from 9% to 18% across the seven hospitals ($p<0.01$)
- The rankings of hospitals varied depending on whether one adjusted for age, comorbidity level, or cancer stage

Quality of Care Example

- Begg et al used the SEER-Medicare linked database to study the relationship between the volume of major cancer surgeries performed and the hospital operative mortality rate

- The investigators used the Medicare discharge summary from the index hospitalization to generate a comorbidity severity score

- Higher surgical volume was linked with lower mortality

- This volume -- mortality relationship persisted even after adjustment for age and comorbidity

- By having comorbidity information, the authors were able to rebut the complaint that high volume hospitals were, in some way, selecting less sick patients

Clarify Impact of Other Variables

- Comorbidity assessment important even when it is not independently statistically significant
- Hillner found decrease likelihood of axillary node dissection with increasing comorbidity
- After adjusting for age and size of primary tumor, comorbidity no longer associated with node dissection
- Inclusion of comorbidity allowed for more robust conclusions about age

Comorbidity Instruments

- Several instruments have been developed to classify different comorbid diseases and to quantify the severity of the overall comorbid condition
- None of the instruments were specifically designed to study comorbidity in cancer patients
- Nevertheless, these instruments have been used to classify comorbidity in several types of cancers and have performed well

- Instruments to measure the severity of comorbidity can be classified into four mutually exclusive groups depending on the

  - origin of the data
    (medical record review *vs.* claims-based)

  - applicability of the instrument
    (general *vs.* disease-specific)

Medical Record Review

- Kaplan-Feinstein Index
- Charlson Comorbidity Index
- The Index of Co-Existent Disease

Kaplan-Feinstein Index

- Developed from the study of comorbidity in patients with diabetes mellitus
- The KFI has been used to study the impact of comorbidity in several cancers
- Specific diseases and conditions are classified into four groups-- none, mild, moderate, or severe according to severity of organ decompensation and prognostic impact

Kaplan, Feinstein. *J Chron Dis.* 1974;27:387-404

Example

Congestive Heart Failure

- Mild – Exertional or paroxysmal dyspnea which has responded to treatment
- Moderate – Hospitalized more than six months ago
- Severe – Hospitalized within last 6 months or ejection fraction < 20%

Overall Comorbidity Score

- Highest ranked single ailment
- In cases where two or more Moderate ailments occur in different organ systems, the Overall Comorbidity Score should be designated as Severe

Example

CONDITION	DECOMPENSATION
Myocardial Infarct more than 6 months ago	Moderate
DBP 90-114 mm Hg	Mild
History of alcohol abuse, but not presently drinking	Mild
Overall Comorbidity Score	Moderate

Example

CONDITION	DECOMPENSATION
Chronic exertional angina	Moderate
Major depression controlled with medication	Mild
Diabetes requiring insulin	Moderate
Overall Comorbidity Score	Severe

Modified Kaplan-Feinstein Index

- KFI modified for two important reasons:
  1. Did not include diabetes since this was index disease
  2. Did not include several other important conditions. For example, AIDS and dementia

- The investigators sought advice from clinical experts and the published literature to assign levels of comorbidity to the ailments not included in KFI

Modified Medical Comorbidity Form

Identify the important medical comorbidities and grade severity using the index. Overall Comorbidity Severity Score is defined according to the highest ranked single ailment, except in the case where two or more Grade 2 ailments occur in different organ systems. In this situation, the patient's comorbid severity should be designated Grade 3.

Cogent comorbid ailment	Grade 3 Severe Decompensation	Grade 2 Moderate Decompensation	Grade 1 Mild Decompensation
Cardiovascular System			
Myocardial Infarct	M.I. w/in past 6 months	History of multiple M.I.s in past	M.I. more than 6 months ago. ECG evidence of coronary disease.
Angina	Hosp. for angina pectoris. Unstable angina. Severe CAD as documented by cath.	Chronic exertional angina. Recent CABG for severe CAD (w/in past 6 months). Angina pectoris not requiring hospitalization.	Acute angina. Angina attack compensated with treatment. CABG for severe CAD (> 6 mo.)
Congestive Heart Failure	CHF w/in past 6 months H/o Transplant w/in past 6 months or acute rejection. Ejection < 20%	CHF > 6 months Transplant >6 months and/or no rejection	Exertional dyspnea. PND

Charlson Comorbidity Index (CCI)

- Developed from studies of one-year mortality for patients admitted to a medical unit of a teaching hospital
- Scores for comorbid diseases derived from a weighted index based on the adjusted relative risk of mortality associated with each disease
- Total score is sum of weighted scores

Charlson ME, *et al.* J Chron Dis 1987;40(5):373-383.

Index of Co-Existent Disease (ICED)

- Designed to predict LOS and resource utilization after hospitalization
- Instrument assesses patient status in two domains
  - Individual Disease Severity (IDS)
    - reflects severity of health categories (0-4)
  - Functional Severity
    - assesses physical impairment before treatment (0-2)
- Peak intensities for each domain are grouped to give ICED score (0-3)

Greenfield S, *et al.* Med Care 1993;31(2):141-154.

Claims-Based

- Modifications of Charlson
  - Dartmouth-Manitoba ICD-9 conversion algorithm
  - Deyo et al
  - Ghali et al
- Von Korff et al chronic disease score from automated pharmacy records

Charlson Comorbidity Index—Electronic Version

Assigned weights for diseases	Conditions	ICD-9-CM Codes
2	Hemiplegia	344.1, 342-342.9
	Moderate or sever renal disease	582-582.9, 583-583.7, 585, 586, 588-588.9
	Diabetes with end organ damage	250.4-250.6
	Any tumor	140-172.9, 174-195.8
	Leukemia	204-208.9
	Lymphoma	200-203.8
3	Moderate or severe liver disease	572.2-572.8, 456.0-456.21
6	Metastatic solid tumor	196-199.1
	AIDS	042-044.9

Impact of Methods of Assessment

- Concato et al studied the association of comorbidity, as assessed by medical record review, and operative mortality after transurethral resection of the prostate (TURP) and open prostectomy (OPEN) for patients with benign prostatic hypertrophy
- Previous research, using administrative databases, had shown the relative risk of 5-year mortality for TURP was elevated, relative to OPEN

- These findings were counter-intuitive since TURP is a less invasive procedure and would be expected to have lower mortality rates

- In addition, procedure-associated mortality would be expected to occur within 30 days of the procedure and would not be significant at five-year follow-up

- Concato performed detailed chart review to assign levels of comorbidity based on several different comorbidity indices to 250 men undergoing TURP or OPEN prostectomy between 1979 and 1981
- For the TURP group, the crude 5-year mortality rate was 17.5% (22 of 126 patients) and for the OPEN group 13.5% (17 of 126 patients)
- Patients who received TURP were older and had a higher level of comorbidity than patients undergoing OPEN

- As the detail and quality of the assessment of comorbidity increased, the adjusted risk of mortality after TURP decreased

- Concato concluded that comorbidity adjustment is complex and that inadequate or incomplete assessment of comorbidity may lead to false conclusions regarding relative treatment effectiveness

Medical Record Approach

- Comorbidity severity can be assigned to a majority of patients within tumor registry
- Very accurate assessment of comorbidity
- Comorbidity coding added approximately 3% additional work effort

Claims-Based Approach

- Available in many states for many people
- Attractive alternative to more expensive methods of ascertaining comorbidity
- Claims-based databases may not be available for all patients in a tumor registry
- Less accurate assessment

- As part of a National Cancer Institute-sponsored cancer education grant, five Certified Tumor Registrars (CTR) were taught to code comorbidity
- A modification of Kaplan-Feinstein Index was used to classify different comorbid diseases and to quantify the severity of the overall comorbid condition
- The goal of this presentation is to describe the results of the comorbidity education program and to demonstrate the impact of comorbidity

Education Program

- Entire education program lasted 10 hours
- The importance of comorbidity
- Use of the Modified Kaplan-Feinstein Instrument
- Documentation book and clinical examples
- Comments and observations were incorporated into the education program

Educational Program Assessment

- CTR coding performance was assessed with weighted kappa statistic, sensitivity, specificity, and interviews
  - Trained research assistant and co-investigators served as “gold standard” for the assessment of overall comorbidity
  - Difficulty coding and time commitment

- Weighted kappa statistic – the degree of agreement beyond what would be expected by chance
  - .41 - .60 Moderate
  - .61 - .80 Substantial
  - .81 - 1.00 Almost perfect
- Sensitivity – the proportion of correctly identified individuals with severe comorbidity
- Specificity – the proportion of correctly identified individuals without severe comorbidity

- The study population consisted of five CTR from Barnes-Jewish Hospital
- Two senior registrars and three new registrars
- Registrars coded comorbidity severity from the medical records of new cancer patients

CTR Coding Performance

CTR	WEIGHTED KAPPA	SENSITIVITY	SPECIFICITY
1 SENIOR	**0.95**	3/3 = **100%**	14/16 = **88%**
2 SENIOR	**0.93**	1/1 = **100%**	16/18 = **89%**
3 NEW	**0.85**	3/3 = **100%**	14/15 = **93%**
4 NEW	**0.79**	3/4 = **75%**	14/14 = **100%**
5 NEW	**0.86**	5/7 = **71%**	14/14 = **100%**

How difficult is coding comorbidity?

CTR	How difficult is coding comorbidity?
1	Slightly
2	Not at all
3	Not at all
4	Slightly
5	Slightly

"Once it's incorporated into the routine, it's no big deal."
"Comorbidity is no harder than any other thing (in the abstraction)."
"It's hard to learn as a new abstracter, but for an experienced abstracter, it would be a snap."

How time consuming is coding comorbidity?

CTR	How time consuming?	Average time to abstract chart (minutes)	Average time to code comorbidity (minutes)
1	Slightly	30-60	2
2	Slightly	90	15
3	Not at all	30	1
4	Not at all	45-60	3
5	Not at all	90	2

"You are weeding through the chart anyway,
so it doesn't take much time."

Association of Baseline and Clinical Features with Survival

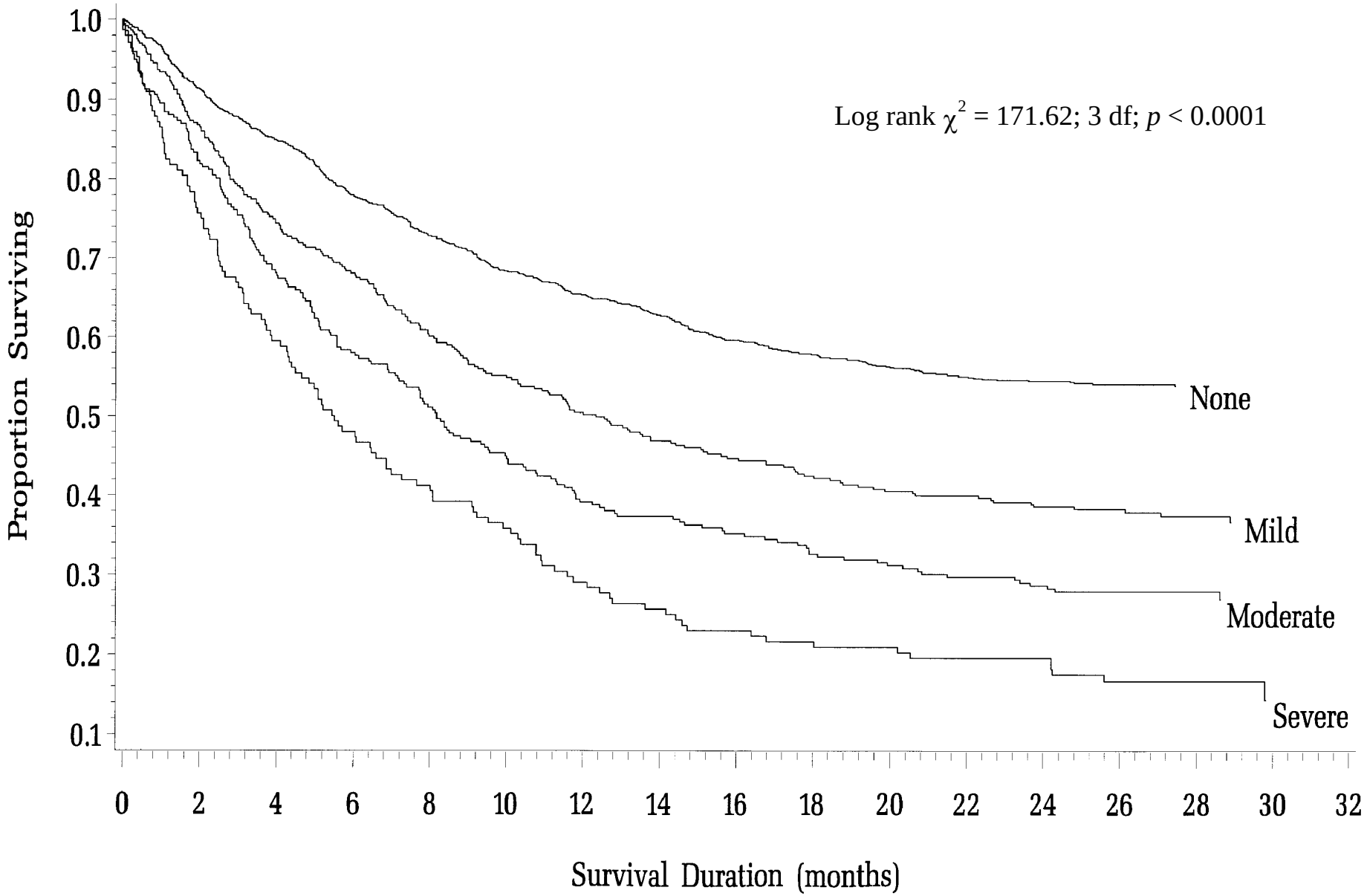
Variable	Category	N	Two-year survivors, n	Two-year survival rate, %
Total	--	1721	756	44
Age group ***	≤ 50	273	145	53
	51-60	363	187	52
	61-70	494	218	44
	71-80	402	159	34
	≥ 80	189	47	25
Gender	Male	944	428	45
	Female	777	328	42

Variable	Category	N	Two-Year survivors,n	Two-Year survival rate, %
Race* **	White	1378	652	47
	Black	333	101	30
Comorbidity* **	None	668	352	53
	Mild	264	104	39
	Moderate	198	54	27
	Severe	101	22	22
Anatomic Site* **	Prostate	298	272	91
	Breast	161	117	73
	Female	157	81	52
	Head & Neck	58	25	43
	Lung	254	49	19
	Brain	47	6	13
	Colorectal	57	6	10
	Other	689	200	29

Variable	Category	N	Two-Year survivors,n	Two-Year survival rate, %
TNM* **	In-Situ	27	24	89
	I	427	313	73
	II	198	127	64
	III	110	28	25
	IV	469	40	8

Impact of Comorbidity on Survival

N = 1721



Cox Proportional Hazards Multivariate Regression Model

Variable	Category	Risk Ratio	95% CI	p Value
Age	≤50	1	--	--
	51-60	1.25	0.96-1.54	0.1137
	61-70	1.60	1.28-2.00	0.0001
	71-80	1.84	1.47-2.29	0.0001
	>80	2.48	1.93-3.19	0.0001
Gender	Male	1	--	--
	Female	1.19	1.03-1.38	0.016
Race	White	1	--	--
	Black	1.25	1.08-1.45	0.0037
Comorbidity	None	1	--	--
	Mild	1.34	1.14-1.58	0.0005
	Moderate	1.48	1.24-1.77	0.0001
	Severe	2.01	1.63-2.48	0.0001

Variable	Category	Risk Ratio	95% CI	p Value
Anatomic Site	Prostate	0.23	0.14-0.39	0.0001
	Breast	1.03	0.64-1.65	0.9070
	Female	1.74	1.13-2.68	0.0119
	Head & Neck	1	--	--
	Lung	2.12	1.47-3.07	0.0001
	Brain	2.48	1.55-3.97	0.0001
	Colorectal	2.30	1.47-3.61	0.0003
	Other	1.86	1.30-2.66	0.0006
TNM Stage	In-Situ	0.442	0.21-0.95	0.0359
	I	1	--	--
	II	1.21	0.93-1.58	0.1516
	III	2.64	2.11-3.29	0.0001
	IV	5.32	4.34-6.53	0.0001

Conclusions

- Results show that CTRs can code comorbidity efficiently and effectively
- Severity of comorbidity is associated with survival, selection of initial treatment, and assessment of quality of care
- Therefore, comorbidity coding should be included in hospital-based and national cancer registries

Future Work

- To demonstrate that the teaching program has broad generalizability to CTRs at five different oncology data centers across the United States (i.e., small, rural, community and large, urban centers)
- The intended outcome of this project is the demonstration of the validity and generalizability of the educational program created at Barnes-Jewish Hospital

Once it has been demonstrated that comorbidity can be coded accurately and reliably at non-academic medical centers, we plan to work with the American College of Surgeons' Commission on Cancer, the National Cancer Registrars Association, and the North American Association of Central Cancer Registries to advocate for the inclusion of comorbidity information in national cancer databases