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Inter-Rater Reliability Assessment and Electronic Collaborative Stage Data Collection in Ontario, Canada

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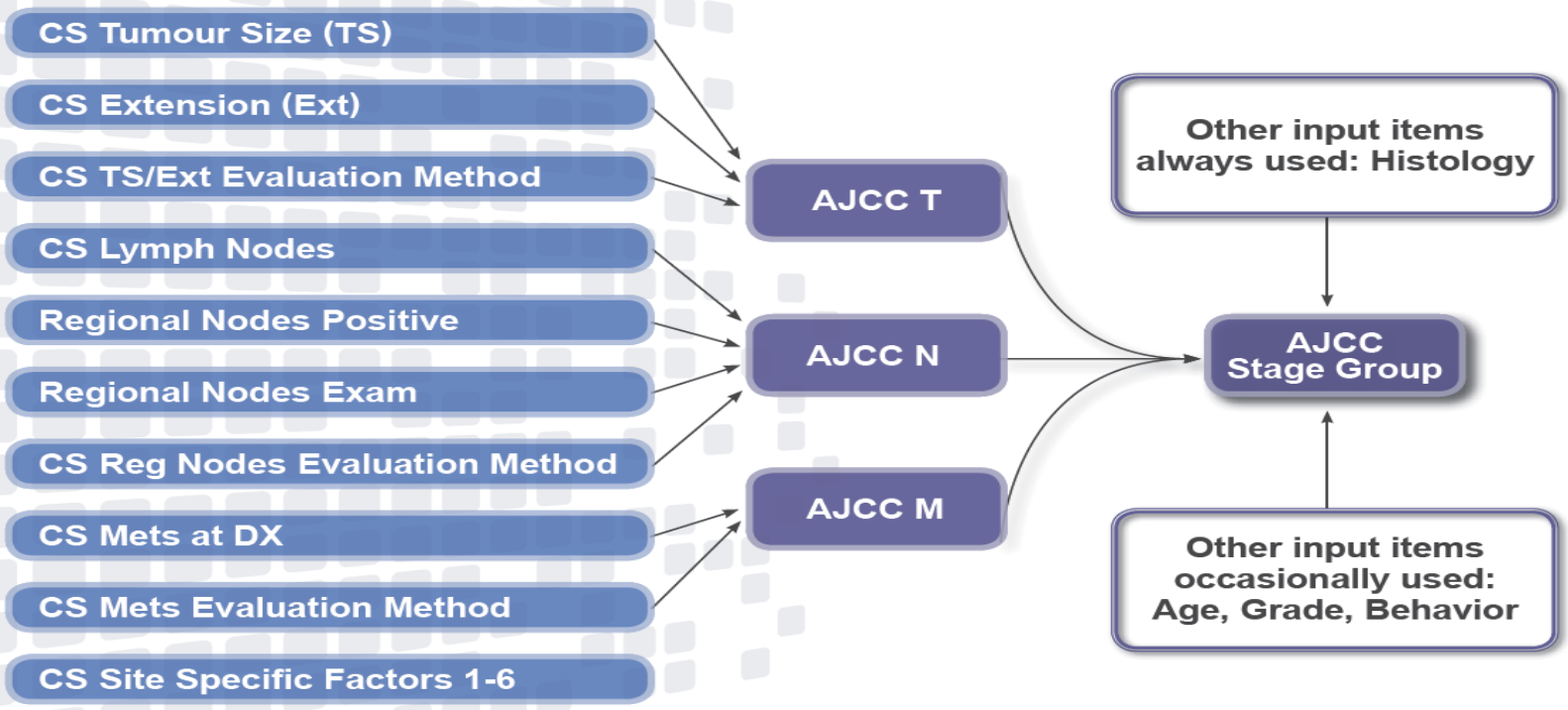
Better cancer services every step of the way

CS is the new standard in Ontario for cancer staging beginning with 2007 cases

- CS is replacing TNM reporting to align with pan-Canadian guidelines

Schematic Diagram of Relationships of Inputs and Outputs for Collaborative Staging v1 to TNM System



CS implementation in Ontario led by CCO with all acute care hospitals

- A provincial initiative that aims to improve the quality & completeness of cancer staging data in Ontario
- CS data collection system
  - CCO trained analysts
  - Remote access to hospital records
  - Registry Plus™ software developed by CDC
- CS data collection initiated in 71 non-Cancer Centre hospitals for top 4 disease sites from 2007 forward
  - 14 Cancer Centres to start with 2010 diagnosis year

Robust data quality program Implemented to ensure CS data is of high quality

- Providing extensive ongoing training of centralized CCO analysts with support from the Public Health Agency of Canada

- Comprehensive array of DQ measures implemented to assess and monitor multiple dimensions of data quality
  - **Reliability**
  - Timeliness
  - Completeness
  - Validity
  - Usability

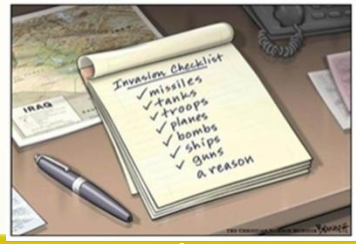
- Bi-annual reporting of stage data with chart level reporting for all staged cases is being provided to all participating hospitals

Comprehensive inter-rater reliability assessment undertaken

- Measures the degree to which the same stage result can be obtained through re-abstraction process among CS analysts
- Assesses stage data quality for the dimension of reliability
- High inter-rater reliability assures data users that there has been consistent application of CS data collection system rules by CS analysts

Process for Assessing Inter-rater Reliability (IRR)

1. Chose reliability indices/measures
2. Established an acceptable level of reliability
3. Tested selected reliability indices with a small subgroup of cases
4. Determined sample size of cases and randomly selected charts for IRR study
5. Calculated reliability results for 5 CS analysts involved in IRR study
6. Analyzed results and identified opportunity for improvement in CS abstraction



Indices selected to assess inter-rater reliability

Index	Multiple coders	Metric	Chance agreement	Agreement/ correlation
Percentage agreement	N	Nominal	N	Agreement
Scott's Pi	N	Nominal	Y	Agreement
Cohen's kappa	Y	Nominal	Y	Agreement
Krippendorff's Alpha	Y	Nominal,Ordinal ,Interval, Ratio	Y	Both
Perreault's Pi	N	Nominal	Y	Agreement
Spearman's Rho	Y	Ordinal	N	Correlation
Pearson's r	Y	Interval	N	Correlation

Two indices used to measure inter-rater reliability

- Modified Percent Agreement
- Krippendorff's alpha

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Modified Percent Agreement

- Percent Agreement= $\left(\frac{O_a}{O_a + O_d}\right)*100$
  - Where O_a is observed agreement; O_d is observed disagreement
- Percent agreement = Number of agreements of group stage scores divided by the number of total decisions (agreements + disagreements)
  - Modified agreement is assumed when three or more of the five analysts produce the same stage value for a case.
- Advantages - easy to calculate even with multiple analysts; provides information at analyst level
- Limitations – does not consider agreement due to chance; therefore Krippendorf's alpha is also used to mitigate this issue

Krippendorff Alpha

- Krippendorff's Alpha is expressed as

$$\alpha = 1 - \frac{D_o}{D_e}$$

Krippendorff (2007)

Where

Do = disagreement, observed

$$D_o = \frac{1}{n} \sum_c \sum_k o_{ck \text{ metric}} \delta^2_{ck}$$

De = disagreement, expected by chance

$$D_e = \frac{1}{n(n-1)} \sum_c \sum_k n_c \cdot n_{k \text{ metric}} \delta^2_{ck}$$

- Advantages – can apply to multiple metrics, multiple coders; Considers agreement by chance, and for missing data
- Limitations – complex calculation, does not provide information at analyst level, more conservative measure relatively

Inter Rater Reliability Assessment: Defining acceptable level of reliability

Value	Level of Agreement
<=0	none
0.01-0.20	poor
0.21-0.40	slight
0.41-0.60	fair
0.61-0.80	good
0.81-0.92	very good
0.93-1.00	excellent

Inter Rater Reliability Assessment: Sample Size Determination

An approximation to the sample size will be determined by following formula (Douglas G. Bonett, 2002)

$$n = 8z_{\alpha/2}^2\{(1-\tilde{\rho}_I)^2(1+(k-1)\tilde{\rho}_I)^2\}/\{k(k-1)w^2\}+1$$

- Where
- $Z_{a/2}{}^2$ is the point on a standard normal distribution exceeded with probability α/2
- ρ_i is Intra-class correlation coefficient
- W is desired width obtained by setting w= $2z_{\alpha/2}(\mathrm{var}\ \hat{\rho}_I)^{1/2}$
- K is number of CS analysts

Inter Rater Reliability Assessment: Sample Size

- **Assumptions:**
  - Two-way random effects model was used in the analysis.
  - α=0.05, two-sided;
  - power=0.80;
  - ρ_i is Intra-class correlation coefficient, it was from pilot study and is 0.70
  - W=0.20;
  - K=5
- Final total sample size for four disease sites is 198
- Random cases selected from hospitals and coded by five raters: 49 colorectal cancers (CRC), 49 lung cancers, 48 breast cancers and 52 prostate cancers.

Results: Percent Agreement on Derived AJCC Group Stage

Diagnosis Site	Coder 1	Coder 2	Coder 3	Coder 4	Coder 5	All
BREAST	91.3	**65.2**	97.8	84.8	91.3	86.1
CRC	98	92.2	96.1	88.2	92.2	93.3
LUNG	86.5	88.5	92.3	86.5	88.5	88.5
PROSTATE	94.2	88.5	94.2	96.2	94.2	93.5
Total	92.5	**84.1**	95	89.1	91.5	90.4

Results: Krippendoff Alpha

Scenario	Diagnosis Site	Alpha	CI 95%
Scenario one: no any exclusion, data as nominal	**CRC**	0.85	0.82--0.89
	LUNG	0.69	0.63--0.74
	BREAST	0.69	0.64--0.73
	PROSTATE	0.79	0.74--0.84
	All four diagnosis	0.8	0.78--0.82
Scenario two: stage unknown as missing, data as nominal	**CRC**	0.92	0.89--0.94
	LUNG	0.76	0.71--0.80
	BREAST	0.89	0.85--0.93
	PROSTATE	0.91	0.86--0.95
	All four diagnosis	0.89	0.88--0.91
Scenario three: stage unknown as missing, stage value was truncated as ordinal (0,1,2,3,4)	**CRC**	0.98	0.96--0.99
	LUNG	0.88	0.84--0.91
	BREAST	0.95	0.94--0.97
	PROSTATE	0.94	0.90--0.98
	All four diagnosis	0.96	0.95--0.97

Findings

- "Good" or "Very Good" level of reliability was found in the abstraction of CS data
- Opportunities to improve CS data collection processes were identified and mplemented
  - Provided additional education on application of rules to assign Stage Unknown for breast and lung cancer cases (esp for one CS analyst)
  - Introduced tools to monitor participation of CS analysts in education and training (and processes for follow-up if sessions are not attended)
  - Created better access to training materials and resources for CS analysts to apply in daily practice

Next steps:

- Establishing process for performing inter-rater reliability (IRR) assessment on regular basis
- Reviewing whether future assessments should consider options for a gold standard based audit i.e., comparison of physician staging

Questions?

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