DISPARITIES IN SYSTEMIC THERAPY USE IN ADVANCED-STAGE NON-SMALL CELL LUNG CANCER BY SOURCE OF HEALTH INSURANCE

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CALIFORNIA CANCER REPORTING AND EPIDEMIOLOGIC SURVEILLANCE (CALCARES) PROGRAM
NAACCR ANNUAL CONFERENCE
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BACKGROUND

Second most common cancer

Leading cancer-related cause of death

Non-small cell lung cancer (NSCLC) is most common type (~84%)

50% diagnosed at an advanced stage
  • 5 year survival 4.5% distant disease
BACKGROUND

Systemic treatments are primary treatment
- Chemotherapy
- Targeted therapy
- Immunotherapy

Treatment choice
- Histology
  - Nonsquamous
  - Squamous
BACKGROUND

Nonsquamous

- Chemotherapy
- Targeted Therapy
- Immunotherapy

Squamous

- Chemotherapy
BACKGROUND

Nonsquamous

- Chemotherapy
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Squamous

- Chemotherapy
OBJECTIVES

1. Describe systemic therapy utilization among stage IV NSCLC patients
2. Describe survival differences among treatment groups
3. Investigate disparities in treatment use by source of health insurance
METHODS

• California Cancer Registry data
• Manual review of treatment text fields for stage IV NSCLC patients diagnosed 2012-2014
• Categorize 6 treatment regimens that align with NCCN guidelines
  1. Platinum Doublets
  2. Pemetrexed-based
  3. Bevacizumab-based
  4. Pemetrexed + Bevacizumab
  5. Single Agents
  6. Tyrosine Kinase Inhibitors
• Cox PH models: survival differences among treatment groups
• Logistic regression models: association between health insurance type and treatment
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• Cox PH models: survival differences among treatment groups
• Logistic regression models: association between health insurance type and treatment
RESULTS

17,310 patients
24,845 text field records, manually reviewed
Specific treatments for 78%
OBJECTIVES

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RESULTS

Squamous, n=3,165

- Platinum Doublets: 33.6%
- Pemetrexed-based: 0.4%
- Bevacizumab-based: 0.8%
- Pemetrexed + Bevacizumab: 0.1%
- Single Agents: 2.9%
- Tyrosine Kinase Inhibitors: 1.0%
- Chemo Not Otherwise Specified: 5.7%
- No Treatment: 37.8%
- Unknown: 17.6%
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RESULTS

Nonsquamous, n=14,145

- Platinum Doublets: 11.5%
- Pemetrexed-based: 14.8%
- Bevacizumab-based: 3.6%
- Pemetrexed + Bevacizumab: 4.5%
- Single Agents: 1.6%
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- Chemo Not Otherwise Specified: 4.5%
- No Treatment: 30.3%
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Hazard Ratios for Overall Survival for Treatment Groups

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<thead>
<tr>
<th>Treatment Group</th>
<th>HR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
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<tbody>
<tr>
<td>Platinum doublets (reference)</td>
<td>1.00</td>
<td>0.79-0.9</td>
<td></td>
</tr>
<tr>
<td>Pemetrexed-based</td>
<td>0.85</td>
<td>0.65-0.8</td>
<td>&lt;0.001</td>
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<tr>
<td>Bevacizumab-based</td>
<td>0.73</td>
<td>0.62-0.7</td>
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<tr>
<td>Pemetrexed+Bevacizumab-based</td>
<td>0.69</td>
<td>1.02-1.3</td>
<td></td>
</tr>
<tr>
<td>Single Agents</td>
<td>1.18</td>
<td>1.02-1.3</td>
<td>0.03</td>
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Adjusted for sex, race/ethnicity, insurance type, SES, rural/urban residence, age at diagnosis, comorbidity score, NCI designation, radiation treatment, time to treatment.
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<tr>
<td>Pemetrexed-based (reference)</td>
<td>1.00</td>
<td>1.09-1.2</td>
<td></td>
</tr>
<tr>
<td>Platinum doublets</td>
<td>1.17</td>
<td>6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Bevacizumab-based</td>
<td>0.86</td>
<td>0.77-0.9</td>
<td>0.006</td>
</tr>
<tr>
<td>Pemetrexed+Bevacizumab-based</td>
<td>0.81</td>
<td>9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Single Agents</td>
<td>1.38</td>
<td>1</td>
<td>&lt;0.001</td>
</tr>
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Tyrosine kinase inhibitors

0.72 8  <0.001
### RESULTS

**Nonsquamous, n=14,145**

- **Platinum Doublets**: 11.5%
- **Pemetrexed-based**: 14.8%
- **Bevacizumab-based**: 3.6%
- **Pemetrexed + Bevacizumab**: 4.5%
- **Single Agents**: 1.6%
- **Tyrosine Kinase Inhibitors**: 11.9%
- **Chemo Not Otherwise Specified**: 4.5%
- **No Treatment**: 30.3%
- **Unknown**: 17.3%
Percentage Treatment by SES

Bevacizumab-based

TKIs

0% 10% 20% 30% 40%

1 (Low) 2 3 4 5 (High)

14% 12% 21% 16% 14% 9% 16%
OBJECTIVES

1. Describe systemic therapy utilization among stage IV NSCLC patients
2. Describe survival differences among treatment groups
3. Investigate disparities in treatment use by source of health insurance
ASSOCIATION BETWEEN HEALTH INSURANCE TYPE AND TREATMENT

Logistic regression

Outcome:
1. Any systemic treatment (yes/no)
2. Bevacizumab combinations or TKIs (yes/no)

Predictor: Type of health insurance
1. Private
2. Medicare
3. Medicaid/Other public
4. Medicare-Medicaid Dual Eligible
5. Military
6. Uninsured
Any systemic treatment (yes/no)

- Platinum Doublets: 15.5%
- Pemetrexed-based: 12.2%
- Bevacizumab-based: 3.1%
- Pemetrexed + Bevacizumab: 3.7%
- Single Agents: 1.9%
- Tyrosine Kinase Inhibitors: 9.9%
- Chemo Not Otherwise Specified: 4.7%
- No Treatment: 31.8%
- Unknown: 17.3%
Association between health insurance type and receipt of systemic treatment

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</tr>
<tr>
<td>Medicare</td>
<td>0.98</td>
<td>0.86-1.11</td>
<td>0.75</td>
</tr>
<tr>
<td>Medicaid/Other public</td>
<td>0.40</td>
<td>0.35-0.46</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Medicare-Medicaid Dual-Eligible</td>
<td>0.87</td>
<td>0.80-0.96</td>
<td>0.005</td>
</tr>
<tr>
<td>Military</td>
<td>0.72</td>
<td>0.56-0.93</td>
<td>0.01</td>
</tr>
<tr>
<td>Uninsured</td>
<td>0.29</td>
<td>0.22-0.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Unknown</td>
<td>0.61</td>
<td>0.46-0.80</td>
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Adjusted for sex, race/ethnicity, SES, rural/urban residence, age at diagnosis, comorbidity score, NCI designation, histology
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Bevacizumab combinations or TKIs (yes/no)

Nonsquamous, n=14,145

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### Association between health insurance type and receipt of bevacizumab or tyrosine kinase inhibitors

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<td>Medicare</td>
<td>1.06</td>
<td>0.89-1.26</td>
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<tr>
<td>Medicaid/Other public</td>
<td>0.50</td>
<td>0.42-0.59</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Medicare-Medicaid Dual-Eligible</td>
<td>0.97</td>
<td>0.86-1.10</td>
<td>0.66</td>
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<tr>
<td>Military</td>
<td>0.50</td>
<td>0.34-0.74</td>
<td>&lt;0.001</td>
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FINDINGS

• There has been variable uptake of treatments
• Treatments associated with the best survival had low use
• Substantial disparities by source of health insurance
  • Medicaid, military, or no insurance have decreased odds
  • Tyrosine kinase inhibitors
  • Bevacizumab combinations
  • Any systemic treatment
FINDINGS

- Used registry data to find specific treatment information for 78% of the cohort
- Text fields in registry data are a valuable source of information
- Extend clinical trial findings
- Text mining techniques can speed up the process
ADDITIONAL STUDIES

Text mining using SAS

• Perl regular expressions in SAS 9.4
• Compare results to the manual review
  1. Percent agreement
  2. Kappa
  3. Sensitivity
  4. Specificity
  5. Positive Predictive Value
  6. Negative Predictive Value
SAS BASED TEXT MINING

• Perl regular expressions in SAS 9.4
  • Matches characters in text
  • Search for drug names from each treatment group
    • Start with groups with fewest, most specific drugs
    • Account for:
      • Generic and brand names
      • Abbreviations, capitalization, misspellings
      • Negation
    • Visual review of matched and unmatched records
SAS PERL REGULAR EXPRESSIONS

TKIs

- Erlotinib (Tarceva)
- Crizotinib (Xalkori)
- Afatinib (Gilotrif)

```
re1=prxparse('/.*ib\b/i');
re2=prxparse('/tarc.va/i');
re3=prxparse('/xalkori/i');
re4=prxparse('/gil.trif/i');
```
1. alimta & carboplatin on 3/14, then performance status too low so d/c; med onc 4/04 not want hospice yet, so Tarceva; 5/02 refer to hospice

2. Consult with Dr.; Tarceva recommended due to EFGR positivity. Pt refused in favor of herbal remedies

3. Tarceva was recommended; Unknown if given

4. Offered Tarceva but pt expired before tx could start
ACCOUNT FOR NEGATION

re1=prxparse('/\brec*.*\bunknown/i');
re2=prxparse('/\brec*.*\brefused/i');
re3=prxparse('/\brec*.*\bnot given/i');
re4=prxparse('/\bexp*.*\bbef.*\bgiv.*/i');
re5=prxparse('/\bexp*.*\bbef.*\bstart.*/i');
re6=prxparse('/^\(carbo|cis|pem|alim)/i');
re7=prxparse('/\bdeclined*.*\brefused/i');
re8=prxparse('/\bplan*.*\bexp.*/i');

Decreased false positives
SEARCH ALGORITHM

1. Tyrosine kinase inhibitors
2. Pemetrexed and bevacizumab
3. Pemetrexed
4. Bevacizumab
5. Platinum doublets
6. Single agents
7. No systemic treatment

Use if/then logic in SAS
RESULTS

% agreement: 91.1% - 99.4%
Kappa: 0.71 - 0.92
Sensitivity: 74.3% - 97.3%
Specificity: 92.4% - 99.8%
PPV: 60.4% - 96.4%
NPV: 92.9% - 99.9%
FINDINGS

Accurately detected systemic treatments in unstructured free text records for 17,310 patients using SAS-based Perl regular expressions

Some manual review required

Time saving:

- Manual review: >300 hours
- Text mining: ~50 hours

Can be applied to other cancer types
ACKNOWLEDGEMENTS

- Cyllene Morris
- Arti Parikh-Patel
- Ken Kizer
- Rosemary Cress
- Theresa Keegan
- Chin-Shang Li
- Patrick Lin
- California Cancer Registry
QUESTIONS
KAPPA

Kappa = (% agreement observed) - (% agreement expected)

\[
\frac{100\% - (% \text{ agreement expected})}{100\% - (% \text{ agreement expected})}
\]

- 0.81-1.00 Excellent
- 0.61-0.80 Good
- 0.41-0.60 Moderate
- 0.21-0.40 Fair
- <0.20 Poor
Matched for age, sex, race, SES, comorbidity, NCI designation; 2,104 patient pairs.
Propensity Score Matched

Kaplan-Meier Plots

Matched for age, sex, race, SES, comorbidity, histology, NCI designation; 3,182 patient pairs